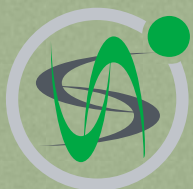


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## Preface

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### Welcome to SCIECONF 2013 Proceedings

The organizing committee of the SCIECONF is pleased to introduce you the first edition of the SCIECONF conference proceedings. The SCIECONF 2013 is co-organized by Goce Delchev University Shtip, Macedonia (FYROM), Business Academy Smilevski, Institute of Management, Macedonia (FYROM) and Thomson Ltd., Zilina, Slovakia. This conference aims at bringing together different research disciplines, and encouraging discussion and collaboration between scientists working in different fields on the common topic of feature selection.

All papers have been thoroughly peer reviewed by at least two qualified expert reviewers; most of the papers have been reviewed by three reviewers. The SCIECONF features 93 papers of consistently high quality and originality.

It has been an enjoyable process for us to work together in achieving the aims of this conference. We would like to convey our immense gratitude to the members of the scientific and reviewers committee for their great reviewing job, and to the authors who have contributed to make this conference a success. Furthermore we would like to thank Goce Delchev University, Shtip (FYROM), Macedonia, Business Academy Smilevski, Institute of Management, Macedonia (FYROM), Thomson Ltd., Zilina, Slovakia for giving us the opportunity to organize this conference.

*Conference Editorial Board*

June, 2013

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# SECTION 1.

*Business Management*

# The Facility Manager Architect

## The social responsibility as an added value

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**Abstract—** From the very first steps to execute a building, it is essential to analyze its life cycle. Similarly, we should consider the life cycle when projecting an urban intervention. Professionals of the Facility Management take part in construction projects, developing and managing DBFMO projects (Design, Build, Finance, Maintenance & Operate). Whatever the nature of the promoter is – private or public – promoters are leaders in projects of responsible management of spaces, whether these are work spaces, leisure spaces or residential spaces. They know and identify with the company and its performance, its values and its needs. These professionals give sustainable solutions in the life cycle of buildings (offices and housing), new ways to work and initiatives of innovations linked to current social changes: technology, social networks, and new habits.

Concepts where innovation is essential should consider responsible values. Social, economic and sustainable aspects have to associate with the management performed by a Facilities Manager when considering the three groups of stakeholders with which it is linked: economic (shareholders), contractual (users), non-contractual (neighborhoods, organizations, etc.).

Marcus Vitruvius Pollio, at the beginning of his book "The Ten Books on Architecture" describes and argues how the distribution in buildings must always adapt to their inhabitants. Let us build cities and buildings with responsible criteria, bearing in mind all its users and the needs of each one of them. Not to mention the need to adapt to future requirements with minimum cost and maximum profitability. These needs, under responsible management, are competencies developed by a Facilities Manager in his day to day. He cares and takes over the entire life cycle of buildings and their surroundings.

This work is part of the PhD project whose main aim is to study the added value to the architectural profession when social responsibility criteria are applied in his/her role as Facility Manager.

**Keywords:** *architect; facility management; social responsibility.*

### I. INTRODUCTION

All those tasks in which architecture was related to maintenance have been allotted to other technical profiles that were associated with the life of a building. This is so for two reasons: first, there was neither the need nor the knowledge of maintenance management, secondly, real estate assets were not considered as a value in themselves within the company.

The Spanish Language Dictionary of the "Real Academia de la Lengua" (*Royal Spanish Academy*) defines maintenance

as "the set of activities and cares undertaken to keep facilities, buildings, industries, etc., operating properly". Maintenance will allow to upkeep the activity for which the installation, building, industry, etc. was created and consequently to prolong their life cycle.

This maintenance should be performed by skilled staff in each one of the activities that takes part in the maintenance of a building. During the last decades, it has been understood that with the mere compliance of current regulations the effect was more than enough to keep a facility. The regulatory framework is advancing and is becoming more oriented to prolong the life of the facility in question, although the legislation does not move forward with the speed one would wish.

The maintenance concept has also progressed and now includes not only what is legal from a technical perspective. If an owner wants his property asset is attractive, either by its activity income, or because it is representative of his company, he will make all possible improvements to get it.

Speaking of maintenance, we refer to maintenance of the property as a whole. Maintenance is dealing not only with machinery, technical and legal reviews, but also with taking care of the facilities, people, procedures, criteria, etc, and enables a fully functioning of a property with the desired performance in terms of occupation. That is, the owner is responsible and cares. It is an unrewarding activity and yet, the end user of the property - whoever he is - can do his job without any incidence from the beginning, during the staying up to the end of his working hours, visit, residential use, leisure use, etc.

The activity about property management and support services, known as Facility Management, is defined as "the integration of processes within an organization to maintain and develop those agreed services which support and enhance the effectiveness of the main activities of the organization" [1]. This profession has only been recognized as such relatively recent, and it is beginning to be important in market leading organizations.

The discipline now known as Facility Management was born in USA and came to Europe through England, Norway and Northern Europe to reach Asia and Africa.

Marcus Vitruvius Pollio, at the beginning of his work "The Ten Books on Architecture" already describes and argues the knowledge of an architect, and concludes: "it will seem a marvel that human nature can comprehend such a great number

of sciences and keep them in the memory ... Still, the observation that all sciences have a common bond of union and intercourse with one another, will lead to the belief that this can easily be realized"[2]. He describes the three supports on which Architecture was based: Beauty (Venustas), Firmness (Firmitas) and Utility (Utilitas) and how the distribution in buildings should always adapt to its residents. He finishes with his Book X which he addresses to innovation: the machines.

In Spain there is still truly scarce training offer in this area - Facility Management - the professional - Facility Manager -has sometimes difficulty in establishing uniform criteria among colleagues in many of the tasks they perform. The publication of the UNE EN 15221 sets homogeneous concepts related to the management of property and enumerates some performances a Facilities Manager has to carry out. Nonetheless, we should highlight the voluntary character that many of those rules have.

Due to the current economic situation and since cost savings is a priority for any company, the FM worker has to optimize even more the services he manages. If we talked about the private sector, one of the constant aims in the profession is the economic bettering plus the final satisfaction of the client. If talking about the public sector, and because of the crisis, the aim to outline is, once the need has been aroused, to know what they have available, how, etc.

Once that situation is reached, the Spanish Civil Code must be followed. According to that code, every one of us has to behave in our daily lives with the so-called "diligence of a good family father". It should be understood that the Civil Code requires a demanding diligence, superior than the simple average diligence.

With the same voluntary basis, it was issued the Spanish ISO 26000 rule on *Social Responsibility*.

It is interesting to see how many of these values were already highlighted in antiquity as previously discussed when trying "Ten Books on Architecture" by Vitruvius. Or for example, the familiar term "La machine à habiter" of Le Corbusier. However, today, we ask us again "why architecture magazines' photography is uninhabited?" And we return to do proposals such as "let's learn to live again, let's recover our concern for the environment and turn our gaze to places and the conditions they have to offer, to meet again with the architecture and let's start building the house of the man of the XXIst century "[3].

Marcus Tullius Cicero, in his defense of the poet Aulus Licinius Archias, comments: "... in fact, all the arts which belong to humanity, have some common bond and are somehow linked with each other" [4]. This defense is considered among the most important pieces of literature and the first text intending to draw attention to the personal and social importance.

## II. FACILITY MANAGEMENT

The origin of this discipline arises from a new need in the working spaces in the seventies due to an innovation: the emergence of personal computers and their connection to the

company network via their workstation. New, more specialized and more dynamic ways to manage spaces appeared.

In 1978, the Herman Miller furniture company held a conference in Ann Arbor, Michigan, under the title "Facility Influence on Productivity". It was during this conference that the three founders of the National Facility Management Association (NFMA): George Graves of Texas Eastern Transmission Corp., Charles Hitch of Manufacturer's Bank in Detroit and David Armstrong of Michigan State University stated the need for an organization of professional installations. In May 1980 George Graves hosted a meeting in Houston to establish a Facility Management Association: the National Facility Management Association NFMA. In 1981 the NFMA replaced the term "national" for "international" becoming then the International Facility Management Association (IFMA) [5].

In 1982 David Armstrong, founder among others of the "Facility Management Institute", wrote his famous article describing the principal value of the Facility Management: "The integration of people, processes and spaces." In 1984 with the "IFMA Report # 1" the model became well known. The scheme was simple, it explained the connection between these three factors (people, processes and spaces) and how the common element among them was the figure of the Facilities Manager. It could be said that under the Facilities Manager's responsibility, his proposal covers from the parking activity to the buildings outdoor spaces, building systems and services, furniture, decoration of the workspace of people, etc.



Figure 1.

In 1984 the British architect Sir Frank Duffy began to use in Europe the discipline Facility Manager in the design office. ORBIT I and II are the famous studies that helped develop the Facility Management. In 1985, he founded the Association of Facility Management in England, AFM. Since then, and still today, this discipline development in Europe has been extremely diverse. The different structures, cultures, legislation, market, even the language, have influenced in the direction and how to operate and manage.

In 2002, the national representatives of facilities management from 15 countries decided to develop a European definition of Facility Management. In 2006, 29 European countries agreed to use the following official definition for facility management, "Integration of the processes within the organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities." The field of Facility Management was being grouped into two

categories representing "People, place and process": Space & Infrastructure and people & Organization [6].

Space and Infrastructure include client demand in the workplace through services such as distribution/space planning, workplace itself, its design, construction, leasing, occupancy in the management of buildings, maintenance, furniture, equipment, technical facilities, cleaning, etc.

People and Organization include client demand for catering services, event management, ICT, hospitality, security, human resource management, logistics, stationery supply, document management, accounting, marketing, etc.

Until then, September 2010, it hadn't been achieved a European agreement with common definitions such as Real Estate, depreciation, etc.. The proposed rules were formally voted in late 2010. In Spain, it was not until September 2012 that these terms could be translated into Spanish. In 2011 we developed a guide on "Performance Benchmarking" which currently is not published.

#### A. Facility management competencies

The word competency is defined as the skills, aptitude, suitability to do something or act in a particular case. Within this term will be included the attributes and demonstrated aptitude to apply knowledge and skills.

As argued above, the first occasion where reference was made to the competences a Facility Manager should have, was in 1982. It was David Armstrong, in his article: "The integration of people, processes and spaces." In this article, he differentiated 8 groups of activities: patrimony, long-term planning, space management, interior planning, interior installations, maintenance and operations, architectural and engineering services, and budgeting [6].

In 2009, the international IFMA describes a set of competencies as "The Core Competencies of Facility Management. A worldwide analysis of jobs (GJTA) defined 11 core competencies. The GJTA included the answers of many professionals from 62 countries. This is the most comprehensive survey up to date and the first one that truly can be considered a global survey-analysis. The competencies obtained were: communication, continuity plan, contingencies, emergencies, environmental management and sustainability, finance and business, human resources, leadership and strategy, operations and maintenance, project management, quality, real estate and property management, technology.

The competencies vary greatly depending on the scope to be developed. A special emphasis should be put on certain aspects that IFMA Spain has developed in relation to competition. Within its training courses, there is the so-called CPR module [7]: "Competencies and Practice Facility Management".

In this training, IFMA Spain arranges the roles of this discipline into 6 groups according to BIFM (British Institute of Facilities Management) and graphically associated them to three levels of management: operational, tactical and strategic. These competencies add up to those "intangibles" with which a Facilities Manager performs his profession. Below, we list the six groups with their details: understanding the organization of

the company, managing people, managing property, managing services, managing the work environment, manage resources.

#### B. The figure of facility manager

In 1933, an article was published in the "*Revista Occidente*" related to the essay by D. José Ortega y Gasset entitled "Scheme of the Crisis". Its first sentence is a true reflection of the status of the profession of Facility Manager in Spain: "We do not know what happens to us and that is precisely what happens to us" [8].

Is very likely that years ago, having inherited the English terminology "*Facility Manager*", there has been resistance to use the term either by the language difficulty or by not associating the term to a real need

When to the concept of patrimony manager, we associate terms like spaces, processes, people and technology, the figure of a Facility Manager is better bounded. If at the same time, we bear in mind that this profession manages the second largest cost that a company has, only preceded by the wage cost, we begin to see the breadth of the term.

The first difficulty a Facility Manager has to face, whether he provides his services in-house or externally, is precisely that his position is not valued within the hierarchical organization of the company. And this is due to the lack of specific information about this sector and the activities he is responsible for.

A Facility Manager is a key and strategic figure within the company and he should have particular technical and social skills. Many companies opt to the familiar "In medio, virtus" and structure their organization so that everything is outsourced except the more strategic role of this discipline. Thus, you get maximum savings and control is maintained through reporting systems previously agreed.

Depending on the organization, this delegated task can be unified into a single service provider or otherwise, and always according to the strategy set in the organization, diversified into two / three service providers. This latter is justified by the risk diversity, maximum specialization per service, etc.

The Facility Manager can also meet global processes with National, European, EMEA, Global, etc. scopes. In these cases, the strategy is marked also by the organization and both the guidelines and the provision of the service, have a high level of knowledge and control (also known by monitoring).

The possible drawback can arise in such cases by the own scale level in which the service occurs. That is, the provision of services, language barriers, culture, etc.. However, these aspects are often frequently solved from the start of the service by having clearly defined processes, benefit levels and control.

It is therefore evident that depending on the size of the organization and especially its business philosophy, this profile can be sufficiently valued and supported to directly improve the overall results of the organization and, unfortunately, insufficiently appreciated within the structure being in this case its only "task" to solve tactically the issues that arise on a daily base.

The general trends for the development of the Facility Management discipline are based on the profession's own experience and its origins:

- American Trend. It focuses on the most technical aspects of the profession. It is very result-oriented: it works / it does not work. Its purpose is the operation of the product being managed: installation, job, etc.
- European trend. It focuses on the fundamental aspects of the business. It also focuses on the company, its users, and so on. Its aim is to service and give support creating the best spaces with the best technology processes.

Special mention should be made of the trajectory of professionals in Australia, Nigeria, among others, who are doing a professional work and an excellent research in this field, for example in productivity.

It deserves special attention the Payback Productivity Model developed by U.S. General Services Administration (GSA). It is an analytical tool that measures increases in productivity resulting from changes in the workplace environment. Such changes can reach productivity increases superior to 20% if a new distribution of spaces, ergonomics, use of new technologies, etc. are considered.

The figure of the Facility Manager has in very few years grown exponentially and this has been due to several factors that have emerged almost simultaneously and in parallel:

- The economic crisis. Companies are trying to optimize their resources as much as possible. Saving is the main condition. Aspects such as energy efficiency, very well known years ago, are beginning to take hold in corporate cultures.
- The construction sector. Building has now nearly stopped altogether. Now, it arises the need to maintain what is already built in good condition, to maintain its value as an asset, to keep it renovated and updated.
- New trends in companies. The knowledge of real cases, the application of new technologies and the inclusion of new generations bring about changes that office spaces should reflect

These points can only be assumed by a general profile that has extensive knowledge in several fields: economic, technical, social, sustainability and more. This profile must include within its intangibles an inclusive and decisive attitude. This profile is the Facility Manager, the Manager of Patrimony.

### C. Facilities management in Spain

Up to the past January 2011, two associations concerned with Properties Management and Support Services coexisted in Spain: SEFM (created in 1999) with Jose Luis Garcia Cuartero as president of the association and IFMA (established in 2001) with Francisco Vazquez as president of the Association. As in 1978, these projects were led by people directly involved in the management of workspaces. Twenty years have elapsed since then.

In 1997, the first Master on Facility Management was held in Spain. It took place at the *Fundación Antonio Camuñas* and later, new institutions showed their interest in this discipline: La Salle University, School of Architecture of Madrid, Association of Technical Architects, UEM, etc.

In addition, and in parallel, the two existing associations then, performed a great outreach through seminars, lectures, briefings, conferences, debates, etc., producing a great work to the disclosure of this profession. Currently, this profession has a great development.

In 2011, the Spanish Society of Facility Management (SEFM) and International Facility Management Association, Spanish Chapter (IFMA Spain), merged into the Spanish IFMA Facility Management Company [8] whose presidency was led from the beginning of 2013 by D. Salvador Torres Barroso.

This proves the interest in the profession and the efforts carried out to make this profession known. Today, it is still largely unknown in many sectors

The Facility Management discipline in Spain is installed in large companies that from their parent company have implemented standardized criteria for the management of their assets. This has helped other domestic enterprises and service providers to discuss these methods that seem so new.

## III. SOCIAL RESPONSIBILITY

As with the Facility Management discipline, Social Responsibility within business is poorly implemented. The reasons are pretty even: their voluntary nature, many definitions and criteria, apparent lack of need, etc. In many cases, Social Responsibility is considered a fashion requirement to gain competitive advantage.

Social Responsibility covers many areas related, directly or indirectly, with the company. There are both tangible and intangible factors within the three existing management levels in Facility Management: operational, tactical and strategic.

To know the origin of Social Responsibility we must go back to two existing movements in the nineteenth century. It can be highlighted the Quaker George Cadbury [9], cocoa businessman, who believed that if he protected his employees they would also protect his company much better. We can also highlight Robert Owen [10], utopian socialist and considered the creator of the cooperative, who introduced welfare measures, previously unknown. In Spain there are cases like the Colonia Güell in Santa Coloma de Cervello (Barcelona) or the entrepreneur Barreiros.

The World Business Council for Sustainable Development (WBCSD), without trying to make an official definition, defines social responsibility as "the commitment of companies to contribute to a sustainable economic development, working with employees, their families, the local community and society as a whole, to improve their quality of life "[11].

Today, the attention paid to Social Responsibility is varied. Despite the existing globality in which we are, this discipline often is only associated with environmental or human tasks. However, in addition, it must be considered that the interesting groups – stakeholders - occupy a very important position. And

these groups, classified into three levels, are the ones the Facility Manager should consider when managing properties.

- Shareholders and business owners. Those who have a relationship / economic link.
- Internal and external users of these companies. Those with a relationship / bond contract.
- Neighbors, authorities, etc. Those with a relationship / non-contractual bond.

In contrast to the discipline of Facility Management, there are many rules that have been created from the various associations defending the values of Social Responsibility. We emphasize the ISO 26000 for its an international character and others such as UNE 165010 EX, SSG 21, etc.. Also we highlight institutional initiatives such as Social Accountability 8000 (1996), Global Reporting Initiative 1997, United Nations World Pact (2000).

#### IV. VOLUNTARY NATURE

Both disciplines - Facility Management and Social Responsibility -, hold a voluntary basis to their implementation and development in companies. However, as different stages of each of them consolidate, new opportunities for improvement arise and as a result, new added value in management develops.

This voluntary basis may mean a cost increase at first sight. However, both disciplines have excellent advantages among which we can highlight:

- It increases among employees, levels of satisfaction, fidelity, commitment and loyalty.
- It reduces operating costs
- It places and distinguishes the brand name from the competition
- It retains their clients
- It attracts Investors
- It enhances relationship with the environment and increases the influence of business in society.

#### V. CONCLUSIONS

The current crisis makes the Facility Manager profession a worthwhile task. This is the only figure that can achieve savings in a company, maintaining the strategy of the company under responsible criteria.

The culture of Facility Management has to be enforced and shown to Businesses and clients. The need for this profession to demonstrate the added value produced in their companies. In recent years some sectors -marketing, technologies -, have adapted their businesses and their spaces to current needs with responsible criteria. However, there still are many other areas where concepts such as physical presence in the workplace, the permanence of space, among others remain.

The Facility Manager is habituated to manage change. However, there is great resistance in Spain to implement many of the concepts it provides: business strategy, added value,

labor productivity improvement, flexible work spaces, etc. All this caused by the absence of experience and the belief of the loss of control of the business.

New technologies, which are example of innovation-, have provided many new solutions for companies, their users their and processes. The Facility Manager implements these new technologies adapting them to the real needs of each company obtaining perfectly measurable savings and improvements.

Spain boasts great professionals who with their daily work show their great professionalism. It is a very young profession that takes advantage of the concerns of future generations to evolve.

The Facility Management professionals also participate in construction projects, developing and managing projects of DBFMO (Design, Build, Finance, Maintenance & Operate). They are also the leaders in project management workspaces. They know the company, its values and its needs. They provide sustainable solutions in the building life cycle, new ways of working and innovation initiatives of business services.

The combination of demographic trends, the climate change and the advances in the technologies of the information society offers the opportunity and challenge to both the profession and the company.

The challenge the professional has to face occurs, almost before he has been able to establish his credentials as Facilities Manager and without having found a position of leadership within organizations.

The next target is set in Lisbon with "Europe 2020, strategy for smart, sustainable and inclusive growth" European Union Strategy, which should define the contribution of the Facility Management in three main areas: knowledge economy, the sustainable growth and employment, social and environmental objectives.

The next generation of Facility Managers should take a leadership role in transforming organizations and should contribute responsibly to the European knowledge economy.

Future Facility Managers will need support from researches developing the concepts above discussed with responsible criteria in their three levels of management (operative, tactic and strategic) and in their three areas (people, places and processes).

These researches should set their main objective in responsible innovation. The solution is not to make many mandatory rules. (Regulation does not ensure good management of a service). It is a correct management for each of the services that a Facility Manager develops through excellence what counts.

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# Contract, Trust and Outsourcing

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**Abstract**—The aim of this article is to present a summary of the relation between the contract and trust in outsourcing relationship on the basis of existing literature. Outsourcing is a widely used concept of management. Nowadays many organization use outsourcing concept as a part of cost reducing policy within their companies. However building strong outsourcing relationship is not an easy task. The outsourcing relations between parties depend on many factors such as: trust, commitment, communication and agreed service level. This article is focused on examination of two factors, trust and contract, in relation to two main approaches towards business relations in outsourcing: contractual and relational governance.

**Keywords**- outsourcing, contract, trust, contractual management, relational management

## I. INTRODUCTION

Outsourcing is a widely used concept of management in enterprises among the whole world. Along to the conceptual approach towards outsourcing, an outsourcing process can be perceived as the activity transferred to be carried out by another company [1]. The strategic perspective focus on a transfer of outsourcing processes in order to supply efficient realization of business objectives and innovation development [2].

The main reason for outsourcing implementation is cost reduction. Taking account all indirect costs of materials and management, hiring external provider is simply less costly. However, cost cutting is not the only reason for such activity of enterprises. Many organization decide on outsourcing, in order to supply themselves in a specialists expertise. Outsourcing is a way to cost cutting of experts. Companies find it, as a cheaper way to pay for external expertise knowledge, in compare to internal costs of recruitment, training and skills development of the employees. Many companies outsource processes to find a better way to solve problems. In this case outsourcing is a tool for simplifying complexity of such processes. In other words, outsourcing the organization's problem to external provider, in order to possess a better solution.

Outsourcing is a complex concept which in its nature creates conflicts between parties. Companies often forget about taking responsibility for outsourcing processes, trying to move it all to the outsourcing partner. Such misunderstanding of outsourcing concept is a common reason of conflict creation and lack of trust between the parties. This attitude is clearly visible already at the stage of initial negotiations of the outsourcing contract. Both parties of the outsourcing project have different reason for establishing a partnership. Vendor's aims focus on margins growth and establishing a long-term relationship while customer aims are simply cost reduction and

focus on core competencies. This ambiguity has its reflection in outsourcing contract.

The contract is the output of defining outsourcing objectives with reference to the outsourcing cycle. Contract should reflect the prescribed outcome and both parties should agree on it. So why the outsourcing projects fail? The reason could be lack of trust between partners. The lack of trust is caused by many reasons: sometimes the vendor overpromise and then fail to deliver the service on agreed level, the service levels are too hard to accomplish and sometimes the contract itself is sloppy and causes misunderstandings. As a result of lack of trust companies dump long-term deals. They prefer to set up short-term, small contracts with variety of vendors. In order to ensure process safety, they are forming relationships with several outsourcers by preparing shorter contracts. This may lead companies to rethinking the nature of the outsourcing and re-defining the core business processes and those peripheral ones. The relationship between the outsourcing provider and outsourcing customer is complex and includes many other issues, but trust seems to be one of the most important factor in building long-term relationship.

This article is focused on description of two aspects of outsourcing: contract and trust, stressing the mutual influence of these factors. This article consists of two parts: the first one describes the concept of contractual governance in outsourcing and the outsourcing contract, the second one shows the concept of relational governance of outsourcing project with emphasis on trust issues and a discussion on a mutual relation between contractual and relational governance of outsourcing projects.

## II. CONTRACTUAL GOVERNANCE

### A. Contracting Theory

There are many classifications of contract, originated from concept of various schools of thought and usually connected with a certain ideas of various authors. The most typical type of contracts, resulting from entirety-part approach is a division of contracts on complete and incomplete. The concept of complete contracts origins from an assumption that the contract is signed and both parties are willing to realize it according to agreed terms, and acting with consistency with their own preferences, and then are separated from each other [3]. Traditional contracting theory is focused on complete contracts. This theory considers contracts as costless for parties to identify contingencies and design suitable covenant [4]. The principle is that contract can never be too detailed or long. The core issues of complete contracts are commitments and renegotiations. Commitments are the abilities of parties to limit their future activities in order to ensure the contract fulfillment

within agreed term. The renegotiations in complete contract theory it is assumed that all the parties of the contract agree on contract's change into a new one, giving up all penalties and compensations. The complete contract is a contract, in which all the variables which may influence on contracts relations are taken into account. The time perspective is also included. The complete contract includes all of its variables in whole period of its duration. This sentence leads to a question about loss of efficiency caused by the other forms of contractual obligations. According to the complete contract theory, there are two phenomena which influence the level of contract's efficiency. The one is an adverse selection, the second one is a moral hazard, which have been studied widely by agency theory.

Another classification of contracts is the one presented by Stankiewicz [5]:

- Classic contract – is the agreement which is sporadically established by the fully autonomous parties. The relations between parties are regulated by the price mechanism while overall economic situation generates low level of uncertainty.
- Neoclassic contract – is disposable or occasional act of exchange, but in a condition of uncertainty, which complicates setting contract's terms and conditions precisely. The contract's object has specific and unique features.
- Relational contract – includes relations between parties, which even in significant uncertainty conditions, is characterizes long-term continuity.

The comparison of these three types of contracts is presented in Table 1.

TABLE 1. COMPARISON OF CONTRACTS

Contract Features	Contract Types		
	<i>Classic</i>	<i>Neoclassic</i>	<i>Relational</i>
Term	short-term	can be long-term	long-term
Prolongation mechanism	none, self-elimination contract	expected	exists
Formalisation	formalized	formalized	generally – informal
Protection mechanism	protected by the court	arbitrage	self-fulfilling
Conventional	conventional	non-standard	non-standard
Fullness	full	incomplete	incomplete
Adaptation mechanism	none	exists	exists when it play an important role

[5] pp. 112.

The complete contract theory points that if parties were able to distinguish all of their rights and duties for every possible states of contract's implementation in future, such contract is perceived as one without any gaps. Such a state is abstract and hard to achieve in real business environment.

## B. Incomplete Contracts

The literature on process of developing and implementing contracts is reach. The incomplete contract model represents an attempt to formalize Williamson's transaction-cost approach. Transaction cost economics (TCE) describes the choice of governance mode in economic activities. TCE suggests that in response to exchange hazards, firms either craft complex contracts or choose to vertically integrate when such contract are too costly to craft and enforce. There is a widespread view that, with reference to incomplete contracts practice, parties are willing to renegotiate at any time. The motivation of contractual incompleteness has been clearly presented by Hart and Moore [8, p.115]:

*"Imagine a buyer, B, who requires a good (or service) from a seller, S. Suppose that the exact nature of the good is uncertain; more precisely, it depends on a state of nature which is yet to be realized. In an ideal world, the parties would write a contingent contract specifying exactly which good is to be delivered in each state. However, if the number of states is very large, such a contract would be prohibitively expensive. So instead the parties will write an incomplete contract. Then, when the state of nature is realized, they will negotiate the contract, since at this stage they know what kind of good should be traded."*

The complete contract theory has many interpretations. According to Tirole:

- there are transaction costs of negotiating deals,
- complete contracts may be wasteful contracts,
- completing contracts involves rent-seeking [4].

If the contracting has been chose as a governance mechanism, as the exchange hazards rise, so the contractual safeguards either [6]. Key assumptions of incomplete contracts model are:

1. symmetric information between decision makers,
2. incomplete foresight of the kind of improvement to be achieved but perfect knowledge of the costs of its realization and of the probability that the improvement will occur [7].

According to TCE bounded rationality and uncertainty, parties are prevented from writing detailed and complete contracts, that include all contingencies [8]. The feasibility of writing complete contracts must challenge the argument that all contracts are incomplete for goods or services that are exchanged at a future state that is unknown [9]. According to Fried, it is impossible to design contracts that address all future contingencies and uncertainties. Fried states that the nature of contract is to provide a catalog of promises that exchange partners have agreed on [10].

## C. Contracts in Outsourcing

The contract is the agreement between the parties which governs their legal and business relationship. It is a legal document that provides the framework for the implementation of agreed terms of outsourcing project. The contract defines the services to be provided and the responsibilities of the parties.

The contract is a potential risk management tool. It provides various methods of avoiding and resolving problems and conflicts. Contracts is also an overriding framework which governs the conduct of the parties. According to an important role of a contract, especially in IT outsourcing, much care must be taken to ensure that the parties to the contract are correctly identified. At the stage of contract developing it is important to provide much information to both parties. This enables both partners prepare to negotiation and precise their conditions and possibilities. The contract contains formal provisions governing the arrangements between the parties, such as:

- parties identification (name of organization, seat, persons representing the company etc.),
- the service to be supplied,
- the personnel to be transferred,
- the service price,
- the assets transfer,
- other service's costs;
- contract's duration,
- change management framework,
- contract's duration,
- complaints management framework,
- penalties and bonuses to the provider,
- provisions to the supplier
- other issues according to type of outsourcing service.

The contract has a complex nature. There are various areas in the contract which are important, however there of them seems to have the biggest impact on outsourcing project: service management, personnel transfer and asset transfer. This article is focused on one of them, which is service management.

Service management is a set of all activities which lead to successful implementation of the contract, resulting in achieving potential efficiency. Service management will be reference to:

- optional services,
- extra services,
- quality standards,
- timescales,
- disaster management,
- contract continuity,
- management team,
- performance measures,
- audits,
- payment procedures,

- price change,
- change management.

The main contract is a document, which outline the services, but specific details of service level, is provided by another document called Service Level Agreement (SLA). A service level agreement (SLA) is an addendum to the main contract describing the products or services to be delivered by the outsourcing provider [11]. The main role of SLA is to specify service level. Once agreed service levels are the subject of continuous monitoring, reporting and reviews.

SLA developing must be proceeded by clear specification of service required. Service levels must be established from current data. The potential improvements in service levels must be identified and can be included in SLA negotiation process. According to Giverin three service level can be distinguished:

1. service levels which are measured on a continuous basis,
2. measures for all events completed in the measurement period,
3. service level which measures a sample to confirm whether the sample meets a required standard [12, p.126].

The scope of SLA is the quality of the service. The process is not important as the results. The SLA is the management tool by which supplier and organization manages the contract's performance. SLA defines all levels of the service in order to ensure a consistent standard of provision.

Effective contract governance is critical to the success of outsourcing project. There are three characteristics of SLA in IT outsourcing: foundation characteristics, change characteristics and governance characteristics [11].

Foundation characteristics of SLA includes provisions that specify:

- the key principles and agreements between the parties,
- the key process owners,
- the roles and responsibilities of key process owners,
- target levels of a product,
- service performance.

The main goal of foundation characteristics in SLA is to express common goals of the parties and general commitment toward the outsourcing relationship [13]. Defining the intent and goals of the outsourcing relationship, helps both parties of the contract and their employees to understand and share common relational norms [13]. Foundation characteristics ensure the standards and responsibilities of the parties that are involved in outsourcing relationship.

Change characteristics of SLA include provisions:

- processes for resolving unforeseeable outcomes of future demand,

- processes for implementing foreseeable contingencies and changes,
- process for introducing new innovations coordinated with incentive plans,
- processes of feedback and efficient adjustment in the contract.

These processes are designed to deal with a future contingencies. The change characteristics are the reflection of the incomplete contract approach, where by the reason of bounded rationality, limited and intentional rationality is translated into incomplete contracting [6].

Governance characteristics of SLA specify:

- clear statement of the measurements,
- penalties and incentives,
- exit options and responsibilities,
- communication framework,
- conflict resolution framework.

These processes aim to set an administrative procedure to constant assessing the value to stakeholders and good relationship governance by the outsourcing parties [14].

### III. TRUST IN RELATIONAL GOVERNANCE

Trust is the concept of interdisciplinary research in the subject of many scientific disciplines, among others sociology, psychology economics and management. There are many definition of trust in the literature. Mayer, Davis and Schoorman attempted to integrate various perspectives of perception of trust in the organization. They have defined trust as a readiness (take risk) to accept second part's actions, based on assumption that the other party will execute certain actions which are essential for the trust creditor [20, 21]. Trust is also referred to as a psychological state that express the intention to accept the readiness of action of the other part [22]. Trust exists in conditions if uncertainty and risk but it should be regarded as a positive concept – by giving someone trust, we expect positive, desired results.

The literature of the outsourcing contracts acknowledge the importance of legal contracts, however it is pointed that legal contract is insufficient for a description of outsourcing complexity. Governing outsourcing projects must spread beyond traditional contractual clauses toward building and maintaining relationship management between the outsourcing parties [15, 16].

Empirical work shows that relational governance is associated with trust and trust improves the performance of interorganizational exchanges [19, 18].

Uzzi presents an approach, which states that key properties of relational governance are important: information exchange, trust and conflict resolution [17]. Trust have been found to be influential on outsourcing relationship, because it reduce concerns and opportunism and provides the confidence between the parties.

In IT outsourcing studies trust is a crucial relationship factor. Zaheer et. al points that trust allow parties to focus on long-term objectives, with less worry about day-to day issues [18]. Trust reflects one party's belief that its requirements will be fulfilled through future actions undertaken by the other party [19].

Past research on interorganizational relationships has explored the interplay between the contractual and relational governance of outsourcing projects. There was a discussion if relational and contractual governance can act as substitutes or complements in outsourcing projects. There are evidences for viewing relational governance as substitutes [23], however there are also evidence for viewing relational governance as complements [11, 16].

According to Goo et. al harmonious conflict resolution and mutual dependence of the parties positively influence trust. Their study suggests that change characteristics in contract can dampen trust due to the reciprocal interdependence inherent in the contract change process requiring mutual adaptation rather than contractual clauses [11].

Rai et al. claim that BPO relationships should be governed by using a strategy that applies relational governance mechanism as substitutes for certain contractual governance mechanism. Client should evaluate their trust in the vendor, the costs of information exchange and their ability and motivation to resolve conflicts with the vendor information exchange and trust can substitute for goal expectations [23].

### IV. CONCLUSIONS

IT organizations do not possess a well-structured SLA, which enables them to manage the activities and relationships, which occur with their outsourcing projects. There is a need to promote relational governance among IT organizations in order to help them in managing the outsourcing project and maintaining close relationship with the vendor in long-term perspective. According to Poppo and Zenger companies should invest in relational governance only when significant hazards are present. Absent these hazards incurring the costs of relational governance may not be warranted [16].

The concept and research debate on relation between contractual and relational governance in outsourcing project have just began. The most explored area is IT outsourcing where SLA are substantial. There is a need to research other types and areas of outsourcing with emphasis not only to contract and trust but all elements of contractual and relational governance.

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# The Role of Business Ethics on Corporate Governance and International Internal Control Frameworks

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**Abstract**—This paper reports on an analysis of how business ethics is approached within internal control (IC) frameworks provided by the most relevant bodies issuing guidance in this area. The comparative content analysis of the international frameworks shows that only three of them (i.e. COCO, ERM COSO, and King Report) are in fact conceptually concerned with business ethics. It was observed that ERM COSO is the most effective framework to address ethical issues according to the analyzed perspective. The results point out that an adequate structure of IC can contribute to achieving significant levels of corporate governance (CG), and delivering on improved managerial and operational efficiency and effectiveness.

**Keywords**- business ethics; corporate governance; management control systems; internal control frameworks.

## I. INTRODUCTION

Business ethics has drawn the attention not only of scholars [41], but also of accountants, economists, managers, auditors, regulatory bodies worldwide [8] and has become a topic of concern to the public and business community [14]. Scholars have engaged in a debate on precise means of both assessing the veracity of information provided by companies and developing mechanisms to assure information quality. This debate is relevant because of the large amounts of money involved and because the external auditors' lack of credibility and governments' failure in identifying recent frauds such as Enron (cf. [17] [38]). The main question of the business ethics concept from a CG perspective is the investors' costs to obtain accurate information. These costs have been a potential barrier to international capital movement. Good CG practices usually assist in reducing information discrepancies across countries, protecting investors' interests, increasing international capital flow and harmonizing accounting standards. According to Bonvin and Dembinski [4], much has been said about the importance of providing transparent information to clients, but transparency in itself could be an illusory virtue. In fact, asymmetrical information is the corollary of many financial markets. These authors showed that transparency between two people who are not equally capable of understanding a piece of information in itself will frequently not necessarily lead to more responsible behavior. In Jensen and Meckling's [25] Finance Theory-based explanation, managerial behavior influences ownership and management relationships.

Therefore, owners are supposed to incur agency costs to reduce managers' opportunism emerging from information asymmetry, especially when managers make decisions on their own behalf, rather than on behalf of shareholders. The reduction of agency conflict is assumed to be possible by means of IC and auditing practices aimed at monitoring and controlling agent's decision-making. IC consists of accounting and administration processes and routines that are designed to organize a company in such a way that its employees understand, respect and comply with its policy [29]. Additionally, such controls are expected to encourage people to uphold ethical standards, to protect asset integrity and to ensure accurate financial reporting of the company's operations. Usually introduced in IC frameworks and conceived of as a highly important dimension impacting on CG, ethics is crucial to ensure a company's credibility and public trust in the financial market, especially because both of them have been highly affected by scandals and frauds in large-sized companies' financial reporting (cf. [6]). This paper reports the results of a comparative analysis of international IC frameworks providing a disclosure of the most relevant bodies issuing guidance on IC and pinpoints the one that best addresses the business ethics standards on its IC structure. This paper aims to provide theoretical contributions to improve the incipient understanding of how business ethics is approached within the major international IC frameworks, and empirical contributions so companies and managers can gain a better understanding of the international IC frameworks that address ethical issues and thus have a meaningful impact on CG. The paper is structured as follows. After this Introduction, Section II presents the main methodological framework under which the study is based. Section III focus on the links between control systems and business ethics. Section IV reports on the seven major international IC frameworks mentioned in the methodology section. Finally, Section V presents the main conclusions of the paper.

## II. METHODOLOGY

The research herein reported consists of a qualitative, descriptive, explanatory study [11] [15], which is seemingly sensitive enough to capture and analyze the complexity of the existing IC frameworks. The study by Colbert and Bowen [8] was used as the basis to define the IC frameworks to be

described in this paper. These authors presented a comparison among the COBIT, SAC, COSO and SAS 55/78 frameworks. Based on the studies by Rittenberg et al. [36] and Zanette et al. [43], three frameworks were added to the list: COSO ERM, King Report and Turnbull Report. The IC frameworks addressed in this paper are COSO [9] [10], COCO [7], COBIT [22], SAC [24], the Frameworks developed by the American Institute of Certified Public Accountants [1] [2], the Turnbull Report [23], and the King Report [27]. The analysis of the frameworks built primarily on the public information available from the entities' websites. In order to increase internal validity, data was triangulated [26] with information collected from other sources. The variables used to content analysis of international IC frameworks and to compare the international IC frameworks focus on the role each of them ascribe to risk management, performance assessment, and promotion of ethical attitudes. Drawing on the analysis of the particularities of each IC framework, the discussion aimed at indicating the model that could be deemed as the most adequate to integrate the MCS. The discussion also sought to pinpoint the model that could help companies improve ethical behavior, increase efficiency and efficacy, and reduce risks.

### III. CONTROL SYSTEMS AND BUSINESS ETICHIS

Gomes and Salas [16] provide a comprehensive approach to managerial control systems (MCS). This consists of a systemic approach to the company aiming to meet, as much as possible, the expectations of different stakeholders within the organization. They say that a control approach aligned with the intent of promoting employees' engagement in the management process is, from a strategic perspective, a way to obtain competitive advantages, and, from an organizational perspective, a way to orient the organization and its members towards the administration's objective. Some new MCS have also complemented the formal control systems with informal mechanisms to encourage people to behave in accordance with managerial expectations [34]. Rosanas and Velilla [37] show how the development of technical and moral values is crucial to the long-run survival of companies. Over time, there was a need for a new look at the role of ethics in business as well as the relationship between ethics and management. In general, ethics refers to principles and moral standards that orient both individuals' and groups' behavior [41]. The business ethics of a company is supposed to be translatable into a set of values stated in standards, rules, codes of conduct and *modus operandi* as put forward by the administration both formally and informally [39]. According to Forte [14], the value of ethical reasoning is a premise upon which several countries and business enterprises are founded. High moral reasoning and the continued development of ethical standards are goals to which governments, businesses, and educational systems must ascribe. According to Palazzo et al. [35], many models of (un)ethical decision making assume that people decide rationally and are frequently able to evaluate their decisions from a moral point of view. However, some people might behave unethically without being aware of it, because they are ethically blind. Based on a survey mailed to 400 CPAs (accountants) who prepare financial reports in the USA, D'Aquila [12] shows that accountants generally perceive management's conduct as ethical and believe that management

expects them to behave ethically. In conclusion, the author observed that managers can create organizational environments that promote ethical decisions only if they understand the factors that shape employee perceptions.

One way to stimulate business ethics is by adopting an IC framework that first affects the chief executive and progressively impacts on the routine of every employee and every department in the company [31]. The adoption of an efficient IC framework will not prevent incidental or intentional failures [31], but will certainly contribute to reducing frauds, protecting asset integrity and promoting employee's compliance with the administration policy [29]. Although such a framework is not free of error probability, it certainly assists in recognizing, correcting and avoiding errors. IC activities build on mechanisms to review records, actions or results in the light of pre-established parameters, legal resolutions, and expected results [39]. Such mechanisms, constantly refined by ongoing MCS improvements, help companies promote high CG standards by encouraging ethical behavior through the incorporation of people's expectation into the organizational culture. As Steil and Sanches' [40] study show, organizational commitment is in fact an efficient form of control. According to Herreman et al. [19], all companies face uncertainty when searching for risk reduction as a means of dealing with that uncertainty. However, uncertainty can present itself as either negative or positive: negative as risk, positive as opportunity. The authors state that companies face risk at many organizational levels and apply appropriate controls that will avoid, share, or manage the risk. Policies and control procedures can be implemented to both reduce risks and to facilitate the creation of opportunities. However, sometimes these policies and procedures can hinder rather than generate opportunities. According to D'Aquila [12], there have been numerous studies of how employees perceive their work environment. Specifically, these studies have been aimed at determining the prevalence of conflict between personal ethics and company goals, as well as the importance of senior management in influencing managers faced with ethical dilemmas. Therefore, managers' role within the teleological ethics framework is to encourage people to behave "in a morally adequate way" and achieve the best results for the companies for which they work. However, the issue of what an ethical behavior in fact is varies in time and in space, which means the same behavior will not be regarded "morally adequate" across cultures or even among different people – hence the need to understand the ethical dilemmas that may have different impact on different people and organizations. Under this Machiavellian approach, an IC analysis builds on individual values and their impact on the corporate culture and thus seeks to assure moral parameters to underlie the decision-making process and valorize human commitment, company reputation, and fulfillment of the organizational mission. According to Bragues [5], although some people have a restricted view about Machiavelli's work; his ideas have presently been used to support business participation structures. Considering the modern competitive arena, the main point in Machiavelli's work is that people who occupy or wish to occupy leadership positions must be prepared to go beyond the conventional morality and apply a live according to a different set of rules which sometimes can

be considered cold. However, according to Machiavelli, to be good in business will lead to failure because the memorable qualities of a leader are redefined in such a way to take into account the competitiveness related to businesses. Bragues [5] points out that in this new ethic the virtue is connected to ambition, flexible moral and management of competitive image, which are the necessary values to create and manage a big company. According to Laufer and Robertson [28], the consideration of social control and ethics initiatives leads to a number of research and managerial implications. First, social control hypotheses should be carefully explored. Hypotheses that cross environmental, organizational, and personal levels of control are of particular interest. Second, possible interactions between organizational variables and social control perspectives should be explained. Third, managers must consider the rationale underlying ethics initiatives as well as their stated objectives. Finally, in planning corporate ethics initiatives managers should carefully consider organizational design factors. Organizational design factors also include compensation and control systems as well as the nature of the work performed. The MCS literature refers to this approach as a form of social control. Mota's [33] study on social control within organizations shows that companies use socialization processes, such as recruiting and training, in order to better prepare the individuals to fulfill their organizational needs. In this context, an MCS plays an important role in influencing people's behavior, as it sustains budgeting, performance assessment, and compensation and punishment systems that in turn lead to specific attitudes. On the other hand, the individuals try to influence the organization and in their attempt to gain personal satisfaction they push the company to recognize their claims for better wages and more engagement in the decision-making processes. In this sense, the organizations should be aware that poor management of the employees' pressures leads to conflicts, frustrations and discontentment, which means a company must establish codes of conduct and other norms that clearly define which attitudes and behaviors it considers suitable for every situation and for the promotion of improved CG practices. Only this definition can set the framework for a stimuli system (e.g., compensation and punishment) that will assumedly promote the desired attitudes that will be converted into the desired results. Companies are impacted by cultural differences across countries and geographic regions where they operate [20] [21]. Perhaps this is the reason why the organizations have increasingly resorted to cultural controls. Differently from the bureaucratic, legal and rational control, the cultural control draws on internal forces, such as social commitment, common lexicon, shared history, and feeling of belonging [20] [40]. Cultural controls are based on peoples' commitment and constitute a form of making employees internalize organizational values and underlying rules that result in an iron cage with virtually invisible bars to the workers behind them [40]. Wherever the individuals' expectations are included in the company's objectives, they tend to commit to self-regulation and to encourage their colleagues to pursue planned goals and compensations. Culture is an essential element in the implementation of an IC or MCS model, because they are the mean to encourage people to assimilate the expected attitudes and consequently develop an ethic specific to the

company in which they work. It is necessary to emphasize that ethic in business must begin with the main executive and his/her directors and staff in order to both develop a broader connection to the MCS and to promote the expected behavior. This ethic would be more aligned to Machiavelli's ideas, according to whom the first opinion that is created about a prince and his understanding is derived from both the observation of men who are surround him and the loyalty and reasoning of these men. In this way, the prince, or the CEO, can be considered a wise man. Mann [30] analyses Machiavelli's work and stresses the high management ethic must also be observed in the selection of employees in a modern organization, because they are valuable assets to that organization. Machiavelli proposes that the people who should be hired should be those who believe in the greatness of the task and of the leader, rather than those who solely consider other factors like money and reputation. In his analysis, Mann [30] observes that Machiavelli believes that all the employees must be involved in tasks and must have responsibilities regarding them. That would not only prepare them to improve the performance but also to enhance their loyalty to the organization. Hofstede's [20] model already pointed to the importance of incorporating organizational culture into the MCS. He considers control as a system capable of adjusting to the different managerial needs in order to provide for all of them. However, because it is only a single system that is supposed to address a wide range of activities, companies should resort to different features of this system according to both the situation they face and their managers' expectations. The author disagreed with the division of labor between controlled and controlling departments as proposed in the cybernetic model, and suggested that an MCS should adjust to the different business needs and focus on semi-autonomous, self-control-driven groups. This homeostatic model thus assigned greater value to: (i) people's objectives, with the possibility that they would then be engaged in pursuing the business objectives; (ii) negotiation, as the system guideline; and (iii) error correction throughout the processes. Hofstede [20] claimed that feedback-based adjustment should focus on the intended results and assume that errors will generate sunk costs. The author suggested that the MCS design should be based on variable policies, cultural values, people's judging capacity and negotiation, as a means of promoting more flexible controls capable of adjusting to every situation. Therefore, every company is supposed to conceive its own MCS to meet its particular objectives, values and ways of coping with changes.

#### IV. DESCRIPTION AND COMPARATIVE ANALYSIS

This section reports on the seven major international IC frameworks mentioned in the methodology section. The COSO framework has been reported in the literature as an international reference in terms of IC [29] [43]. This framework, edited in 1992, conceives IC as a process that is managed by the administration board in partnership with the employees with a view to reasonably assuring the reliability of financial data, compliance with the law, and efficient and effective operations [9]. The COSO framework assumes that the intertwinement of these components will allow for the establishment of a company-specific IC program to meet the

need of every type of organization. However, acknowledging the importance of effective and efficient risk management within a CG framework [43], the CSOTC introduced in 2001 a new integrated IC model, namely: COSO II or ERM COSO. This new version enables companies to identify the events that impact negatively on their business and the managerial behavior necessary to minimize their effects. Assuming that both actual and potential risks should be identified, analyzed and controlled, the enterprise risk management (ERM) framework is supposed to assist in the management of both internal and external risks that may impact on the business operations, from the conception of organizational objectives to the execution and control of organizational tasks and activities [10]. This IC framework basically aims to allow for the observation of events that may affect the company's objectives without losing sight of its different information, assessment and monitoring needs. Another international IC framework is the one developed by AICPA, which issued Statements on Auditing Standards SAS 55 and SAS 78 respectively in 1988 and 1995. These statements conceive of an IC framework that is similar to that of the COSO model. Nevertheless, whereas the latter is meant for managers to control the whole organization by means of efficient IC assessments in specific situations, the SAS framework is meant for external auditors to control financial reports and efficiency within a predefined period of time. A third framework is the SAC model put forward in 1991 and revised in 1994. It conceives IC as a set of processes, functions, activities, subsystems and people organized to consciously assure that the organizational objectives and goals will be achieved as efficiently as possible [24]. Despite its focus on information technology, this framework is similar to the COSO model in that it is meant for internal auditors to assure operational efficacy and efficiency, adequate financial reports, and compliance with law and norms. The fourth model, published in 1997 in *The COCO Principles*, aims at risk management in the whole organization. As the three other frameworks, the COCO principles aim to help directors assess and implement a control environment that enables the organization to achieve its operational and strategic objectives [7]. At the same time, this framework also assumes that the IC success is related to a global approach to resources, people, systems, processes, planning, continuous learning, monitoring, and organizational culture and structure. Despite having been influenced by the COSO model, the COCO framework is oriented to the high administration and focuses on the employees' culture and behaviors, rather than on the control structure and procedures [29]. It assumes that the employees' commitment and clear focus on results and ethical values enable the organization to manage and reduce risks intrinsic to its processes and activities. The fifth framework is the Combined Code of CG, also known as Turnbull Report, first published in 1999 and later revised in 2005 [23]. Similarly to the COSO and COCO frameworks, the Turnbull Report aims at assessing business risks; however, it particularly addresses those risks related to asset integrity as a means of promoting a success-oriented business environment. This framework, which was designed for any kind of organization, assumes that risk management requires alignment of the control framework with all operations for identification of all risks within and outside the organization [29]. The sixth

framework, the King Report, developed in 1994, also aims at reducing risks and enabling the achievement of organizational objectives. This framework not only is concerned with promoting high CG standards in South Africa [13], but it also goes beyond the usual CG focus of the abovementioned models. Besides addressing financial reporting and regulation mechanisms, this framework also focuses on social, ethical and environmental aspects. The main assumption is that within certain risk thresholds companies are supposed to give proper value to economic development, environmental issues, and internal social relationships. This model was adapted to adjust to some SOX requirements [29], and The King Report II additionally puts forward that there are several ways to deliver on the expected results and to assure shareholders' satisfaction. The seventh framework is the COBIT model, edited in 1995 and revised in 2001 as an instrument for managers to expand their commitment regarding Information Technology controls. Focusing on organizational safety, this framework approaches IC as a set of processes involving policies, practices, procedures and cultures [22] controlled to promote operational efficiency, information integrity, reliability in financial reporting, and compliance with law. In terms of business ethics, risk management and capability of improving company performance, some of the analyzed IC frameworks were considered satisfactory and others only mention these factors indirectly. In the case of SAS 55/78, it is important to stress the concern of the editing body in terms of having the framework able to help in disclosing financial reports. Another concern is with the improvement of organizational efficiency and effectiveness levels, as well as with the framework adherence to the legal rules and to the IC system. The SAS 55/78 framework does not directly mention ethic. In the case of SAC and COBIT frameworks, they are similar to the SAS 55/78, but both are more focused on processes and in improving the information technology governance. This focus is stronger in the COBIT, that also prescribes actions regarding information confidentiality and integrity. Thus, the COBIT contributes to promoting more ethical attitudes. The Turnbull Report is more clear in presenting concerns with the identification and the management of risks. Besides, it also prescribes the IC alignment with the operations management, and recommend improvement in the organization competitiveness. In that sense, the King Report is similar to the Turnbull Report. However, the King Report is less restrict in terms of comprehensiveness. It exceeds the traditional control function and shows a broader perspective because it prescribes higher CG standard. It also recommends accountability regarding assuming different risk levels, as well as focuses on social, ethical and environmental issues. The COCO framework is focused on achieving organization objectives, and is similar to the King Report in terms of risk management. The King Report framework is focused on behavioral values, and the COCO is explicitly more focused on improving the company CG. Besides, in the COCO is perceived as a broad concept, differently from the other frameworks, which consider IC as a process or as a working system. Most of the time all the analyzed frameworks show similar concerns to the COCO in terms of involving all the elements which could contribute to achieving the organization objectives. It is important to note that this concern in the SAS 55/78, Turnbull Report and

COBIT is perceived in a more indirectly manner. SAC and SAS 55/78 focus on the search for higher levels of effectiveness, while the Turnbull Report focuses on creating and sustaining competitive advantages. The COBIT, by its turn, focus both on finding failures and on promoting the improvement of processes, policies and procedures which lead to achieving objectives, despite having the center of attention on information technology CG. Finally, since its creation in 1992 the COSO has a concern with assuring that the company has an adequate financial information disclosure, complying with the legal rules. It is also concerned to efficient and effective operations. The COSO ERM came to make the framework more comprehensive and included the risk management as the central focus of its IC process. Besides, the ethic concern was initially more implicit and is now more explicit in order to encourage the IC to be closely related to the MCS. It also promotes the adherence between the framework and the organizational culture, as noted by Mota [33] as social control. In this sense, the results corroborate the assertions of that author regarding the role of recruitment, selection and training activities to promote acculturation, and the involvement of employees with managers in the working processes in order to lead them to become also responsible to reaching pre-defined performance objectives and goals. Overall, all the frameworks aim at increased transparency, reduced cases of fraud and improved, reliable financial reporting, but only the COCO, COSO and King Report frameworks are clearly concerned with the ethical dimension. The COCO framework is culture-oriented and concerned with encouraging behaviors that will help the organization deliver on the expected results within ethical standards. The COSO model consists of a sound IC framework set to promote ethics, transparency, efficacy and risk management within a control environment grounded on organizational values, codes of conduct, sources of power, and cultures. The King Report, designed to broaden the usual CG focus, is the only framework that primarily focuses on social, ethical and environmental issues and thus assigns great value to economic development, environment and social engagement. As Zanette et al. [43] point out, corporate business management-oriented IC frameworks have outreached the usual accounting and management control functions and have assigned great value to the safety and quality of human, material and technological resources as a means of optimizing their applications within an organization. Colbert and Bowen [8] claim that irrespective of their different focuses, all the IC frameworks aim at helping companies achieve their objectives. In a sense, all the IC frameworks herein described assist companies in their attempts to mitigate risks, but only the COCO, COSO and King Report models are clearly concerned with business ethics. These three models potentially contribute to implementing high CG standards, stimulating ethical behavior and meeting the company's objectives. Our analysis points to the ERM COSO model as the one providing the most comprehensive framework because it is concerned with the organization as a whole. This is also supported by Maia et al. [29], who compare the COCO, COSO, King Report and Turnbull Report frameworks. They argue that all of them are oriented to risk management, contribute to validating and understanding the processes necessary to assure business continuity, and except for the COCO model that is

grounded on behavioral values, propose control frameworks and procedures. However, the COSO model provides the most adequate IC framework, because it is a reference worldwide, is particularly recommended by the North-American law, is concerned with simplifying managers' tasks, and promotes companies' operational success. Nevertheless, the fact that the COSO model is a reference worldwide does not assure that it is failure-free and all the organizations and reviews accept it without question. For instance, Gupta et al. [18] carried out a survey with IMA (Institute of Management Accountants) and IIA (Institute of Internal Auditors) members holding different positions of internal auditing, controllership, and financing management in the USA. They particularly investigated whether the COSO 1992 and other IC frameworks would meet the SOX guidelines and could be used as adequate IC assessment models in the corporations. Their results pointed out that: (i) several respondents did not have a full understanding of the IC frameworks; (ii) some of them indicated other IC proposals as more recommendable than the COSO framework; and (iii) some stated that the COSO framework is seemingly vague. Moreover, one third of the respondents believed the COSO model could provide a reliable framework to assess the five components it puts forward, but only 11 % of the respondents stated this model could be used broadly enough for risk and control management in their companies. The authors argued that the COSO framework could have been used to respond to the critics of SOX Section 404, but the organizations still lack tools to implement such a methodology. On the other hand, there are sound arguments to ground this model, including the features added to the ERM version. Rittenberg et al. [36], for instance, assess the COSO framework as an instrument for the organizations to evaluate and implement adequate control systems. Like Maia et al. [29] and Campbell et al. [6], Rittenberg et al. [36] argue that if the organizations put more effort to understanding how their MCS relates to the COSO components, then they can take several advantages from this IC framework. Rittenberg et al. [36] claim that improved financial reporting and accountability are just one step towards corporate success and the companies should thus make efforts to integrate risk management, strategic objectives and organizational goals with their accountability and law compliance needs. Such a framework could increase employees' awareness of issues related to their activities, make authority and accountability relationships more explicit, and adjust companies' philosophy and organizational structure [43]. Similarly, Oliveira et al. [34] state that world-class companies should understand that the IC is a management instrument that serves a more comprehensive function, and their norms, policies, guidelines and organizational structure should thus be regarded as legitimate integral parts of their control system. This means that companies incorporating ethical variables into their IC designed (now seen as integral part of their MCS) would be stimulating not only high CG standards and the reliability of their actions and reports, but also setting the stage for improved efficiency and efficacy. Considering the potential contributions to individuals, corporations and society, an analysis of the IC frameworks allow the conclusion that all of them are valid and relevant. The frameworks contribute to reducing the inadequacy of financial information disclosure, as proposed by Merchant

[32]. Besides, it was possible to observe that the frameworks contribute to improving the CG level of companies which adopt them, as proposed by Young and Guenther [42]. The frameworks are capable of reducing the risks in the decision-making process in the adopters, because the use of the framework offers standards that make the accounting practices more consistent and consequently lead to more reliable information. All the analyzed frameworks are useful to minimize opportunistic behavior by means of reducing information asymmetry to investors, as proposed by Jensen and Meckling [25] in their Finance Theory-based explanation. The benefits of disclosing more reliable financial information and reducing information asymmetry are derived from the adoption of policies and procedures prescribed by the IC frameworks. Additionally, the empirical results presented by Beaudoin and Cianci [3] converge with the present analysis. If the audit function is associated to a strong IC structure shows that is possible to have a positive impact in the financial information disclosure. As the authors stated, it depends on the business ethic established in the company, which starts from the main executive. More specifically, it was observed that IC models consist of accounting and administration processes and routines that are designed to organize a company in such a way that its employees understand, respect and comply with its policy corroborating the assumption of Maia et al. [29]. The content analysis is consistent with Campbell et al.'s [6] results, that claim that the adoption of an adequate IC framework can add value to an organization, as such a framework assists in delivering on strategies and ensuring both internal and external information quality, risk monitoring, improved accountability, legal compliance and fraud reduction. Additionally, such controls are expected to encourage people to uphold ethical standards, to protect asset integrity and to ensure accurate financial reporting of the company's operations. Usually introduced in IC frameworks and conceived of as a highly important dimension impacting on CG, ethics is crucial to ensure a company's credibility and public trust in the financial market, mainly because both of them have been highly affected by scandals and frauds in large-sized companies' financial reporting. A more thorough analysis of the relations among the IC frameworks shows that there is a constant concern by the editing bodies in giving incentive to people to focus on creating value to the organizations in which they work. Moreover, the concern also relates to both (i) encouraging people to have commitment with corporate policies and strategies, and (ii) adequate behavior towards coworkers, subordinates and managers. These concerns are indirectly related to ethical issues in all the analyzed IC frameworks. Moreover, these concerns are often intrinsic and no explicit reference was found only in the COSO, COSO ERM and King Report IC frameworks. Under Machiavelli's results-based ethics these three frameworks present in their structure an stimulus to behavior that is at the same time aligned to short and long term company objectives, and respects the people to whom have to keep work relations. In terms of business ethics, the King Report framework is by far the most internally consistent in explaining this dimension in its structure, process and control philosophy. Under the point of view of Machiavelli's result-based ethic the COSO ERM was considered the most suitable framework among the analyzed ones. The main reason for that

is that this framework directly and indirectly promotes actions which are ethical in terms of results they produce. These results are not aimed only at achieving the common good, as prescribed by the Plato's ethic. Results in the sense of Plato's ethic match the principles of the King Report framework. In Machiavelli's result-based ethic the behavior is considered ethical in accordance to the results they produce, while Plato's ethic is based on the premise of producing common good. One cannot say that the common good is not desirable, neither can say that attitudes focused on a holistic understanding of the company in its environment should not be encouraged. It is important to note that all issuing bodies praise good practices regarding social and environmental responsibility. The issue here, under the CG point of view, is the need to include the investors' perspective, which is in part forgotten in the King Report framework. In this sense, it is relevant that people be both encouraged to work and accountable for predefined results. If that is not the case, then many efforts dedicated to generate value would be invalid and many management decisions would be wasted. Therefore, the analysis of the frameworks under the view of CG indicates that still there are flaws which need to resolve. One can say that the King Report exceeds the traditional focus of CG because it is oriented to social, ethical and environmental issues, and because it promotes both the improvement of results and the reduction of corporate risks. Moreover, the COSO ERM is similar in all accounts to the King Report, but it is somehow closer to the expectations regarding the value creation demanded by the market. Therefore, the COSO ERM can be considered the one most suitable to satisfy all the variables considered in the analysis described in this paper. This conclusion is in line with those results presented in the literature. Besides, it is also possible to conclude the COSO ERM is the framework better related to MCS aimed at results and value creation.

## V. FINAL REMARKS

MCS influences employees' ethical behavior and enables managers to assess whether the organization's actions and processes are being carried out according to plan with a view to promoting efficacy and delivering on the organizational mission. The IC frameworks herein described help companies achieve these objectives, specially the COCO, COSO and King Report frameworks, which are clearly concerned with business ethics. The COCO particularly focuses on behavioral values and points to culture as a means of encouraging behaviors oriented to the achievement of results while maintaining the highest ethical standards. The COSO builds on a control environment grounded on the organization's values, codes of conduct, structure of power, and culture to promote ethical behaviors, transparency, operational efficacy and efficiency, law compliance, and risk management. The King Report is the one most concerned with business ethics; it was designed to go beyond the usual CG focus and sustains economic development, environmental issues, and social engagement. Those frameworks could potentially serve as a tool to implement high CG standards, encourage ethical behavior, and achieve companies' strategic objectives. However, the ERM COSO model is, according to the analysis herein reported, the most completed of the models, as it incorporates a management framework that encompasses the whole company with a view

to reducing risks and encouraging ethical behavior. Additionally, this model is internally consistent and broadly used both in the USA and worldwide. The improved implementation of an IC framework depends on both a clear understanding of its limitations and focusing on the particularities of each company, specially its strategy, structure, culture, and context. On the one hand, a framework such as the ERM COSO is capable of providing a common language in terms of control, risk management, improved processes and law compliance. On the other hand, the efficacy of such a framework depends on the specificity of each business, and once they are fully understood, companies can reduce their risk levels, improve their performance, and take more advantage of the IC framework adopted. The analysis herein reported points out that the implementation of an adequate IC framework can lead to improved CG practices, management processes, and business control while maintaining the highest ethical standards. This paper reports on an analysis of how business ethics is approached within internal control (IC) frameworks provided by the most relevant bodies issuing guidance in this area. The comparative content analysis of the international frameworks shows that only three of them (i.e. COCO, ERM COSO, and King Report) are in fact conceptually concerned with business ethics. The results point out that an adequate structure of IC can contribute to achieving significant levels of CG, and delivering on improved managerial and operational efficiency and effectiveness. More empirical investigation is needed to a better understanding on how international IC frameworks address ethical issues and the impact on CG.

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# Ranking Key Performance Indicators of the Occupational Safety Community of Practice

## Delphi-Fuzzy AHP Approach

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**Abstract—** This paper presents quality indicators of the community of practice for occupational safety, and the model for ranking key performance indicators of the community based on the Delphi method and fuzzy analytical hierarchy process. The method is applied in order to assess the importance of the indicators of the occupational safety community of practice in a cluster of small enterprises in construction sector. According to achieved results, the quality of occupational safety community of practice is primarily based on technical and organizational factors.

**Keywords-** safety; community of practice; Delphi method; fuzzy AHP; sensitivity analysis

### I. INTRODUCTION

Safety processes are supporting processes that significantly contribute to achieving the organization's business performance. The experts from different professions perform activities related to safety, and most employees are involved in interaction and collaboration activities [1].

Safety is a form of organizational expertise or a form of knowledge that is sustained in the organization by collaboration among different actors, and at organizational level by the interactions among companies in the industry and federal or local institutions [2]. As stated in [3], organizational learning on safety is based on the social character of the construction of knowledge and on the situated knowledge in work practices. According to [4], learning on safety is a collaborative and social activity within communities of practice.

Initially, communities of practice are developed ad-hoc, and today they are developed with the intention, and the idea is to solve some organizational problems. When it comes to occupational safety, the idea is to increase the level of protection and raise the intellectual capacity of employees. This paper presents basic characteristics of occupational safety communities of practice (CoP), their attributes (indicators), success factors, and appropriate multi-criteria ranking of quality indicators of the communities based on the Delphi method and the fuzzy analytic hierarchy process.

### II. FACTORS, PERFORMANCE AND INDICATORS OF THE SAFETY COMMUNITY OF PRACTICE

Some success factors of the communities of practice are presented in [5]. The most important success factors are activities relevant to members and domain of safety, the attitude to share and collaborate, definition of clear roles and expectations, employees' desire to participate and share the knowledge, reward mechanism and organizational modification to support participation, and different work organization in order to give members enough time to participate in community activities.

In [7], main components of a community of practice are presented according to four pillars (organizational, cognitive, economic, and technological). In this paper is used different classification of community of practice indicators, according to four factors (technical/technological, human, economic, and environmental), based on the quality criteria for safety presented in [8], commitment of members, identification with group's expertise, and lifetime that is defined by interests of maintaining group. The other indicators are defined according to special characteristics of the occupational safety community of practice, focused on learning, sharing knowledge and solving problems in the domain of occupational safety.

### III. THE METHOD

The method consists of three phases, as presented in Fig. 1. During the first, preparation phase, after the literature review, initial list of indicators is created, and experts for assessment are selected. The outcome of this phase is a questionnaire that experts will use during the assessment.

The second phase is a modified Delphi method [8]. The experts answered the questionnaires in three rounds, and after each round, a moderator provided a summary of the decisions from the previous round. The final decision is made after achieving the consensus, based on the Kendall's W value ( $W > 0.6$ ).

The fuzzy AHP method is used during the third phase [9], [10]. A triangular fuzzy number can be denoted as  $M = (l, m, u)$ , and the membership function is defined as:

$$\mu_F(x) = \begin{cases} \frac{x}{m-l} - \frac{l}{m-l}, & x \in [l, m] \\ \frac{x}{m-u} - \frac{u}{m-u}, & x \in [m, u] \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where  $l \leq m \leq u$ ,  $l$  and  $u$  are the lower and upper value of the support of  $M$ , respectively, and  $m$  is the middle value. When  $l = m = u$ , it is a crisp number.

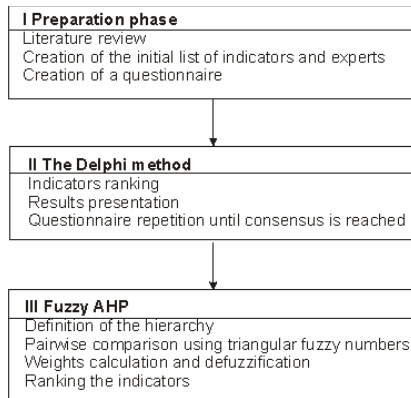


Figure 1. The research method used for ranking performance indicators of occupational safety community of practice

The goal is to rank key indicators of occupational safety community of practice, and to identify the relative importance for all indicators. In this paper, basic requirements on which occupational safety community of practice is based (technical, human, organizational, and external environmental factors) are identified as criteria, and the key occupational safety indicators are defined from the list of indicators shown in Table I (based on [6], [7]) are identified as alternatives. This list is neither complete nor unchangeable, and experts could extend the list by adding new indicators during the first round in the Delphi method.

The fuzzy AHP method presents a problem in the form of hierarchy, where the top level presents goal, intermediate level presents appropriate factors, and the lowest level are indicators. Fig. 2 shows the hierarchical scheme for ranking performance indicators of occupational safety communities of practice.

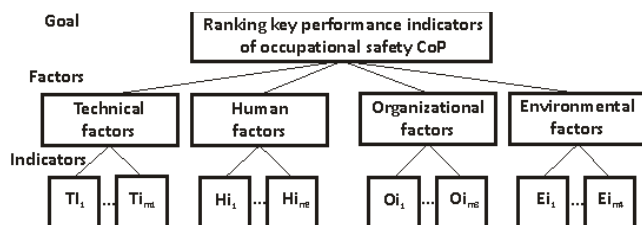


Figure 2. Hierarchy scheme for ranking performance indicators of occupational safety community of practice

Pairs of elements at each level are compared according to their relative contribution to the elements at the hierarchical level above. The scale used during the comparison is shown in Fig. 3. The fuzzification is implemented by triangular fuzzy numbers with a fuzzy distance  $\delta=2$  for odd values, and  $\delta=1$  for

pair values, due to consistency of obtained results. In the further text, all fuzzy numbers are denoted as  $\tilde{a}$ .

TABLE I. INDICATORS OF OCCUPATIONAL SAFETY COMMUNITIES OF PRACTICE

Factors	Indicators
Technical	Application of knowledge management technologies in CoP Availability and failure/maintenance rate of used platform CoP infrastructure costs CoP maintenance costs Functionality of supporting technologies Intensity of use the technology in CoP Number of protective levels Reliability of supporting technologies Simplicity of technological platform
Human	Degree of compliance with working procedures Degree of innovativeness of employees Employee satisfaction index Index of communication and reporting skills Index of personnel skills and knowledge Level of teamwork of employees Percentage of employees actively involved in CoP Roles of CoP members (leaders, supporters, members)
Organizational	Annual average number of hours of training employees Knowledge gaps among CoP members The average experience of employees Number of documents on applied safety measures Number of guidelines for OH&S protection of employees Number of documents on jobs at risk and lost workdays Number of CoP support persons (facilitators) Number of meetings in CoP Percentage of employees trained in OH&S involved in CoP Relationship with existing organizational structure Rewarding employees for participation in CoP The level of networking in/among organizations
Environmental	Formal acknowledgement Level of legislation implemented Level of protection technologies Number of available databases on accidents and incidents Number of available funds Number of implemented standards of quality Number of implemented standards of safety

Pair-wise comparisons at each level, according to the top-down approach, are presented in the square matrix form:

$$A = \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \dots & \tilde{a}_{2n} \\ \dots & \dots & \dots & \dots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & \tilde{a}_{nn} \end{bmatrix}, \quad (2)$$

where  $A$  is an  $n \times n$  matrix ( $n$  is the number of compared elements at appropriate level). Elements of  $A$  matrix,  $\tilde{a}_{ij}$ , are judgments about the relative importance of alternative  $i$  over alternative  $j$ , with following characteristics:  $\tilde{a}_{ij}=1$  for  $i=j$  and  $\tilde{a}_{ij}=1/\tilde{a}_{ji}$  for  $i \neq j$ .

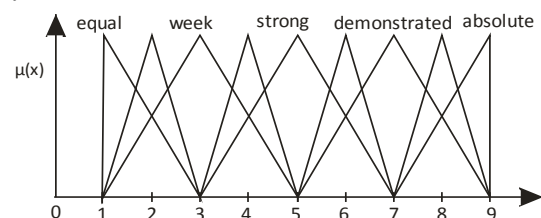


Figure 3. Fuzzy scale, judgment description (equal importance; week, strong, demonstrated and absolute dominance)

The main laws for operations for two triangular fuzzy numbers  $M_1 = (l_1, m_1, u_1)$  and  $M_2 = (l_2, m_2, u_2)$  are:

$$M_1 \oplus M_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2), \quad (3)$$

$$\lambda \cdot M_1 = (\lambda \cdot l_1, \lambda \cdot m_1, \lambda \cdot u_1), \quad \forall \lambda > 0, \quad (4)$$

$$M_1 \otimes M_2 = (l_1 \cdot l_2, m_1 \cdot m_2, u_1 \cdot u_2), \quad l_1, l_2 > 0, \quad (5)$$

$$M_1^{-1} = (l_1, m_1, u_1)^{-1} = (u_1^{-1}, m_1^{-1}, l_1^{-1}), \quad (6)$$

Final criteria weights are derived through the aggregation of the weights at two consecutive levels, where the  $N$  alternatives are compared with respect to each of the  $K$  criteria. After obtaining  $K$  fuzzy judgment matrices, the element of the final decision matrix is calculated as follows:

$$x_{ij} = \sum_{k=1}^K \tilde{a}_{ik} \otimes \left[ \sum_{l=1}^N \sum_{m=1}^K \tilde{a}_{lm} \right]^{-1}, \quad i = 1, \dots, N; j = 1, \dots, K. \quad (7)$$

In the decision matrix  $X$ ,  $x_{ij}$  presents the resultant fuzzy value of the alternative  $A_i$  ( $i = 1, \dots, N$ ) with respect to the  $j$ -th criterion ( $j = 1, \dots, K$ ). As a result of applying the procedures for determining relative weights, the following vectors are defined: eigenvector of criteria, and eigenvector of alternatives for every criterion [11].

To finally rank the alternatives, the defuzzification is required. The method described in [10] is applied on triangular fuzzy numbers:

$$(a_{ij}^\alpha)^\lambda = (\lambda \cdot l_{ij}^\alpha + (1 - \lambda) \cdot u_{ij}^\alpha), \quad 0 \leq \lambda \leq 1, 0 \leq \alpha \leq 1, \quad (8)$$

where  $M = (l, m, u)$  is a triangular fuzzy number,  $\lambda$  is index of pessimism, and  $l_{ij}$  and  $u_{ij}$ , calculated as follows,

$$l_{ij}^\alpha = (m_{ij} - l_{ij}) \cdot \alpha + l_{ij}, \quad u_{ij}^\alpha = u_{ij} - (u_{ij} - m_{ij}) \cdot \alpha, \quad (9)$$

present the left-end and right-end value of  $\alpha$ -cut for  $\tilde{a}_{ij}$ .

#### IV. EXPERIMENTAL RESULTS

The described method of ranking community of practice indicators is used in the occupational safety community of practice consisting of seven small enterprises (5-100 employees) in the field of construction industry and services. Many of them have a long and successful tradition in the field, and currently are the leaders in the domain of domestic construction industry services, as evidenced by the number of newly-constructed residential and office buildings in South and East Serbia. The activity of companies includes: construction and maintenance of residential buildings, construction and maintenance of office buildings, construction of public buildings, and construction and maintenance of buildings of special purposes. Since their main activity is not directly related to safety, and safety has a significant impact on performance, competitiveness, social acceptability and effectiveness of their organizations, limited human resources dedicated to the protection of people and goods was initiated

by the need for joining the organizations in the community of practice.

During the research of indicators in this safety community of practice, it is started from factors that influence the quality of a community of practice (technical (TF), human (HF), organizational (OF), and environmental (EF)), and a list of indicators (Table I). This list is presented to the occupational health and safety officers and safety managers in the organizations that participate in the community of practice. Kendall's W values for the three rounds in Delphi method were 0.36, 0.49 and 0.67. Among the listed indicators, the experts selected 20 key indicators (five indicators from four groups), that best represent the state of occupational safety community of practice (presented in Table VII). Subsequently, the fuzzy AHP method was applied, which is based on the following comparisons: comparison of criteria (technical, human, organizational and environmental factors), and comparison of key indicators within each criterion. Resulting pair-wise comparison matrices for factors and indicators are shown in Tables II-VI.

TABLE II. FUZZY AGGREGATE PAIR-WISE COMPARISON MATRIX FOR FACTORS

Goal	TF	HF	OF	EF
TF	1, 1, 1	1,4,2,4,3,4	0,84,1,07,2,6	1,2,2,3,4
HF	0,29,0,42,0,71	1,1,1	0,44,0,77,1,4	0,87,0,9,2,6
OF	0,38,0,94,1,19	0,71,1,3,2,27	1,1,1	1,1,8,3,4
EF	0,29,0,45,1	0,38,1,11,1,15	0,29,0,56,1	1,1,1

TABLE III. FUZZY AGGREGATE PAIR-WISE COMPARISON MATRIX FOR TECHNICAL INDICATORS

TF	TI1	TI2	TI3	TI4	TI5
TI1	1, 1, 1	1,2,4,3,8	0,77,1,2,2	1,2,6,4,2	1,3,5
TI2	0,26,0,4,1	1,1,1	0,2,0,37,1	1,1,4,3,4	1,1,4,3
TI3	0,45,1,1,3	1,2,73,4,4	1,1,1	1,2,8,4,6	1,4,3,4,6
TI4	0,2,0,38,1	0,3,0,71,1	0,2,0,36,1	1,1,1	0,9,1,3,2,6
TI5	0,2,0,33,1	0,33,0,7,1	0,2,0,3,0,7	0,4,0,8,1,1	1,1,1

TABLE IV. FUZZY AGGREGATE PAIR-WISE COMPARISON MATRIX FOR HUMAN INDICATORS

HF	HI1	HI2	HI3	HI4	HI5
HI1	1, 1, 1	1,1,6,3,4	0,3,0,8,1,7	1,2,6,4,2	1,4,1,6,3,4
HI2	0,3,0,63,1	1,1,1	1,1,4,3,4	1,3,5	1,1,6,3,4
HI3	0,6,1,2,2,8	0,3,0,71,1	1,1,1	1,3,5	1,2,8,4,6
HI4	0,24,0,4,1	0,2,0,33,1	0,2,0,33,1	1,1,1	0,2,0,3,0,9
HI5	0,3,0,6,0,7	0,3,0,63,1	0,2,0,36,1	1,1,3,4,76	1,1,1

TABLE V. FUZZY AGGREGATE PAIR-WISE COMPARISON MATRIX FOR ORGANIZATIONAL INDICATORS

OF	OI1	OI2	OI3	OI4	OI5
OI1	1, 1, 1	1,3,5	1,1,4,3,4	1,2,2,3,4	1,2,6,4,2
OI2	0,2,0,33,1	1,1,1	0,2,0,3,1	1,1,6,3,4	1,2,3,8
OI3	0,29,0,7,1	1,3,5	1,1,1	1,3,5	1,3,5
OI4	0,29,0,4,1	0,29,0,6,1	0,2,0,33,1	1,1,1	1,1,2,3
OI5	0,24,0,4,1	0,26,0,5,1	0,2,0,33,1	0,33,0,8,1	1,1,1

TABLE VI. FUZZY AGGREGATE PAIR-WISE COMPARISON MATRIX FOR ENVIRONMENTAL INDICATORS

EF	EI1	EI2	EI3	EI4	EI5
EI1	1, 1, 1	1,2,8,4,6	1,2,4,3,8	1,2,6,4,6	3,5,7
EI2	0,2,0,36,1	1,1,1	1,1,3	1,1,6,3,4	1,3,5
EI3	0,3,0,42,1	0,33,1,1	1,1,1	1,1,4,3	1,2,8,4,6
EI4	0,2,0,38,1	0,3,0,63,1	0,33,0,7,1	1,1,1	1,2,8,4,6
EI5	0,1,0,2,0,3	0,2,0,33,1	0,22,0,4,1	0,2,0,36,1	1,1,1

According to the previous results and sensitivity analysis, the following can be concluded. The quality of occupational safety community of practice is primarily based on technical and organizational factors, followed by human factors, while the least important are environmental factors being underestimated by participants in this questionnaire (Table II).

Based on the values of global priority of occupational safety community of practice indicators (Table VII), the best ranked indicators are: (1) the relationship with organizational structure ( $w_{OI,3}=0.1001$ ); (2) the level of networking in/among organizations ( $w_{OI,1}=0.0997$ ); (3) the CoP infrastructure costs ( $w_{TI,3}=0.086$ ); (4) the simplicity of technological platform ( $w_{TI,1}=0.0859$ ); (5) formal acknowledgement ( $w_{EI,1}=0.0617$ ); (6) defined roles for CoP members ( $w_{HI,3}=0.0591$ ); (7) rewarding employees mechanism for participation ( $w_{OI,2}=0.0585$ ); and (8) percentage of employees involved in CoP ( $w_{HI,2}=0.00559$ ).

TABLE VII. FINAL WEIGHTS (FW) OF INDICATORS

Fac.	Indicators	FW $\alpha=0.1$ $\lambda=0.5$	FW $\alpha=0.1$ $\lambda=0.7$
TF	Simplicity of technological platform-TI1	0.0859	0.0842
	Intensity of technology use in CoP-TI2	0.0468	0.0467
	CoP infrastructure costs-TI3	0.0860	0.0840
	Reliability of supporting technologies-TI4	0.0341	0.0337
	Knowledge management in CoP-TI5	0.0260	0.0255
HF	Index of communication & reporting skills-HI1	0.0554	0.0563
	Percentage of employees involved in CoP-HI2	0.0559	0.0568
	Roles of CoP members (leaders...)-HI3	0.0591	0.0598
	Level of teamwork of employees-HI4	0.0193	0.0198
	Compliance with working procedures-HI5	0.0353	0.0356
OF	Networking in/among organizations-OI1	0.0997	0.1002
	Rewarding employees for participation-OI2	0.0585	0.0592
	Relationship with organizational structure-OI3	0.1011	0.1013
	Number of CoP support persons-OI4	0.0401	0.0406
	Number of documents on safety measures-OI5	0.0294	0.0296
EF	Formal acknowledgement-EI1	0.0617	0.0613
	Databases on accidents and incidents-EI2	0.0376	0.0378
	Level of legislation implemented-EI3	0.0308	0.0307
	Number of available funds-EI4	0.0252	0.0250
	Number of implemented Q standards-EI5	0.0121	0.0122

The calculation is done for different values of  $\alpha$ -cut values (0.1-0.5) and index of pessimism. Fig. 4 shows the weights calculated for  $\lambda=0.5$  value of pessimism index.

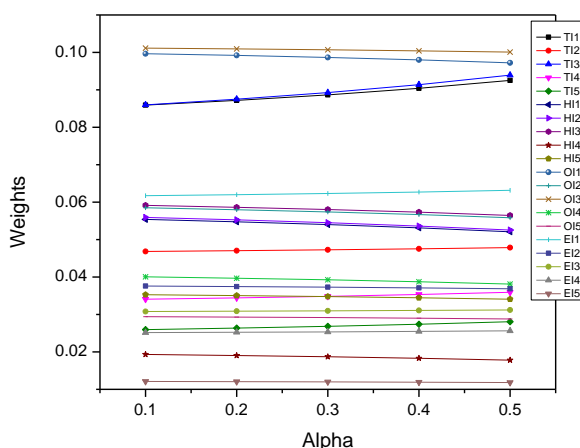


Figure 4. Weights for different  $\alpha$ -cut values and  $\lambda=0.5$

## V. CONCLUSION

In this paper, indicators of quality of occupational safety community of practice are classified into four categories: technical, human, organizational, and environmental factors. According to case study carried out in the occupational safety community of practice that consists of seven small and medium enterprises in the field of construction industry and services, quality of the community is primarily based on technical and organizational factors. The pair-wise comparison is more intuitive for safety officers and safety managers when there are used fuzzy number, because it is very hard to define exactly how dominant is one characteristics of the community over the other one, as it is necessary when it is applied analytic hierarchy method with crisp numbers. Thus the fuzzy analytic hierarchy process is selected for ranking indicators. The described assessment process is proposed to be part of the business intelligence toolkit for safety, where the online Delphi method and the fuzzy AHP method will help the safety officers and managers to rank the indicators and to monitor the level of safety in connected organizations.

## ACKNOWLEDGMENT

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# The significance of resources and competencies of cooperatives in the area of quality management on the example of dairy cooperatives from the Świętokrzyskie voivodeship

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**Abstract** — Cooperatives, like other enterprises, must constantly adapt to changing requirements of the customers and to the changing environment to be more competitive. One of the areas in the enterprises that affect its competitiveness is quality management. Each company however otherwise sees the importance of used resources and competencies in the field of quality management, hence the objective of this paper is to analyze the validity and the state of resources and competencies in the field of quality management in comparison with competition, basing on selected dairy cooperatives from Świętokrzyskie voivodeship. The analysis is based on the results of direct interviews conducted with the help of the questionnaire.

**Keywords** – cooperatives, resources, competencies, quality management

## I. INTRODUCTION

To lead and operate an organization successfully, it is necessary to direct and control it in a systematic and transparent manner. Success can result from implementing and maintaining a management system that is designed to continually improve performance while addressing the needs of interested parties. Managing an organization encompasses quality management amongst other management disciplines [1]. Quality management can be defined as a philosophy or an approach to management made up of a set of mutually reinforcing principles, each of which is supported by a set of principles and techniques [2]. We can find eight quality management principles on which the quality management system standards of the ISO 9000 series are based [3]. They have been identified that can be used by top management in order to lead the organization towards improved performance [1]. These principles are: 1. Customer focus, 2. Leadership, 3. Involvement of people, 4. Process approach, 5. System approach to management, 6. Continual improvement, 7. Factual approach to decision making and 8. Mutually beneficial supplier relationships [3].

In the language of traditional strategic analysis, firm resources are strengths that firms can use to conceive of and implement their strategies [4], while competence is the ability to sustain the coordinated deployment of resources in ways that

helps an organization achieve its goals (creating and distributing value to customers and stakeholders) [5].

Taking into account resources and competencies owned by the enterprise and the area of quality management, could be assumed that the sphere of quality management consists of the following resources and competencies [6]:

- Owned quality assurance systems.
- Owned certificates of quality of products.
- The use of “philosophy” of total quality management (TQM).
- Motivation systems used for high-quality performance.
- The use of systems of quality improvement of processes and products.
- Awareness of “pro-quality” of employees.
- The degree of involvement of top management in the implementation of a high quality assurance programs.
- Knowledge and abilities of personnel responsible for the improvement and control of the quality.
- The level of computerization of applied quality management systems.

The objective of this paper is to analyze the validity and the state of resources and competencies in the field of quality management in comparison with competition, basing on selected dairy cooperatives from Świętokrzyskie voivodeship. The analysis is based on the results of direct interviews conducted with the help of the questionnaire.

## II. ANALYSIS OF THE VALIDITY OF RESOURCES AND COMPETENCIES USED BY COOPERATIVES IN THE AREA OF THE QUALITY MANAGEMENT

Cooperative executives were asked to assess the degree of importance of each resource and competence used by cooperatives in the field of quality management from the point of view of competition. Interview results are shown in Table 1 and Figure 1.

From Table 1 and Figure 1, it is clear that cooperative “A” considered owned quality assurance systems as extremely important, cooperative “B” as very important, and cooperative “C” as quite important (average rating is 4.0). Owned certificates of quality of products are considered as very important in cooperatives “A” and “B” and as quite important in cooperative “C” (average rating is 3.7). The use of “philosophy” of total quality management (TQM) was found to be extremely important in cooperative “A” and very important in cooperatives “B” and “C” (average rating is 4.3). Motivation systems used for high-quality performance and the level of computerization of applied quality management systems were considered as extremely important in cooperative “B” and as very important in cooperatives “A” and “C” (average rating is 4.3). For extremely important was considered the use of systems of quality improvement of processes and products in cooperative “C”, while in cooperatives “A” and “B” it was considered as very important (average rating is 4.3). Awareness of “pro-quality” of employees was found to be extremely important in cooperative “C” and quite important in cooperatives “A” and “B” (average rating is 3.7). The degree of involvement of top management in the implementation of a high quality assurance programs was considered as extremely important in cooperatives “B” and “C”, while in cooperative “A” it was considered as very important (average rating is 4.7). All analyzed cooperatives considered the knowledge and abilities of personnel responsible for the improvement and control of the quality as very important (average rating is 4.0).

Analyzing separately each cooperative, it appears that:

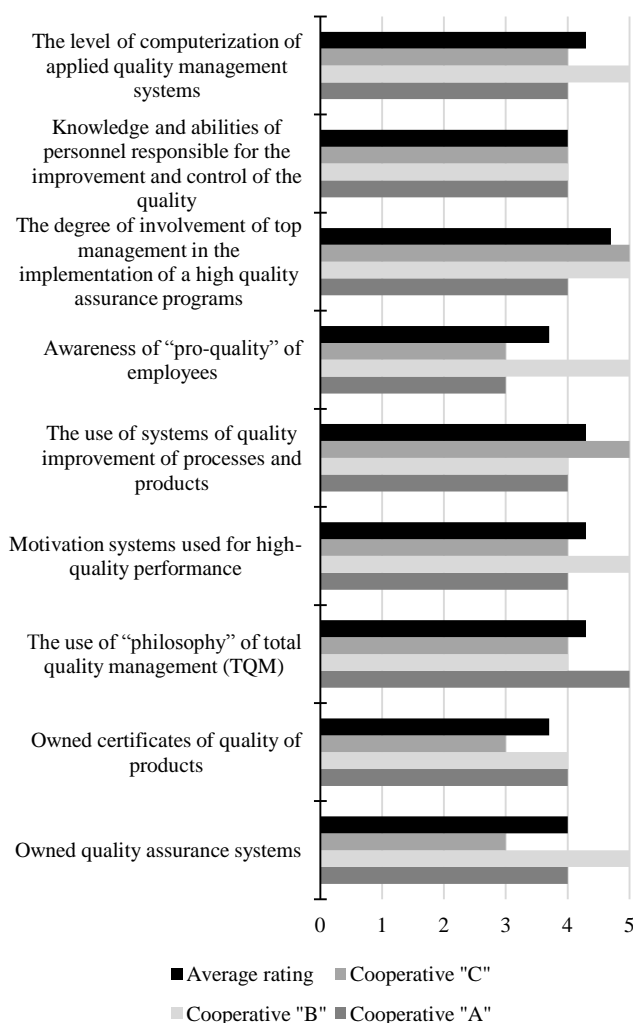
- Cooperative “A” considered as extremely important the use of “philosophy” of total quality management (TQM), while as very important were considered the owned quality assurance systems and certificates of quality of products, the motivation systems used for high-quality performance, the use of systems of quality improvement of processes and products, the degree of involvement of top management in the implementation of a high quality assurance programs, the knowledge and abilities of personnel responsible for the improvement and control of the quality and the level of computerization of applied quality management systems. For quite important was found the awareness of “pro-quality” of employees.
- Cooperative “B” considered as extremely important the owned quality assurance systems, motivation systems used for high-quality performance, awareness of “pro-quality” of employees, the degree of involvement of top management in the implementation of a high quality assurance programs and the level of computerization of applied quality management systems. For very important were found the owned certificates of quality of products, the use of “philosophy” of total quality management (TQM), the use of systems of quality improvement of processes and products and the knowledge and abilities of personnel responsible for the improvement and control of the quality.

TABLE I. ASSESSMENT OF THE VALIDITY OF RESOURCES AND COMPETENCIES USED BY COOPERATIVES IN THE AREA OF THE QUALITY MANAGEMENT FROM THE POINT OF VIEW OF COMPETITIVENESS

Resources / competencies of the cooperative in the field of quality management	The degree of importance on a scale of 1 to 5															Number of indications					Average rating
	Cooperative																				
	„A”					„B”					„C”										
	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5			
Owned quality assurance systems					x						x			x				1	1	1	4.0
Owned certificates of quality of products					x						x			x				1	2		3.7
The use of “philosophy” of total quality management (TQM)						x					x				x				2	1	4.3
Motivation systems used for high-quality performance					x						x				x			2	1		4.3
The use of systems of quality improvement of processes and products					x						x				x			2	1		4.3
Awareness of “pro-quality” of employees				x							x				x			2		1	3.7
The degree of involvement of top management in the implementation of a high quality assurance programs					x						x					x			1	2	4.7
Knowledge and abilities of personnel responsible for the improvement and control of the quality					x						x					x			3		4.0
The level of computerization of applied quality management systems					x						x					x			2	1	4.3

Rating scale: 5 - extremely important, 4 - very important, 3 - quite important, 2 - little important, and 1 - completely unimportant.

Source: Compiled by author.



Rating scale: 5 - extremely important, 4 - very important, 3 - quite important, 2 - little important, and 1 - completely unimportant.

Source: Compiled by author.

Figure 1. Assessment of the validity of resources and competencies used by cooperatives in the area of the quality management from the point of view of competitiveness.

- Cooperative "C" considered as extremely important the use of systems of quality improvement of processes and products and the degree of involvement of top management in the implementation of a high quality assurance programs. As very important were considered the use of "philosophy" of total quality management (TQM), motivation systems used for high-quality performance, knowledge and abilities of personnel responsible for the improvement and control of the quality and the level of computerization of applied quality management systems. For quite important were found the owned quality assurance systems, owned certificates of quality of products and awareness of "pro-quality" of employees.

### III. ANALYSIS OF RESOURCES AND EXPERTISE IN THE FIELD OF QUALITY MANAGEMENT IN COMPARISON WITH COMPETITORS

In the second part of the questionnaire, cooperative executives were asked to assess the state of resources and competencies used by cooperatives in the area of quality management. The interview results are shown in Table 2 and in Figures 2 and 3.

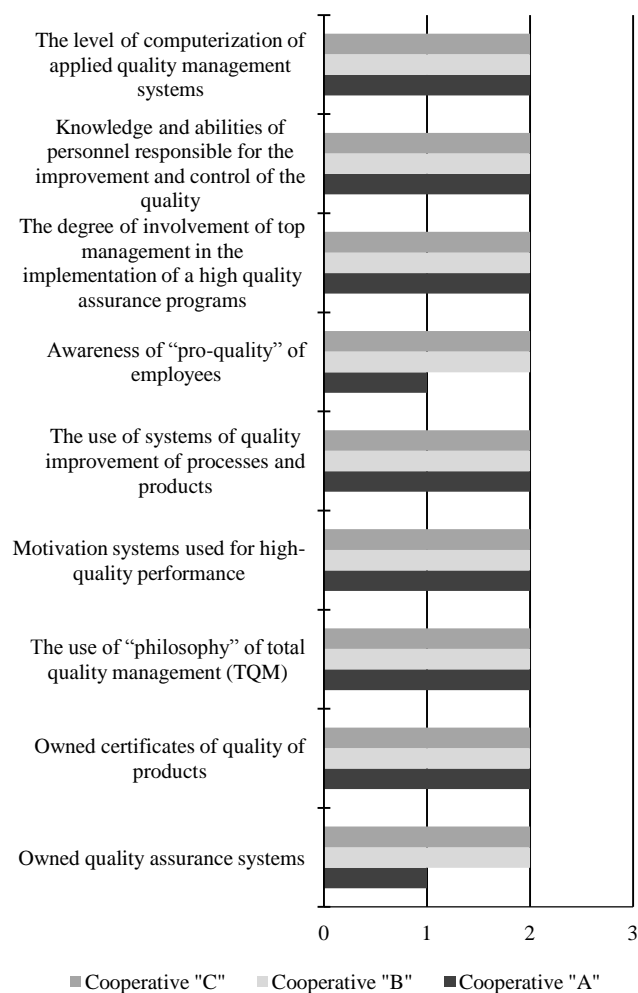
TABLE II. EVALUATION OF THE STATE OF RESOURCES AND COMPETENCIES USED BY COOPERATIVES IN COMPARISON WITH COMPETITORS

Resources / competencies of the cooperative in the field of quality management	State						Number of indications			Percentage of indications		
	Cooperative											
	„A”			„B”		„C”						
	B	S	W	B	S	W	B	S	W	B	S	W
Owned quality assurance systems	x			x		x	1	2		33.3	66.7	
Owned certificates of quality of products		x		x		x		3			100	
The use of “philosophy” of total quality management (TQM)		x		x		x		3			100	
Motivation systems used for high-quality performance		x		x		x		3			100	
The use of systems of quality improvement of processes and products		x		x		x		3			100	
Awareness of “pro- quality” of employees	x			x		x	1	2		33.3	66.7	
The degree of involvement of top management in the implementation of a high quality assurance programs		x		x		x		3			100	
Knowledge and abilities of personnel responsible for the improvement and control of the quality		x		x		x		3			100	
The level of computerization of applied quality management systems		x		x		x		3			100	

State: B – better, S – similar, W – worse.

Source: Compiled by author.

When analyzing Table 2 and Figures 2 and 3 it can be seen similar state of used resources and competencies in the field of quality management in comparison with the competition which occurs in all cooperatives in the owned certificates of quality of products, the use of "philosophy" of total quality management (TQM), motivation systems used for high-quality performance, the use of systems of quality improvement of processes and products, the degree of involvement of top management in the implementation of a high quality assurance programs, knowledge and abilities of personnel responsible for the improvement and control of the quality and the level of computerization of applied quality management systems. However, in the case of the owned quality assurance systems and the awareness of "pro-quality" of employees, the state in two cooperatives is similar (which is 66.7%) and in one is better in comparison to the competition (which is 33.3%).

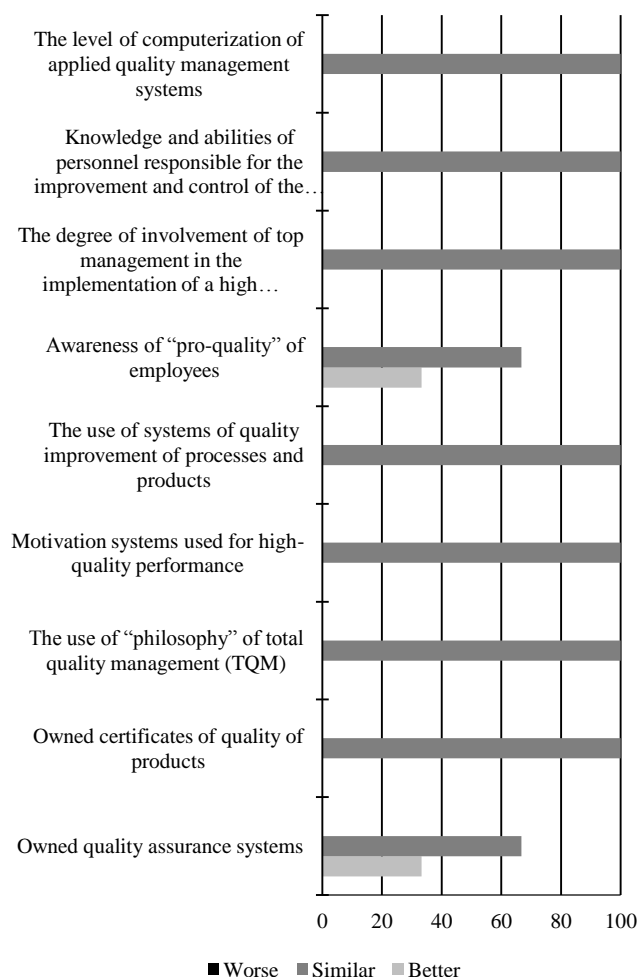


State: 1 – better, 2 – similar, 3 – worse.

Source: Compiled by author.

Figure 2. State of resources and competencies used by cooperatives in comparison with competitors.

In the case of cooperative "B" and "C", the state of all used resources and competencies in the field of quality management in comparison with the competition is similar. Cooperative "A" concluded that the similar state to the competition in terms of used resources and competencies occurs in the case of owned certificates of quality of products, the use of "philosophy" of total quality management (TQM), motivation systems used for high-quality performance, the use of systems of quality improvement of processes and products, the degree of involvement of top management in the implementation of a high quality assurance programs, the knowledge and abilities of personnel responsible for the improvement and control of the quality and the level of computerization of applied quality management systems, while the better state occurs in the case of the owned quality assurance systems and the awareness of "pro-quality" of employees.



Source: Compiled by author.

Figure 3. State of resources and competencies used by cooperatives in comparison with competitors (in %).

#### IV. CONCLUSIONS

Cooperatives, like other enterprises, must constantly adapt to changing requirements of the customers and to the changing environment to be more competitive. One of the areas in the enterprises that affect its competitiveness is quality management. And in the area of quality management a very important role play resources and competencies. An analysis of the validity of resources and competencies in the area of quality management, based on the results of conducted research in dairy cooperatives from the Świętokrzyskie voivodeship, shows that from the point of view of competitiveness, cooperatives assess the highest the degree of involvement of top management in the implementation of a high quality assurance programs. The lowest in terms of validity, the cooperatives found owned certificates of quality of products and the awareness of "pro-quality" of employee. Two out of three analyzed cooperatives recognized that the state of all kinds of resources and competencies in the field of quality management is similar to the state of competitors. One cooperative concluded that the state of two of its resources / competencies is better in the comparison to the competition,

while state of other resources and competencies is similar to the competition.

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# Technology orientation in relation to online service adoption

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**Abstract—** In this paper<sup>1</sup> we are exploring the technology experience influence on the usage of Internet banking. Our results suggest that the Internet banking users have more positive beliefs about technology in general, which affect the attitude and behavior toward Internet banking. Our findings also indicate that attitudes toward computers and Internet affect attitudes toward Internet banking. Difficulties in using the computers, and the past experience in this way, seem to be also as important as the past literature suggests. Most of the Non-users do not even have an access to the Internet and a total of 37.1 percent of them said that they have great difficulties in using computers which causes heavy restrain on their Internet banking adoption.

**Keywords-** technology orientation, service delivery, perceptions

## I. INTRODUCTION

With increased working hours, and less free time, customers highly value convenience. Customers also seek intuitive and comfortable interfaces. The design of the business-customer interface will become more critical as it begins to incorporate elements of convenience, transparency, and individualization. Customers no longer need to concern themselves with the details of how the end product or solution is achieved. Customers will increasingly rely on technology to fulfill their needs online. Complete and guaranteed fulfillment online will be expected. Because of the amount of information that can be collected by businesses, customers will do business with companies that meet their priority of high security. [1]

It has been also suggested that the education content of various Internet sites is a key element of success. Most people demand personalized products and timely response and delivery of the product becomes increasingly important as does the updated and immediate information. Customers increasingly demand more options and product diversity. Also interaction, particularly in a community of interest, provides high value to customers.<sup>2</sup>

Already we can see that human behavior is changing rapidly as a result of the latest technological revolution. As people start to change the way they work, communicate, and spend their leisure time, they will undoubtedly exert strong pressure on companies to change the way they do business with them. Clearly, future consumers will be dramatically different from the past or even present consumers. They will be more

demanding, more time-driven, more information sensitive, and highly individualistic. A combination of a ubiquitous broadband digital communications network and high-definition display terminals will further accelerate changes in consumer behavior. Because of interactive advertising, buyers will be much more active in seeking even marketer-provided information. [2]

## II. TECHNOLOGY-BASED SERVICE DELIVERY

Service level management (SLM) is a disciplined, proactive methodology and procedure used to ensure that adequate levels of service are delivered to all IT users in accordance with business priorities and at acceptable cost. Service levels typically are defined in terms of availability, responsiveness, integrity, and security delivered to the users of the service. The leading reason for implementing service level management is client satisfaction. SLM necessitates a dialog between managers and customers. In SLM the acceptable level of service is agreed. But even a process of service level management cannot produce happy customers when service level commitments are not met. However, it can significantly raise overall client satisfaction when commitments are met. [3].

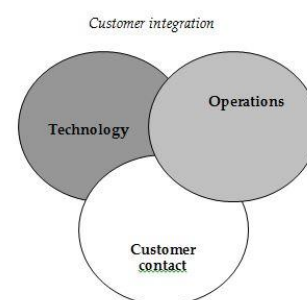


Figure 1. The three factors in Internet-based customer service (modified from [4])

Successful Internet-based customer service will depend on cooperation on three fronts. It is important to build the interface requirement to allow customers to receive instantaneous and efficient support online. The real test will be when the surveys indicate that online customer satisfaction exceeds personal, telephone, or other types of customer support. Once users are used to the new online connection with their suppliers, they will begin to expect more transaction history and instantaneous support to occur on the Internet. It is advisable to augment a virtual reality experience with a live video or audio link to a

<sup>1</sup> Previously discussed also in Mattila 2001 "Essays on Customers in the Dawn of Interactive Banking"

<sup>2</sup> Citation as for [1]

customer support representative. Users thus come full circle back to real human interaction. [5]

Service companies use technology in three ways. First, employees use technology in back-office functions to increase overall efficiency. Second, customer contact employees use technology to make the service encounter more efficient. Third, customers use technology for self-service functions. However, the technological advances are not always welcomed. As opposed to manufacturing sector, it sometimes appears difficult to ascertain the payoffs associated with large investments, such as technological developments require, in the service sector. Technology advances so rapidly that obsolescence is also a significant problem. The importance of the decision to outsource technology and the source of partners with whom to ally must not be underestimated either. Notwithstanding the widespread establishment of departments for IT and information management within many banks, the full range of expertise needed to select, develop, and maintain technologically sophisticated systems does not necessarily reside within themselves.[6]

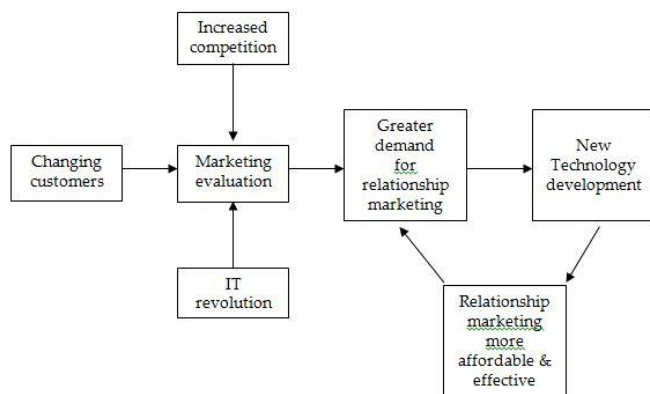


Figure 2. Symbiotic Relationship between IT and (relationship) marketing (adapted from [7])

Service marketing research has traditionally looked at technological services and non-technological services as separate areas of research. With technological development, however, the line between technological and non-technological services is blurring. Service firms across different industries are delivering similar technology-based services with similar implications for marketing. In many industries, such as banking, the initial reason for automation stems from the need to cut the personnel costs service delivery. Today's consumer expects flexible service hours which add to the costs even more. Many companies have cut the costs of customer service with automated, telecommunications based customer services. Service companies use technology in three ways. First, employees use technology in back-office functions to increase overall efficiency. Second, customer contact employees use technology to make the service encounter more efficient. Third, customers use technology for self-service functions.[8]

Dabholkar (1994) introduced a classification scheme for developing marketing strategies in delivering technology-based services. The scheme is based on prior service research and different service classifications. It can be applied to all industries and it takes into account all service delivery options

to be examined. The banking industry was chosen as an example because of its early adoption of technology both internally and in the customer interface (see figure 3). The classification scheme looks at the service encounter from different perspectives: by whom, where, and how is the service delivered. The classification scheme also takes into account whether the encounter is person-to-person or person-to-technology meaning self-service, and is there is physical distance between these two to be detected or not. Nowadays it might be also interesting to expand Dabholkar's model into a three dimensional cube, which would entail a third definition of service encounter: technology-to-technology.

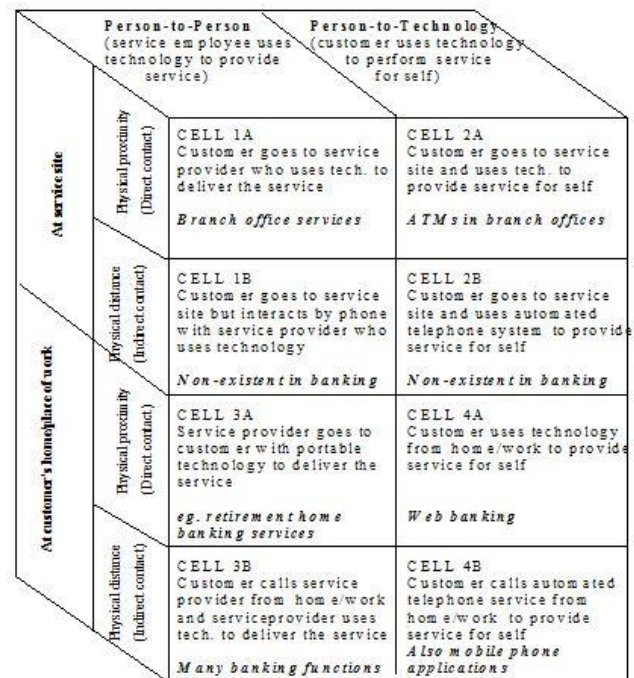


Figure 3. Classification scheme for technology-based service delivery options in the banking industry (modified from [8], presented earlier in [9])

Holmlund (1996) introduced different interaction levels in a relationship [10]. *Actions* are individual initiatives such as phone calls or visits. Interrelated actions may be grouped into *episodes*, such as a shipment process or a negotiation. Interrelated episodes may be grouped into a *sequence*, which is a larger entity on a higher interaction level. The outcomes of sequences are critical to the whole *relationship*, which is the highest interaction level. A relationship includes all individual action as well as larger entities: episodes and sequences. Service interaction levels are useful in designing technology-based service delivery, as the thinking emphasizes the meaning of each individual encounter in the development of the relationship.

### III. EMPIRICAL IMPLICATIONS

Technology experience is one of the most significant variables affecting attitude and intention toward Internet banking. Technology experience is positively correlated with intention ( $r=.182$ ,  $p<0.01$ ). Also the four sub-factors, computer knowledge ( $r=.189$ ,  $p<0.01$ ), electronic payment card

experience ( $r=.151$ ,  $p<0.01$ ), e-mail experience ( $r=.127$ ,  $p<0.01$ ), and Internet experience ( $r=.228$ ,  $p<0.01$ ) all correlate positively with intention to use Internet banking. To be more precise, Internet experience seems to be the most important variable of technology experience affecting intention. These findings are supported by the previous studies (see for example [11]).

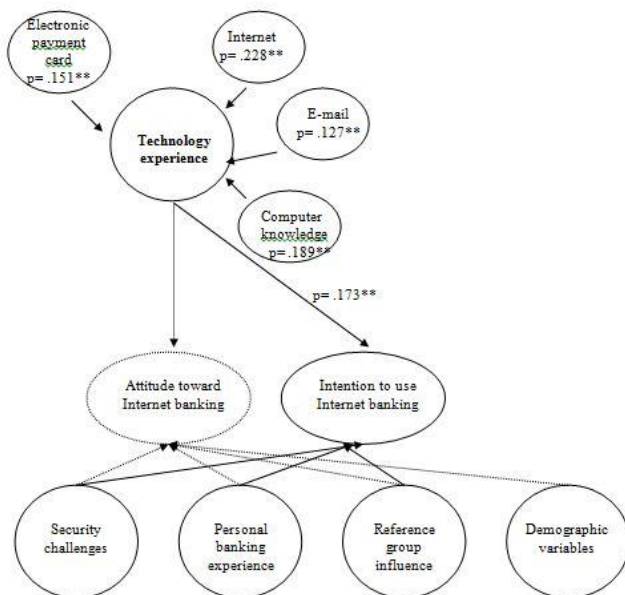


Figure 4. Technology experience in relation to Internet banking adoption

About 40 percent of the total responses indicated that the respondents do not believe that the cash will ever disappear. But for example, from the Old users 17.7 percent believed that there will be no cash in our daily use in 10 years time, and 23.4 percent believed it to happen within the next 20 years. This might indicate that they the Old users are ready for a time with bank and credit cards only. In the previous studies the time spans have been significantly longer (see for example [12]). Our research finding supports the belief that Finnish people are very much technology oriented (see for example [13]). Contrary to our expectations, the Old users thought it to be very unlikely, that the personal service would be fully replaced with technology-based services.

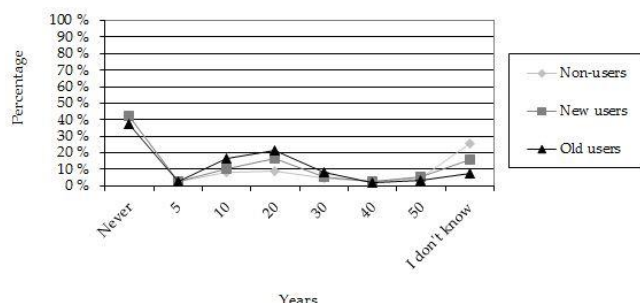


Figure 5. "There is no cash in our daily use"

Whether it's a good or a bad sign from their perspective, can be only guessed upon. The Old users do indicate that they like technology-based services in general. We will return to

this issue later in this essay. But like in the case of the question about the disappearance of cash in our daily use, we can't tell for sure here either, whether the Old users attitude toward this type of change is actually positive, or is it just something they presume to happen whether they liked it or not. From the Old users 27.6 percent believed that everybody will have a personal computer and a mobile phone in the next 10 years compared to the Non-users, from which 11.1 percent thought so. Statistically this postulation is not very far fetched. Actually in the case of the mobile phones it is almost true in Finland. Whether customers are willing to use them, is another question. The respondents did indicated that they prefer computers to mobile phones, and on the other hand that they prefer personal service to computers.

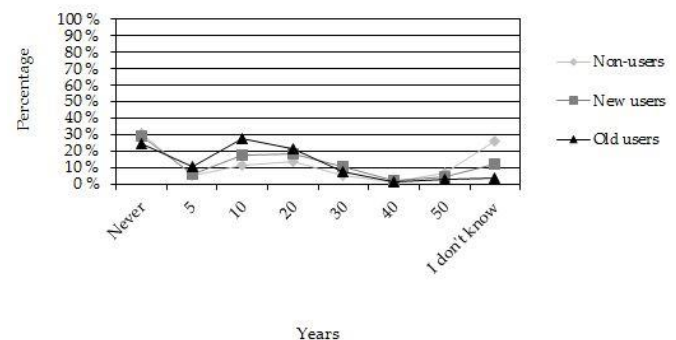


Figure 6. "Everyone owns a personal computer and a mobile phone"

If three out of four respondents believed that everybody will own a personal computer and a mobile phone sometime in the future, the same applies to their beliefs about the usage knowledge of computers and mobile phones. Naturally the Old users see this happening in the very near future, 25.7 percent within the next 10 years and 22.9 percent within the next 20 years, but also the Non-users indicate a possibility of this happening. From the Non-users approximately 10 percent (8.6% - 11.4%) think that everyday routines and affairs are handled through the Internet from 10 to 20 years from now.

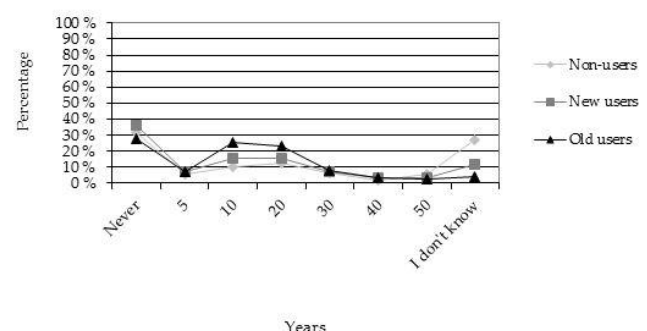


Figure 7. "Everyone knows how to use a computer and a mobile phone"

To confirm this belief, we posed a contradictory question about whether the Internet technology will disappear and we actually return someday back to our roots in banking – to the branch offices.

"I hate how slow my Internet connection is. But its still a whole lot more flexible than going to a branch office. I don't even remember

the last time I paid my bill at a branch office.” Old user, male 63 years, urbanite.

The answers of these two questions were very much in line with each other. Almost nobody of the Old users (88.2%) believed that Internet or similar type of technology would not be in our use in the future. Also close to half (42.3%) of the Non-users didn't saw that day coming ever.

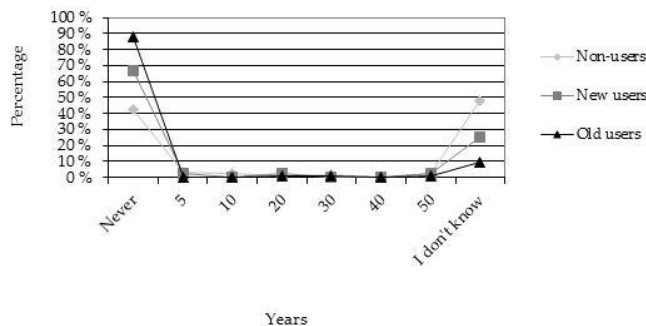


Figure 8. “Internet has disappeared and no equal system has been taken in use (e.g. all the banking would return to be handled only in the branch offices)”

Most importantly, our results showed that the Old users have in fact more positive beliefs about technological developments than the New users or especially the Non-users. The Old users' beliefs may not be any more realistic than the ones of the Non-users, but the Old users see the future as a more technology-enabled than the Non-users. Whether they are ready for this future they have pictured is a question for another study but we get some idea about their attitudes toward technological developments next, when we go through the respondents' feelings toward the current technology-based services.

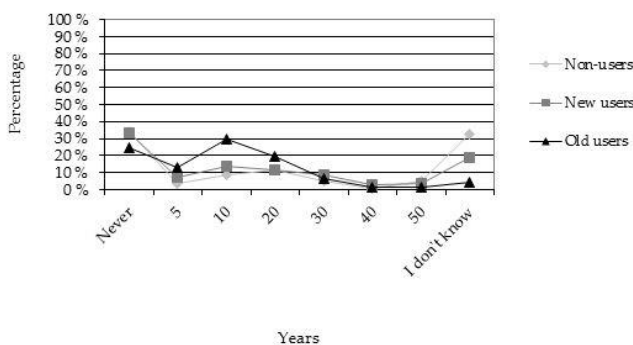


Figure 9. “Everyday routines and affairs are handled through the Internet”

We asked the customers how they feel about different technological developments that are already in their use. As expected, the Users had more positive beliefs about technology than the Non-users. The Old users mean score for a mobile phone was 1.16 (s.d. 1.508), whereas the New users' mean score for a mobile phone was 0.77 (s.d. 1.829), and the Non-users' -0.19 (s.d. 2.176). Consumers' opinion about computer was for the Old users 2.07 (s.d. 1.054), for the New users 1.08 (s.d. 1.849), and for the Non-users -0.46 (s.d. 2.085). Since the computer was found to be more popular than the mobile phone, one might conclude that the mobile phone may not be the most

suitable platform in providing banking services from the customer's perspective.

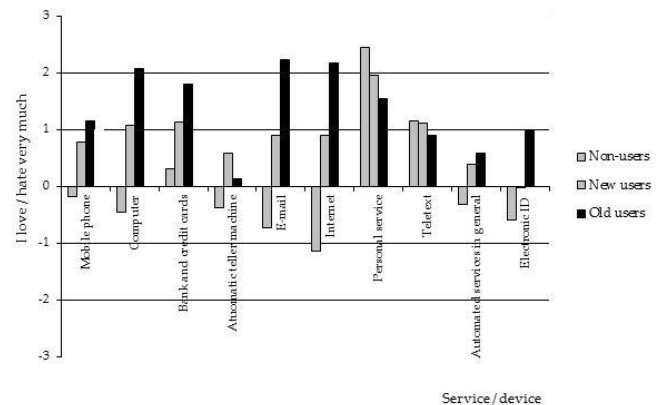


Figure 10. Consumers' beliefs on technology-based services in relation to personal service

Further, the Old users preferred bank and credit cards with a mean score of 1.79 (s.d. 1.178) while the Non-users did not find them so attractive with a mean score of 0.30 (s.d. 2.156). Automatic teller machines very mostly disliked by the Non-users with a mean score of -0.37 (s.d. 2.336). Since the Old users like bank and credit cards, one might assume that they do not need automatic teller machines anymore when e.g. shopping. The Non-users also disliked E-mail and Internet while the Old users found them attractive with mean scores of 2.22 (s.d. 1.102) and 2.16 (s.d. 1.108).

“I would use Internet banking if somebody just taught me how.”  
Non-user, male 70 years, urbanite.

Personal service was found to be most important for the Non-users with a mean score of 2.44 (s.d. 1.053). However, also users added weight on personal service.

“Ten years ago they gave me MS-DOS based discs without any advice or consultation. There hasn't been much social contacts between my bank and myself ever since.” Old user, female 43 years, urbanite.

The final three factors remaining rated the consumers' attitudes toward teletext, a different kind of automated services (such as vending machines) in general, and electronic ID (card). The Non-users were the group most fancied with teletext, which support the idea presented in the literature that people not using Internet are passionate television watchers or radio listeners [14]. Automates in general were most liked by the Old users, as was the electric ID (card).

#### IV. EMPIRICAL IMPLICATIONS

To conclude, beliefs, belief evaluation and their rating seem to be important factors affecting the use of Internet banking. Difficulties in using the computers seem to be as important as the past literature suggests. Most of the Non-users do not have access to the Internet. A total of 37.1 percent said that they have great difficulties in using computers which has a great effect on their Internet banking (non-)adoption. Furthermore, our results suggest that the Internet banking users have more

positive beliefs about technology in general, which affects the attitude and behavior toward Internet banking. Moreover, based on our research findings, we are now able to form behavioral groups and present in figure 11 banking customer behavior grid based on the customers' technology orientation.

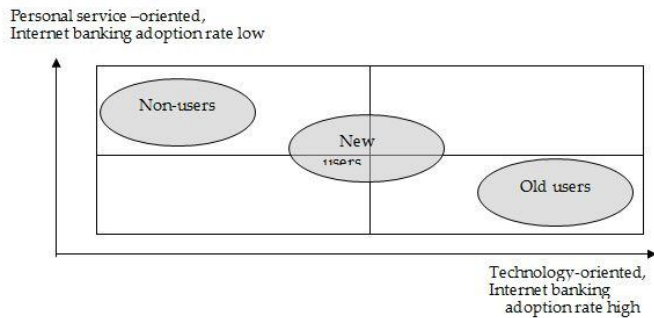


Figure 11. Banking customer behavior grid by technology orientation and Internet banking adoption rate

The branch office customers are more personal service oriented than the Internet banking customers whereas the Internet banking users tend to have more positive beliefs about technology in general and more positive attitudes toward Internet banking. Most certainly future research is needed to determine more carefully the nature of the interdependence relationship between these two variables but based on the fact, that the Users are using Internet banking and are more technology-oriented than the Non-users, we argue that the beliefs toward computer and Internet affect the use of Internet banking. Moreover, we argue based on the above that attitudes toward computers and Internet affect attitudes toward Internet banking.

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# Going global: Health Organizations and networking

## Information society and social media

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**Abstract**—This paper focuses on the analysis of information society and globalization and its' consequences on health organizations. The methods, background, consequences of globalization, and the networking as a way to achieve and become more accessible for the society as a whole.

**Keywords:** *globalization; health organizations; social media*

### I. INTRODUCTION

In this paper, we revisited the different theories that support the use, and the need of using the social media, as a way to communicate and be accessible for the society in a holistic approach.

In the development of health organizations, the globalization, the society of knowledge and information, and the accessibility are considered.

The communication, whether personal or within the major new innovation in communication, the social media, affects health communication contexts, and creates linkages between the intervenient.

This study is an attempt to determine the importance of social media in health, in organizational strategy in a changing context.

### II. CONCEPTUAL BACKGROUND

In fact the information society, and consequently the globalization, is the key element for the profound changes that have been occurring in different economies for the last centuries. The great waves of change fostered new behaviors and requirements, that undoubtedly influence the world with direct repercussion's on the lives and health of people [1]. The holistic process (political, economic, social and cultural) incurred in the social reevaluation and in new epidemiological patterns of health and ways of living [2].

The different ways are structured on three basic pillars. The first one, the Agricultural Revolution (seventeenth century), developed the agricultural processes, and the technologies that increase the productive efficiency of human labor. These innovations meant changes in organizational models, institutional and distribution of the products of labor. The development of technologies that increase productive capacity, allowed the development and population growth, and forced to define new forms of product development and responsiveness. This shift on society leads to the Industrial Revolution, whose great feature is according the generalization of mechanization /

automation for various activities, processes and productive task [3].

The progress and the intensification of mechanization, transforms the industrial revolution as the second wave.

The first phase of the second wave (end of XVIII and early XIX century) is characterized by the dynamic factor the railway, iron, and transportation system, and coal as an energy source. The second phase (decade 20 and 50, of the XX century) the replacement of coal by oil, and the steam engine by electromechanical, accelerates mechanization process started in the First Wave.

The third pillar, corresponding to the Technological Revolution is symptomatic of the Third Wave. In this context has been developed a way of organizing and structuring social perfectly comparable in time in the levels of: techno sphere (energy and technologies); econo sphere (economy, economic units); socio sphere (family, school, political system and relations with nature) and info sphere (media and key ideas).

Toffler [4] considers that the technological revolution advocated in the Third Wave implies an adaptation of individuals and organizations. In this adaptation process, different reactions will be generated, having on individuals and organizations different forms of decision.

The paradigm shift arising from these waves have a much greater impact when consolidated with the process of change resulting from globalization.

#### A. Globalization

Globalization, is a term originated in the works of authors/intellectuals of the nineteenth and early twentieth century, from Karl Marx [5], Saint-Simon [6] and Mackinder [7], to mention that modern societies implies a global integration process, and determines changes at various levels.

The globalization it's considered as a process of expansion of Western culture and the capitalist system over other ways of life and world production, which would inevitably lead to a "clash of civilizations" [8].

Globalization is a phenomenon that occurs in waves, with advances and setbacks, separated by intervals that may last for centuries. If you understand the process of globalization as a phenomenon of integration of proximity between cultures, it can be stated that the process of globalization had its beginning with the Portuguese discoveries.

The ongoing process of greater interdependence among countries, regions, companies, citizens, is very complex and has a multifaceted character. The globalization process has different approaches, from the global skeptical [9; 10] to global believers [11; 12; 13; 14; 15].

For some authors, globalization is seen as a perverse element of the economy, associating the concept to disaster, misery and exploitation. Friedman [14] contrasts these authors, saying that globalization is an inevitable process, natural and healthy, making life easier for the poor, making the world a more equitable and more leveled, enabling developing countries opportunities to get into areas where they weren't able to participate. Stiglitz [15] in turn states that globalization represents progress since it is one of the growth factors of the countries.

Globalization thus becomes a constant process with technical changes, organizational, cultural and social, which made it possible to reduce the cost of transport, communications, technology and access to information. The world becomes flat [14].

Consolidating this perspective, globalization is a revolutionary new process that involves political, technological, cultural and economic globalization [16; 17].

The process that stems from the twentieth century, in which they witnessed and experienced the weakening of the nation in favor of the global economy, state enterprises, exponential technological development, is far from complete [18].

Contemporary globalization has been promoted by policy decisions on matters such as market liberalization, financial regulation, support to national and international corporations and development assistance in the various countries [13].

The role of organizations as actors, play a particular part in this unstoppable process [4; 18], is conditioned by:

- normative structure: objectives and priorities set by administrators, that translate the organization's mission, *id est*, takes into account a set of technical, economic and cultural constraints, for the establishment of performance standards, procedures and forms to be carried out;
- interactive structure: reflects behaviors and performance, dependent on communication and operational design.
- participatory structure: as complement of the regulatory and interactive framework, translates the behavior and feelings of individuals visible in their actions.
- culture: it translates the specific ways of acting, thinking, feeling and living. The symbols, the image and the images, slogans, working methods, philosophical guides, among others, lead to the originality of the common sense of mission;
- strategic and operational plans, medium and short term, and system definition, implementation, guidance and control.

All these constraints have an environment that is the internal environment and the external environment, involving different aspects, such as economy, politics, social

development, culture, technology, and education, as summarized in the figure 1.

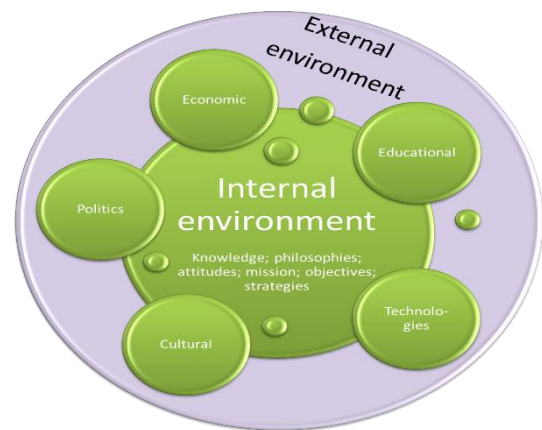


Figure 1. Environment

Subjected to new social, economic, technological, the interaction between environments, organizations and management, must have strategic and operational priorities:

- continuously investigating new segments and markets;
- innovation in techniques of market segmentation;
- identify the profile of the consumer and the client;
- permanently seeking new products that can provide differentiating advantages over the competition;
- create and maintain personalized services (direct marketing);
- creating synergies with new technologies (relationship marketing);
- invest in brand image;
- differentiate service marketing product marketing;
- assume the position as joint scientific but also artistic mix of variables;
- concern with Total Quality Management - TQM and assume its role as a strategic management model;
- to invest in internal motivation of human resources and internal audiences as internal marketing, or more comprehensive multilevel marketing (suppliers, customers);
- bet on the globalization of markets and create dreams and incentive once basic needs are met, the level of the developed world.

TABLE I. ORGANIZATIONAL ORIENTATIONS

	XX (first half)	XX (second half)	XXI
<b>Organization orientation</b>	Product	Market	Society
<b>Organizational structure</b>	Functional	Matrix / divisional	Network
<b>Strategic core</b>	Technical	Economical	Social
<b>Enterprise Focus</b>	Efficiency	Efficacy	Effectiveness
<b>Human Resources Management</b>	Administrative	Provisional	Strategic/ Investment

These guidelines are evidenced by the evolution of the guidelines of the organization due to a process of globalization that entails a new pattern of supply and demand, the creation of large economic blocs (horizontally and vertically), the liberalization of the movement of goods, services, capital and people, encouraging the emergence of new markets for exponential growth, and consequently a new organizational orientation, that evolves from the product to society, and call for a new and dynamic structure, the network (table 1).

Reactive strategies that characterized the first half of the twentieth century were adaptive to changes in the external and internal environment. In the second half there has been a preventive strategy, characterized by exploratory scenarios organizations. Currently, in the era of globalization and the information society, practice forms of proactive strategic management, as to anticipate and promote market trends, economic solutions, and repositioning in the global context.

The entwined revolutions (cultural, economic, technologic, and social) of the last decades have given birth to another system [19]. Advances in information and communication technologies have also revolutionized health and market strategies in the organizations. Strategic plans and tactics hospitals include a public website, designed to meet the needs of your audience (user) target [20].

As a result a virtual network is formed, by means of the interaction of diverse mechanisms of it. Those mechanisms, like extranet, information's systems, internet and intranet, as an effect in innumerable aspects of health organizations (economically, organizational, relation between users and staff – medical, auxiliary, nurses, and non-medical), as shown in figure 2.

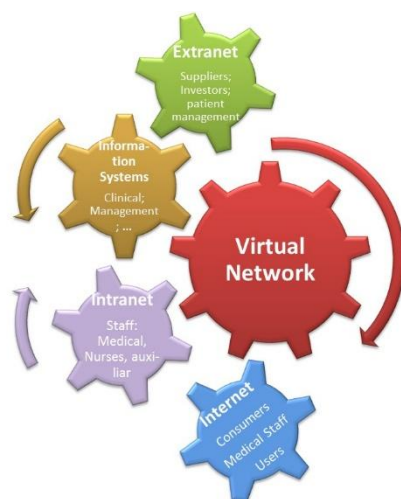


Figure 2. Virtual Network information flow and its role in health organizations

Within the process of globalization there is, a tendency to privatize the "good health", as a commodity that can be bought according to the economic power [1]. However, and despite this trend, as private good (individual responsibility and family) or public good (state responsibility), guaranteed by public, private or public-private partnerships, the development

of the activity has to be conduct according to the market, or market-oriented.

In this follow-up health care organization is not alien to mutations, and therefore there is a necessity to adapt to new processes and manage their specificity according to the requirements of the relevant market.

### B. Management Dynamics

Strategic management is incorporated into organizational culture and enables them to have strategies of market orientation. Associated with the Information and Knowledge society and globalization, organizations adopt a philosophy of integrated strategies towards the target, in order to develop a proactive management. This action allows the anticipation of some trends of the surroundings, as well as the control of certain variables.

The exchange of information allows is valid in health market, as it configures the need for sharing norms, values, beliefs with other actors in search of a greater good, health. As an instrument management provides the society integration to serve the needs from the consumer's point of view [21].

This strategy configures the need of using new ways of reaching to the market, and in the holistic process of globalization, the introduction of technological interface between organizations and their environment. The decision process is influenced by the perceived quality, perceived value, trust and commitment [22], which unveils, the swing, of organizations to the outside and holistic society. In this view, there are no shortcuts for establishing a strategic position in the organization.

The widespread of internet, allows new forms and kinds of experience [23]. The communication between companies and consumers, in the digital age, has a new concept, the social media (o online communication that is interactive, collaborative, and democratic) [24]. Concerning the management strategy, the organization, has to consider the social media as a key element for competitive advantage.

### C. Health Organizations

Since the earliest times that man is sick and needs health care products. The concept of evolution has different connotations depending on societies, cultures, ideologies, economies and / or beliefs.

In primitive societies, the disease was understood as an action of the supernatural, gods, and care was a magical activity, performed by sorcerers. In the middle ages the service and health care was a charitable activity conducted by religious and congregation, with the aim of saving souls. Health organizations or health care approach constituted places of exclusion of patients who needed assistance, and represented a impediment for society.

The Industrial Revolution and the inherent societal transformations spurred improvements in access to health, since workers were now a fundamental element for organizations. As so, there was the introduction of healing purpose in health organizations. This new approach, is not, however, a reflection of improvements in conditions in health

organizations (levels of contamination and hygiene were the same), because the improvement's in this particular are the result of the influence of bacteriology (Pasteur) and aseptic (Lister), in the late XIX century.

Like any organization hospitals improved their activities and suffered influences of management theories (scientific, classical, bureaucratic, TQM, Z theory), developed to meet the constant changes.

The hospital course joins inexorably to medical developments. From the Greco-Roman legacy to middle age Mediterranean, pre-Columbian and pre-colonial America medicines, India and China, the beginning of clinical medicine and its teaching in eighteenth century, through the triumph of laboratory medicine in the second half of the nineteenth century and the explosion of knowledge and biomedical techniques of today and the unification and recognition of the profession 100 years ago. In fact, the last half-century history of medicine is rich in advances in all branches of the healing art [25].

The evolutionary process of medicine, economics, transports us to the modern health organizations that can be addressed on three strands:

- a) Institutions (macro analysis): performs technical functions (e.g., treatment, cure and rehabilitation of disease, medical and paramedical education) and has a social, economic, ideological, scientific and political role. That is, an organization with a set of ideas, beliefs, values and norms of behavior proposed (often imposed) to the individual in a given society.

The existence of a legal basis and material, given by the State legitimizes the health organizations as an institution.

At present, health is, undoubtedly, an economic political and social decisive factor. For this fact, health world is a privileged place for observing changes in modern societies [26].

- b) Organization (micro analysis): composed by the mission or purpose (regardless of the financing system and its legal status and legal); workplace (socio-professional groups directly engaged in the process of providing health care, or support and management functions); a system of power and authority; a system of technical and organizational work (well differentiated from other organizations, because your work is the subject of the human) and their own culture. Health organizations are a specialized organization [27].
- c) Subsystem of the health system: The modern organization is characterized by conceptual disruption conceptual, which means the passage of social (assistance) to health (production of health care), the evolution of the concept of hospitality and charity (poor patients) for the service.

Organizations undergo structure modifications resulting from variations in technology, professional, institutional, social, economic and political.

#### D. Social media

In an era where the use and Internet access become almost universal, the accessibility of information is vital for organizations and should be considered as a success factor. A health organization are not unfamiliar to this process, and do their presence on the internet, reveals the urgent need of to engage and adapt to the demands of society in terms of accessibility to information and updated.

Being the internet a new way to communicate and interact, the recommendations of the people who are close influences ones behavior [28], particularly in the demand for services or products and loyalty known environments that allow access to the information and the products and services you want [29].

In terms of management, the Internet and the development of technology that allows the collection of consumer reports (web tracking software), was established as an element of fundamental importance in defining marketing strategies and has factor of competitive advantage [30].

Apart from internet portals, the dissemination of new media, refers to social media (social networks: facebook, twitter, badoo, second life, UNYK, linkedin, netlog, hi5, orkut, among others) [31], affects health organizations, which, in order to adjust to new realities, use these media for sharing information about their institutions and areas of expertise. In fact social networks represent signatures of social identity - the pattern of relationships between actors reflects the preferences and characteristics of those involved in the network [32].

Being social networking a pattern of relationship among people [33], the benefits obtained by health organizations, are the same as those obtained in the traditional market. It's also possible to increase the volume of activity, establish new organizational relationships, improve their image, making more specific benefits of the study area, awareness gains, sedimentation of the relationship with consumers, and the availability of information to all interested parties, from competitors, investors, professionals and consumers [31]. However there must be taken into procedures to combine proactive policies and employee training as to social media, doesn't converge to legal problems [34].

The presence is all the more important, as the sites of health organizations allow interactivity between cybernautic researcher and information (examples: queries, marking exams, specialties, location, among others).

In an era of information society, the Internet and social media are a vehicle for the dissemination and optimization of resources in spreading information regarding products, services and accessibility of bodies and a marketing tool, whose function is to satisfy the needs of both providers and users, through the exchange process [35].

It is for this reason that the success of management strategies in a world "noisy" and packed with information, advertising programs or measures is not enough. It is necessary for that to take place marketing as a competitive advantage, commitment to the dissemination of products that meet the needs and desires of consumers materialize [31].

### III. CONCLUSION

Every health organization adopted a policy of information and communication due to not only the process of changing legal statutes (EPE), but also through the certification process Health Quality Service (Kings Fund), with location maps, intake forms (referenced emergency, outpatient), financial costs (social security, sub-health systems, private insurance, foreign citizens), accessibility, admission (clinical, administrative formalities, employer, money and personal items, clothing), stay rights and obligations of users, statistics, quality policy, among many other aspects.

The information provided by health organizations it's goes beyond the available services and conditions of access but also, as stated by Eysenbach [36] and Cain [34], "for patient education, information sharing and professional peer connections" (p.1038).

The social media and the convergence of health organizations in the use of it are the natural process of a changing society, that has the ability to, in every second, be informed. Taking into account Keynes [37] quote "what an extraordinary episode (...) the inhabitant of London could order by telephone, sipping his morning tea in bed, the various products of the whole earth (...) and reasonably expect their early deliver upon his doorstep." (p.9), the globalization process and the progress of social media incurs, turns the accessibility a must have in the contemporary society.

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# Application of SWOT and BSC in the management of private schools of higher education

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**Abstract** — As the number of educational institutions grows, especially in the area of higher education, they face increasing problems of efficient management in a more and more competitive environment. In order to respond to those challenges in the right way, it is important to select appropriate managerial methods which will help to achieve strategic goals. In this paper SWOT and BSC methods are explored and combined in unique methodology. This methodology can be used in wider range of private schools of higher education in order to achieve their strategic goals and be successful in the education market.

**Keywords**- *eSWOT, Balanced Scorecard, schools of higher education, managerial methods, strategic goals, cause and effect chain*

## I. INTRODUCTION

The information era produced new business rules and made obsolete some of the basic assumptions about competition in the industrial era. It is not only by means of acquisition of new technologies as their assets or due to good management of financial assets that organisations create significant competitive advantage, but also thanks to successful management of intangible assets, such as knowledge [8]. This is why the need for knowledge and educated employees increases.

International competition in the area of education becomes increasingly intense as many countries invest in university education in order to achieve international competitiveness [3]. Recent discussions have focused on process management and education evaluation. Educational institutions are trying to learn from business organisations, therefore there is a requirement for a series of tools for performance measurement to set the educational goals and standards and increase competitiveness.

Positive financial results can improve teaching processes, provide better teaching equipment and top quality staff according to the international standards. This meets students' expectations and contributes to the achievement of operational goals. However, the fact remains that every school operates under different circumstances, its strategies, long-term and short-term goals differ. Every school bases its goals on its own mission and vision, taking into consideration its own resources and the importance of goals as part of the strategy.

Therefore, there is a need for efficient management and continuous development, which means that measurable goals

should be defined. This would facilitate tracking and supervising of business operations in private schools of higher education, as well as the implementation of their vision and mission.

What has been said so far underscores the necessity of devising the management methodology, which is a combination of proven managerial methods. They can define a model of generic goals for the management and supervision of private schools of higher education. Two standard managerial methods, SWOT and BSC, have been used in the design of this model.

The literature research has shown that applying BSC in the area of higher education is quite limited, although there are some successful examples. A study conducted at business schools in the U.S showed that deans believe that the implementation of BSC method in business schools would be of great benefit, although it is currently low [1]. Also according to the policy of the UK government [4], higher education institutions need to take the performance management models from the profit organizations. The need to balance all aspects of the performance is extremely important if we take into account the number of interested participants in higher education. Because of the need to provide adequate conditions for education, economic pressure can occur, which in turn, may be in conflict with the need to manage the employees-students relationships. Therefore, the authors [4] believe that every university (because of the diversity among them) should apply the BSC method individually.

Faced with global competition VCT (Vocational Training Council, Hong Kong) [5] proposed and formulated a strategic framework for vocational studies integrating some proven strategic tools used in the commercial world, which have been applied since 1999. In the strategic framework, SWOT, BSC and QFD methodology were connected. On the basis of the strategic framework, decisions were made on strategic planning and launching new educational programs.

Chin-Min Institute of Technology (CMIT), a private institution of higher education located in the central part of Taiwan, found itself in serious financial difficulties, but the administration has decided to survive (and solve) the crisis. Therefore, it has been decided to apply the BSC method as a tool for reorganizing. A BSC strategic map, that describes the cause-effect relationships, was created from the set goals, so

all employees can clearly recognize the set goals and adopt the defined vision and mission of the organization [3].

## II. A REVIEW OF SWOT ANALYSIS AND BSC METHOD

### A. SWOT analysis

SWOT analysis is a structured matrix analysis which classifies the factors of the organisation's activities according to its strategy. It gives a diagnosis of the situation in the organisation and the environment in which it is active, so it is essential to recognize as many strategic factors as possible in order to react appropriately in any given situation. The matrix analyses Strengths, Weaknesses, Opportunities and Threats. i.e. internal factors which are under the control of the organisation (e.g. marketing, finances etc.) and external factors (e.g. political and economic factors, competition). How an organisation will overcome threats or weaknesses or pursue opportunities depends on the efficiency of observing the environment and creating an appropriate response to the detected situation.

The value of SWOT analysis lies predominantly in the fact that it means a self-evaluation for the management [7]. However, the problem is that its elements are deceptively simple. In reality, to decide what strengths and weaknesses are, and to assess the probability and influence of opportunities and threats, is much more complex than it seems at first sight. Moreover, with the given classification of SWOT elements this model isn't helpful in the translation into strategic alternatives.

In this article, to analyse strategic goals we have applied an extended SWOT analysis, which consists of four phases [11]:

1. identifying the elements of SWOT analysis (strengths, weaknesses, opportunities, threats) which are called initial elements; 2. ranking within a group of elements i.e. deciding on the impact they have on attaining the goal; 3. finding answers to questions how to use the internal strengths(S) and external opportunities (O) to neutralise the impact of internal weaknesses (W) and external threats (T); 4. the final phase consists of three steps:

- identifying specific activities for the implementation of defined strategies;
- defining a measurable goal for every activity to determine the range of that particular activity;
- identifying the impact on the goals for every single activity.

### B. BSC and strategy maps

According to the authors of the method Kaplan and Norton [8] balanced scorecard (BSC) stands for a system of strategic management. The method has been described in their book *The Balanced Scorecard*, and gives guidelines for present and future implementation of tracking measures from four different perspectives: 1) financial 2) customers, 3) internal business processes, 4) learning and growth. The method is a concept which adjusts strategic management to the business demands in information era. It enables the companies to face and deal with the specific problems in such a way as to structure and expand the traditional strategic planning and management by:

- integrating the clear common vision of the entire company with the operations and a structured approach to defining activities needed to develop the vision;
- updating important information from the whole organisation and its efficient implementation in the assessment and progress of strategic goals ;
- strategic management of intangible and tangible assets by introducing new management parameters along the common financial ones.

A strategy map balanced scorecard [9] gives a framework to illustrate in what way strategy connects intangible assets with the processes which produce new values and is a visual presentation of the strategies. One side depicts how the goals in the four perspectives are integrated and combined, with the objective to formulate a strategy. Every organisation should adjust the strategy map to its specific goals.

## III. DESIGN OF THE GENERIC GOAL MODEL

The results of the survey conducted with the deans of private schools of higher education on their strategic goals are the basis for the model of generic goals. The choice of sample was orientated to private schools in the field of management at the undergraduate level. According to the records of the Ministry of Science, Education and Sport [10], in the Republic of Croatia there were eight private schools of higher education in the field of management education at the undergraduate level. In the Zagreb area, five were oriented to the management education at the undergraduate level, which formed the sample. Five of them, which represent the sample, account for 62% of the above mentioned schools. All contacted deans agreed to participate in the survey. It can be said that the response rate according to the sample size is 100%. Data refers to the school year 2005/2006.

Having recognized the most important strategic goals for each of them we have done the following:

- determined the necessary strategies for achieving the goal;
- specified the activities required for making the strategies operational;
- defined the goals that have to be reached;
- devised the cause and effect chains of goals (strategy maps);
- specified the map of measures.

The survey has thus determined the vision, mission and goals of private schools of higher education. The following goals have been singled out as the most important:

1. Student satisfaction;
2. Employee satisfaction;
3. Competitiveness (definition according to Harmon [6] – competitive advantage occurs when an organisation can make more profit selling its products or services than its competitors);
4. Improvement of the teaching process (supervision of business processes);

5. Continuous updating of the organisation of business processes;
6. Continuous modernisation of the teaching facilities.

Since the respondents of the survey were deans in private schools of higher education, which means that they are financed by tuition fees, their strategic goals are in the Customer and Finance perspective (Table I.).

TABLE I. MATCHING GOALS AND PERSPECTIVES

Goal symbol	Goals of school of higher education
C1	Student satisfaction
I1	Employee satisfaction
C2	Raising the level of competitiveness
I2	Improvement of the teaching processes
I3	Updating of the organisation of business processes
I4	Modernisation of the teaching facilities

The above table shows that two goals are in the Customer perspective, so we will consider them to be strategic goals, and the rest of the goals will result from an expanded SWOT analysis (Table II).

TABLE II. ELABORATION OF STRATEGIC GOALS

Goal symbol	Activity	Target value	Object of change
C1	Increase the number of graduating students	30%	Student satisfaction
C2	Increase the number of teachers	20-25%	Raising the level of competitiveness

TABLE III. ELABORATION OF THE STRATEGIC GOAL *BE COMPETITIVE* – C2

Be competitive - C2							
S1	flexibility and ability to change and adapt quickly to new conditions, e.g. acquisition of new teaching methods	W1	finances (unfavorable influx of finances)	O1	joining the EU – market expansion	T1	demographic changes in the Republic of Croatia (diminishing number of inhabitants)
S2	development of competitive study programs (e.g. short lifelong learning programs)	W2	insufficient number of employees with adequate qualifications	O2	new and different economy requirements	T2	fast growing competition (developing competition)
S3	introduction of one of the methods of promoting quality	W3	inadequate investment in marketing activities	O3	change in attitude of the community to the private schools of higher education	T3	no tradition of private schools of higher education, disparagement of private school diplomas on the labour market (compared to the university diplomas)
S4	entrepreneurial attitude of the owner and clearly defined mission and vision (attainable goals)	W4	lack of managerial skills for managing educational institutions				

After the SWOT analysis elements are ranked according to importance and the consistency of results in Table IV. is checked.

Following the ranking according to the importance of individual elements we observe which strength can eliminate which weakness, i.e. which opportunities can eliminate threats, which is shown in Table V. Weaknesses and threats that are not covered can be obstacles in achieving defined goals.

The structure of Table II is in alignment with the results of the survey on strategic goals that are common and essential to all respondents and correspond to the goals of the Republic of Croatia. The target values are taken from the Development plan for the educational system 2005 - 2010 [12].

The strategy, activities and subgoals which will facilitate the achievement of the above mentioned goals are defined in accordance with the defined steps in the model design. Subgoals, which are defined in this way, together with the initial strategic goals, are distributed regarding the general concept of the balanced scorecard method into four perspectives, which will evaluate the overall success of private schools of higher education.

#### A. Goal analysis

Due to data systematization when defining strategy, activities and goals, that procedure is formal and shown in a table. According to the methodology of expanded SWOT analysis [11], for every strategic goal a separate table is drawn entitled *Elaboration of strategic goal Ci*. Strategic goals refer to the finance perspective (F) or to the customer relations (C), so it is recommended in that respect for C to be marked F (for finance) or C (for customers), and only exceptionally I (for internal processes) or L (for learning).

On the example of the strategic goal "Be competitive", which is marked C2, we will show the procedure.

The following table shows the SWOT analysis for the strategic goal **"Be competitive" - C2**

TABLE IV. RANKING OF SWOT ANALYSIS ELEMENTS - EXAMPLE FOR STRENGTH AND WEAKNESS

Ranking of SWOT elements									
	S1	S2	S3	S4		W1	W2	W3	W4
S1		S2	S3	S1	W1		W2	W1	W4
S2			S3	S2	W2			W2	W2
S3				S3	W3				W4
S4									

Corrective strategies [11] contain the answer to the following question: what should be done to make use of internal strengths (S) and external opportunities (O) in such a way as to eliminate internal weaknesses (W) or external threats (T). That is why the corrective strategy contains parts of type  $(S_i \rightarrow W_j)$ ,  $(O_k \rightarrow T_m)$ ,  $(S_i \rightarrow T_m)$  or  $(O_k \rightarrow W_j)$ . While deciding on the corrective strategy the principles of rationality (don't use too great a strength or opportunity to eliminate a small weakness or threat) and effectiveness (it isn't possible to eliminate a weakness or threat by means of little strength or opportunity) are taken into account. Relations m:1 i.e. to use more smaller strengths and opportunities to eliminate one great weakness or threat are allowed, as well as 1:n i.e. to use one great strength or opportunity to eliminate a number of small weaknesses or threats.

Removing obstacles is a vital but not the only condition for achieving objectives. We should look for other opportunities for this achievement in the remaining free resources and those favourable conditions in the surroundings which can be supported by untapped advantages. This is the way offensive strategies are devised.

Some weaknesses or threats aren't eliminated even after all corrective and offensive strategies have been defined. They have to be tackled by new strategies which are not based on available capacities of internal strengths (S) or external opportunities (O), but new resources have to be found to deal with weaknesses and threats. This is the way defensive strategies are devised.

If some weaknesses (W) or threats (T) cannot be eliminated and remain a permanent obstacle to the achievement of the objectives, and if there are more than one of those weaknesses

or threats per goal, it is necessary to redefine the goals or face the risk of failing to achieve them.

TABLE V. FINDING STRATEGIES TO ACHIEVE A GOAL **BE COMPETITIVE**

SWOT rank				Corrective (S,W), (O,T), (S,T), (O,W)
S3	W2	O3	T2	$S3 \rightarrow W4$
S2	W4	O1	T3	$S2 \rightarrow W1$
S1	W1	O2	T1	$S4 \rightarrow W3$
S4	W3			$O3 \rightarrow T2$
				$O2 \rightarrow T3$
				$O2 \rightarrow W1$
				$O1 \rightarrow W2$

The final phase four [11] has three steps Table VI: specific activities are identified for implementation of previously defined strategies, then a measurable goal for each of these activities is defined to decide the level of accomplishment for every activity. After the first two steps have been taken for all strategies and strategic goals, the decision is made which other strategic goals affect the observed activities. The final step is necessary to devise the integral strategy map Balanced Scorecard.

In order to facilitate coping with a great number of strategic goals which this procedure produces, some formal labeling rules have been introduced. The symbol for every goal consists of two parts: the first tells us from which strategic goal the observed goal is derived, the second presents the perspective to which this goal belongs. The second part of the symbol has an index which shows how many goals have been derived from the same strategic goal in one perspective (f-finances, c-customers, i-internal processes, l-learning and development).

TABLE VI. EXAMPLE FOR TWO STRATEGIES - ACTIVITIES- DERIVED STRATEGIC GOALS – GOAL **BE COMPETITIVE**

Strategies - Activities- Derived strategic goals - Goal <i>Be Competitive</i>					
Strategy	Strategy description	Activities	Goal symbols	Goal description	Effect on goal
$S3 \rightarrow W4$	Provide managerial governance of schools of higher education	Introduction of one of the methods for improving quality.	C1.i1	Optimizing business processes	C2.f2
			C1.i2	Updating work organisation	C2, C2.f2
$S2 \rightarrow W1$	Develop new programs	Participation in EU competitions and projects	C1.f1	Influx of finances	C1.f2

We propose seven strategies for the achievement of the strategic goal *Be competitive* and here is example for two:

-  $S3 \rightarrow W4$  – **Provide managerial governance of schools of higher education** - C1.i1, C1.i2. In order to optimize business and teaching processes in the schools of higher education and ensure efficient management, it is necessary to introduce one of the methods of improvement and supervision of management. This leads to the process of systematic optimization of business processes which also involves a continuous evaluation and comparison of business results.

-  $S2 \rightarrow W1$  – **Develop new programs** - C1.f1. If we want to have a continuous influx of finances, we need to anticipate and respond to market needs and design new programs. Co-operation with the EU institutions and the use of EU funds can contribute to the more successful design of programs.

According to the above procedure the strategic goal "**Student satisfaction**" - C1 has been also elaborated.

#### B. Devising the strategy map based on obtained goals and measures

The strategy map of goals is based on the goals obtained in the procedure explained above and is the basic graphic representation of links between activities performed in order to achieve strategic goals of the organisation (Image 1). For instance, if certain activities are undertaken which are directed at raising the knowledge level of associates (perspective **Learning and growth**), e.g. activity C2.i1 – Application and transfer of knowledge and experience (contacts with EU institutions and the university) in order to achieve C2.u1 "Improving professional skills of the teaching staff", this probably won't have a direct effect on the goal C1.f2

"Revenue increase". On the contrary, this activity will increase operational costs during the training period. However, it is expected that it will have a positive effect on the goal C2.i2, which will indirectly influence the achievement of goals C1.c3, C1.f1 and C2.f2.

Since every activity has a precisely determined goal, it can be concluded that the structure of the goals corresponds with the structure of the activities. Therefore, all the strategic goals and from them derived subgoals constitute a web-like structure with cause and effect links, whose elements are distributed among individual perspectives. The level of the achievement of each goal will be measured and presented by the value of an indicator, which is described in more detail in the next chapter.

Indicators which determine the level of achievement of activities in the perspectives **Learning and growth** and **Internal processes** are the indicators of cause and changes, or *leading indicators*, and they will, with a certain delay, cause changes in the achievement level of goals in the perspectives **Customers** and **Finance**, which will be presented by the indicators of effect and state, or *lagging indicators*.

All the data for the design of the strategy map of goals can be found in the last three columns of Table VI in the previous chapter, i.e. Goal symbol, Goal description and Effect on goal (dependent goal affected directly by the observed goal). This data was used to produce the strategy map of goals for private schools of higher education shown in Image 1. All the goals in the strategy map are distributed within the four standard perspectives.

The structure of the strategy map of goals isn't exclusively structural decomposition tree, but rather a network. Some goals like C2.i2 or C2.i1 affect more than one goal and vice versa some dependent goals like C2.i2 or C1.f1 depend on a number of other goals. For some goals like C1.i3, both link types exist, so they form quite complex knots in the strategy map.

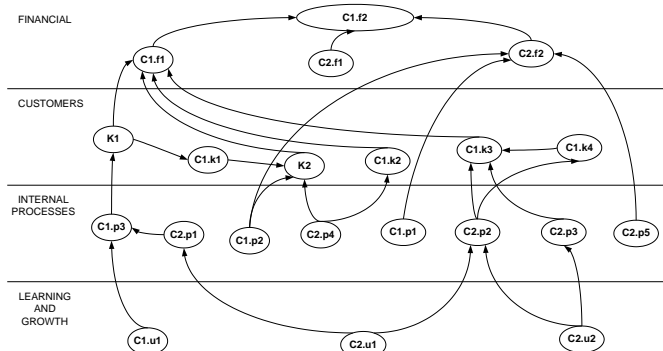


Figure 1. Strategy map of goals for private schools of higher education

### C. Devising the strategy map of measures

The strategy map of goals is associated with the *strategy map of measures* [2] Figure 2 which is its structural equivalent. The rationale behind it is that the level of achievement of each goal should be measured in the particular intervals, the obtained results should be compared and thus decided whether the undertaken activities have the expected impact.

Measuring instruments should be determined for the defined strategic goals in such a way as to enable a continuous monitoring of their level of achievement. To precisely determine the elements of "strategic" measuring instruments, it is important to define the measuring instruments for all the derived goals (example listed in table VI), and graphically shown in Figure 1.

Every goal must have at least one or more measures i.e. measurement values as part of the measuring instruments. All these measures are part of the cause and effect chain which corresponds with the cause and effect chain of the goals derived from strategic goals C1 and C2. This is how the strategy map of measures is produced as shown in Image 2. Every measure has an abbreviated symbol and a description. The values of certain measures are entered into the measuring instrument or calculated according to the Balanced Scorecard model. This depends on two things:

1. the position of the measure in the cause and effect chain ;
2. whether the model is validated/calibrated or used to manage an organisation.

The change indicators are mostly entered measures and the indicators of state are mostly simple and complex measures.

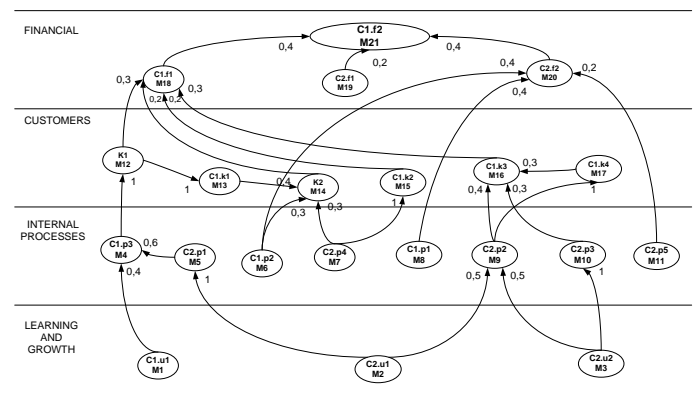


Figure 2. Strategy map of measures

Measuring instruments which are defined for goals [2] are shown in Figure 2 and described in more detail in Table VII. The first two columns of this table contain **Goal symbols** and **Goal name**, whereas the others contain the elements of measuring instruments for goals. Defined are:

**Measure symbol** – e.g. M12 for goal C1 – Student satisfaction;

**Measure name** – e.g. general indicators of student satisfaction for the measure M12 (goal C1 – Student satisfaction);

**Measure type** – the model in Figure 2 contains eight entered measures (E): M1, M2, M3, M6, M7, M8, M11 and M19, six simple measures (S): M5, M10, M12, M13, M15 and M17, and seven complex measures (C): M4, M9, M14, M16, M18, M20 and M21. Measures for strategic goals, in this case M12 and M14 are in general complex;

**Measurement method** – description of the measurement method of the real value of measure.

**Effect ratio** – to what extent does the achievement [2] of certain goals affect the achievement of other goals according to the cause and effect chain. Take for instance the value of simple measure *M5* which is influenced only by the value of entered measure *M2* **Chyba! Nenašel sa žiaden zdroj odkazov.**, because the achievement of the goal *C2.i1* is the consequence of the achievement of only one goal *C2.i1*. Therefore, the effect ratio of the goal *C2.i1* to the goal *C2.i1*, as well as the value of measure *M2* to the value of measure *M5*, equal 1 (Figure 2.) This ratio can be found on the arrow which points from *M2* to *M5*, and is written as **1 M2** in Table VII.

**Measurement frequency** – the frequency of measurements/calculations to monitor the achievement of goals;

**Measurement agent** – organisation unit or person responsible for measurement.

Taking into account the strategy map and measurement map it is evident that all four perspectives of Balanced Scorecard tables can be brought into cause and effect relation which gives the structure to the accomplishment of the overall vision and mission. Both maps demonstrate that it is possible to digest goals in one structured approach and their design illuminates implicitly and explicitly formulated strategies.

We can say that the mapping of strategic questions helps to comprehend the nature of the goals by producing a series of interrelated factors in order to achieve the mission and vision.

TABLE VII. GOALS AND THEIR MEASURING INSTRUMENTS - EXAMPLE FOR THREE GOALS

Goal symbols	Goal name	Measure symbol	Measure name	Measure type	Measurement method	Effect ratio	Measurement frequency	Measurement agent
C1	Student satisfaction	<i>M12</i>	General indicators of student satisfaction	S	Complaints/Number of students ratio	1 M4	quarterly	Dean's office
C1.i3	Employee satisfaction	<i>M4</i>	General indicators of employee satisfaction	C	Complaints/Number of employees ratio	0,4 M1 0,6 M5	quarterly	CEO's office
C2	Be competitive	<i>M14</i>	Indicator of competitiveness on the labour market	C	Graduated/employed students ratio; in the first year	0,4 M13 0,3 M6 0,3 M7	biannually	CEO's office

#### IV. CONCLUSION

Just like any other organisation, private schools of higher education define in their mission and vision where they want to be in the future. In order to accomplish their mission and vision they need managerial tools to help them in the management and supervision of the achievement of goals.

This article has shown how a combination of two methods, eSWOT and Balanced Scorecard, can identify the most important generic goals and measures i.e. cause and effect chain of goals and measures, which can help supervise the management of private schools of higher education, as well as use the data for mutual comparison.

When we look at the strategy map we can see that all four perspectives of Balanced Scorecard can be connected into a cause and effect frame which structures the fulfillment of overall vision and mission. Observing the strategy map we can notice that goals can be digested in one structured approach, whereby the construction itself sheds light on the implicitly and explicitly formulated strategies. The mapping of strategic goals explains the nature of the goals by creating a series of factors which are combined to carry out the mission.

The article deals with two steps in the definition of essential indicators:

1. The findings of the survey, in which the deans of private schools of higher education were interviewed, were analysed and the essential, strategic goals in the customer perspective – Competitiveness and Student satisfaction highlighted. An eSWOT analysis was performed and strategic goals analysed in the way described previously. Subgoals have been identified as entry data for the Balanced Scorecard. The

eSWOT analysis was applied to avoid the rule of thumb method in the identification of subgoals which are distributed in the perspectives of Strategy Map Balanced Scorecard;

2. Strategy map (Figure 1) an strategy map of measures (Figure 2) have been devised, goals linked through all four perspectives and the cause and effect chains obtained which should be quantified and applied to assess the progress of private schools of higher education.

The outcome of the outlined methodology are cause and effect chains and goals which should be followed to enable a better management and supervision in the private schools of higher education, with the objective of the accomplishment of mission and conveying of vision.

The application of the presented model for defining generic goals and measures defines the structure for carrying out the mission and vision. One of the private schools of higher education defined its vision and mission in the following way:

**Vision** – To operate in the Republic of Croatia with international standards and foster student development;

**Mission** – To equip the students with knowledge and skills for lifelong learning and make them competitive in the global market.

It is evident from the strategy map that the following chains should be tracked more frequently: the chain with the elements *Raise the level of professional skills C2.i1* and *Promote the quality of teaching C2.i2* which affect *Change in the community's attitude to the private schools of higher education C1.c4*, and the chain with the elements *Adopt best*

*practice in teaching C2.i2 and Faster adaptation to the requirements for new skills and knowledge C2.i3.* The listed elements in these two chains influence the adoption of international standards in education and the promotion of professional competence and qualification of teaching staff which directly affects the training of students and their gaining a competitive edge on the labour market, in accordance with the defined vision and mission.

In our model, the Balanced Scorecard is the central method for a systematic approach to the recognition of main goals. This method integrated with SWOT analysis can help organisations with strategy management for a longer time period. It explains and translates the vision and mission of the organisation and articulates the goals and measures to everyone involved. This model can be seen as an instrument of change which prepares the organisation for the achievement of excellence in time and gives various advantages to the organisation. For instance, it states the responsibility for the goals within the organisation, links the strategy to the implementation, enables identification and tracking of the headway it makes and gives an opportunity to adjust to the goals. In addition, it helps the employees to understand the causes and consequences of the work they do.

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# Politicians and administrators within history and organization of Italian parliamentary staff

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**Abstract—** Parliamentary administrations as support staff provide support to Members of Parliament outside the operating work flow. Governance of parliamentary administration is based on the relationship between politicians and administrators. Historically institutional and mimetic pressures have influenced the organizational design and roles of governance within evolution of Italian parliamentary staff (1848-1929) leading to mechanisms of governance evolving from separation to complementary interdependence between politicians and administrators coherently with operational and strategic complexity of parliamentary administrations.

*History; governance and organization of parliamentary administrations, relationship between politicians and administrators.*

## I. INTRODUCTION

In any organization work staff is vital. Parliament is no exception. Parliamentary administrations as staff provide aide and support on lawmaking and policymaking to the organization outside the operating work flow [1]. The aim of this paper is to elucidate that institutional pressures have influenced the historical and organizational evolution of mechanisms of governance within design of Italian parliamentary administrations (1848-1929) shaping the relationship between politicians and administrators along a continuum between dichotomy and complementary roles. Institutional pressures may lead organizations to adopt the same organizational form. The primary objective of organizational change is to achieve not better substantive performance but greater legitimacy. Governance of parliamentary administrations is based on the relationship between politicians and administrators that may evolve over time from separate to complementary roles coherently with operational and strategic complexity of staff structure. The dichotomy model does not define the total relationship between politicians and administrators which can be conceived as complementary so that implies distinctness but the emphasis on how each contributes to the whole.

This study relies on archival and qualitative data. I made a review of literature on the organizational design and governance of Italian parliamentary administrations in the fields of law and history. The attentiveness to historical research and perspective in organizational analysis is rising. The appreciation and re-emergence of a historical bent is also

emphasized by analyzing the development of organizations over time in order to investigate endogenous institutional change through long-term study [2, 3] Historical analyses enrich the understanding of present-day organizations reconstructing the human acts which created them in the course of history by urging the organization theories to stand the test of a confrontation with historical developments [4].

## II. ORGANIZATIONAL CHANGE AND DESIGN: A NEO-INSTITUTIONAL PERSPECTIVE

The Institutional theory has become a prominent and interesting lens through which organizational processes of continuity and change are interpreted and understood [5]. Organizations adapt their internal characteristics in order to conform to the expectations of the key stakeholders in their environments. The primary objective of organizational change is to achieve not better substantive performance but greater legitimacy. DiMaggio and Powell have highlighted the importance of the concept of isomorphism based on the assumption that organizations become increasingly similar through institutional forces and proposed three mechanisms through which institutional isomorphism occurs: coercive, mimetic and normative. They viewed mimetic isomorphism as a response to uncertainty and normative isomorphism as a result of professionalization. The organizational choice is limited by a variety of external pressures. Organizations must be responsive to external demands and expectations in order to survive [6]. Institutional pressures may lead organizations to adopt the same organizational form. Organizations seeking legitimacy in their institutional contexts change their strategies, structures, and procedures to imitate other successful organizations. Mimetic behavior is an organizational response to uncertainty and often undertaken by organizations when performance measures are ill defined, such as in government or non-profit organization [7].

## III. THE RELATIONSHIP BETWEEN POLITICIANS AND ADMINISTRATORS: FROM SEPARATION TO COMPLEMENTARITY

The traditional public administration model presents administrators as bureaucrats, professionals and mere executors of political mandates. The relationship between politics and administration is based on dichotomy model. Politicians provide guidance, whereas administrators are responsible for making their neutral competence available to

the policy process and translating value choices into concrete results. Politicians are responsible for the definition of policies and related objectives, and monitoring the results. Managers or bureaucrats are responsible for managing technical, financial and human resources and implementing policies [5]. Administrators should not be involved in partisan politics. Politicians should not be involved in administrative matters. Guy Peters [6] deduced five ideal-typical modes of interaction on a continuum of strict, formal, separation and hierarchy, in which political leaders prevail over neutral bureaucrats, to the administrative-state model, in which technical expertise, bureaucratic activism and command of information allows bureaucratic professionals to dominate the policy process. Four images are identified: i - simple and clear distinction between politicians as policy-maker and bureaucrats in charge to merely implement policies; ii - both politicians and administrators participate in making policy providing distinctive contributions; iii - bureaucrats may play a *political role* because they engage in policymaking and are concerned with politics; iv – a *pure hybrid* without any distinction between the roles of politicians and bureaucrats [7]. Environments, resources, size may shape different forms of the relationship between politicians and administrators as division of labor. Within public organizations the person's centrality or position in the political and administrative hierarchy is a factor to be considered: central administrators may be more tightly linked to politicians and political processes.; politicians as top level will act more actively into administrative matters so that the overlap between the two spheres can occur [8]. The dichotomy model does not define the total relationship between politicians and administrators and may be conceived as complementary which implies distinctness but the emphasis on how each contributes to the whole: politicians may freely make decisions but cannot deny the advisory role and policy-advising activity of the administration [9]. The administration has a role influencing the decisions of the legislature, interpreting the intention of the legislature, and exercising independent judgement in executing policy. Politicians may respect administrative process in abstract but reserve final decisions to themselves and seek to redirect the administrative decisions [10]. The boundaries between the political and the managerial spheres are considered as more blurred than separated. Research showed an extensive, though varying, intermeshing of the two spheres. The two roles appear to be complementary and overlapping. Their features may depend on contextual, organizational and individual factors [8, 11]. Elected officials and administrators maintain distinct roles based on their unique perspectives and values and the differences in their formal positions, but the functions they perform necessarily overlap. Elected official dominate mission formulation although the administrators may play an advisory role in developing proposals and analyzing conditions and trends [12]. Complementarity recognizes and stresses the interdependence and reciprocal influence between elected officials and administrators along with distinct roles; compliance with independence; respect for political control along with a commitment to shape and implement policy in ways that promote the public interest. Administrators accept the control of elected officials. Elected officials respect what

administrators do and how do it [11] The zone of complementarity implies both high-middle levels of political control and professional independence of administrators and holds that politicians and administrators need and help each other in a partnership for governance. In virtue of interdependence and reciprocal influence they fill distinct but overlapping roles in policy and administration [13].

#### IV. GOVERNANCE AND ORGANIZATION WITHIN PARLIAMENTARY ADMINISTRATIONS

Because of the principle of the separation of powers the autonomy of parliamentary assemblies takes three forms: establishing internal rules on its form of organization and procedures; managing finances and facilities; structuring its support staff [14].

Parliamentary staff represent a thread of continuity, institutional memory, and expertise within the institution. Legislatures have expanded their staff levels and the expertise on staff to cope with increasing complexity of governing [15]. The use of parliamentary staffs reflects an effort to acquire institutional expertise and professionalism in the legislative branch to counterbalance a perceived advantage within executive agencies [16]. Legislative staffs are used by the legislature to buffer it from outside influences which it seeks to avoid or control.

Staff is responsible for providing the Members of Parliament (MPs) with non partisan aide being independent of the executive branch agencies [17]. All parliamentary staff are expected to be politically impartial in carrying out their functions. Negri [18] elucidated service function and loyalty of staff towards Parliament as fundamental character of providing support. Staff may emerge as *savant* and custodian of historical and procedural memory of parliamentary institution. Parliament should select a strategy and tailor the staff. Parliament may play a decisional/ratifying behavior on policymaking and be supported by consulting administration able to provide data, information and knowledge. Ratifying Parliament does not play an active role on policymaking being supported by a registration staff able to perform only administrative task (convocation and registration of sittings, handling of documents, transcript of debates). Mixed models may emerge and evolve over time [19].

Mechanism of governance should ensure that parliamentarians as operating core may perform task without being dependent upon information source of the executive authority. Governance of parliamentary administration may imply the relationship between politicians (the Office of the Speaker or Bureau as political apex) and administrators (the Secretary General and senior officials) as necessary mechanism of governance that may require dialogue and cooperation evolving over time in relation to historical and political contingencies. Bureau as governing collegiate body may decide on the procedural propriety of draft bills, appoint SG and other officials senior, organize parliamentary business, arrange the organization and running of service and staff in accordance with procedure and decide the rules relating to the accounts of the Assembly, organize cooperation between Parliament and outside bodies. Most of Parliaments are organized with one SG

for each Chamber as the managerial apex of parliamentary administration accountable to political governing body. The SG may perform a dual role. SG is the principal adviser on law, practice and parliamentary procedures. The SG as top manager may direct legislative and administrative services and ensure the efficient functioning of the parliamentary administration, usually entailing broad management responsibilities for parliamentary staff, budgets and assets. *Hourglass* form is named the mechanism of governance within Italian parliamentary administration. Bureau is the political apex and top level within parliamentary organization. The Secretary-General (SG) may act as nexus between support staff work units and the operating core (Members of Parliament) playing as *trait d'union* between political sphere and administrative sphere [19].

#### V. HISTORICAL AND ORGANIZATIONAL EVOLUTION WITHIN DESIGN OF ITALIAN PARLIAMENTARY ADMINISTRATIONS

The organizational model and parliamentary traditions of French National Assembly and Belgian Parliament exerted influence on designing structure and mechanisms of governance of Subalpine Parliament (1848). The Office of Speaker or Bureau was accountable on organizational arrangements and personnel management. The Deputies Questeurs were responsible for the expenditures, drawing the budget, its preparation and management; real estate, its definition, maintenance and protection. The assembly should appoint both the *Greffier* (The Compiler of minutes process) and the Librarian-Archivist [17]. In nineteenth century parliamentary administrations were strictly dependent on political power. When Members of Parliament are aware of their state of inferiority in front of the executive which has at its disposal the immense resources of the state bureaucracy, they are likely to demand technical and specialized assistance, consulting and advice on lawmaking. The *Statuto Albertino* octroyè by King Carlo Alberto (1848 March 4), stated the organizational autonomy of Parliament. The elective Chamber of Deputies (the Members of the Senate were directly appointed by Crown) required technical and professional staff which could transcript the debates and accounts, provide consultant assistance and support on lawmaking. In the British parliamentary tradition competencies of the bureaucracy of *Clerks* expertise on compiling minutes report (*Journals*) exerted influence on structuring professional contents of parliamentary staff [20]. In 1848 the first parliamentary staff consisted of public servants posted by other governmental administrations and journalists in order to perform only merely administrative tasks.

In 1863 internal regulations on the organizational design of Chamber of Deputies' staff reflected the increasing complexity of task performed. The Office of Speaker was responsible of staff personnel career management and work organization. Professionalism of stenographs and reviewers increasingly improved. Employees were recruited and hired by public examination (at Senate since 1869; at Chamber after 1874; since 1866 for stenographs) [21, 22]. The mechanism of governance within Ministries' administrations (1853 March 23 - law n. 1483) was based on the relationship between Ministry and Secretary-General (SG). The SG could act as a *trait*

*d'union* between politics and administration. Parliament might tailor to the structure of its staff mechanisms of governance within Ministries consistently with changing political majority coalitions [23]. Francesco Crispi, as the Speaker of the Chamber of Deputies (on 1876 November 21), appointed Giovanni Galletti as Director General at the administrative apex of the staff and directly accountable to the Bureau. The organizational structure evolved from a decentralized form to centralized structure. After the death of Giovanni Galletti (1890) the structure of parliamentary administration was grouped into six functional work units under the authority of Bureau (Secretariat, Questure, Revision, Stenography, Library and Archive).

At the beginning of the twentieth century the task of parliamentary staff consisted of maintaining the physical facilities, accounting management for expenditures, and providing transcripts of debates. Quality of lawmaking and professionalism of staff were no more adequate with complexity of legislative and policy affairs. The Speaker of the Chamber should need support of a senior official advisor in law and parliamentary procedure as the workload of the legislature increased. In the period 1900-1914, in virtue of the growing influence of the government on economical and social matters strategic and operational complexity of public administration increased. Thereby, the public servant was becoming a professional and expertise on law and procedure. With Giolitti governing as Prime Minister, the Chamber of Deputies was becoming an effective legislature because of its proactive role on lawmaking. The core of Italian political and parliamentary system evolved from the relationship of confidence between Crown and Cabinet to the *continuum* Cabinet-Parliament based on vote of confidence by parliamentary majority coalition parties [21].

Since the election of Giuseppe Marcora as the Speaker of the Chamber of Deputies (1904 November 20) the Bureau adopted the organizational pattern based on the distinction between legislative and administrative spheres (1905 April 12) (in a similar vein at the French National Assembly's administration) and instituted the position of the Secretary-General (SG). Legislative and administrative structure (1907 June 19) was grouped into four work units: Secretariat, Offices of minutes report, Questure, Library. The Director of Questure assisted the two Deputies Questeurs in financial management and matters. On 1907 July 1 the lawyer Camillo Montalcini (in political alliance with Marcora and Prime Minister Giolitti) was appointed as the first Secretary-General. The Secretary General should ensure the effective functioning of legislative support services. The secretariat was divided into: archive, review, stenography and legislative statistics [21]. The SG was the first advisor of the Speaker and responsible of the archives and minutes report of Bureau. The SG could play as *primus inter pares* among the senior officials. Professionalism of staff improved and operational complexity of structure increased. Parliamentary staff ceased to be considered only as executive appendix of political majority coalition and might play a role relatively autonomous and independent. After the advent of Fascist Regimen the Chamber of Deputies was becoming a ratifying legislature without any influence on policymaking. The organizational

structure was grouped into only three services (Secretariat General, Service of Questure, Direction General of legislative studies, accounts and library) [24]. At Senate (1929) the SG was effectively responsible of administrative and legislative services (Secretariat, Study services, High Court and Accounts) and could attend at sittings of the Bureau [25].

## VI. DISCUSSION AND IMPLICATIONS

Public institutions may change in response to fundamentally, normative and mimetic, institutional pressures [26]. Key actors in organizations have power to implement their views of strategy although institutions are shapers of organizational arrangements. The response to institutional pressures is also function of links between organizational context and internal dynamics [5]. Institutional pressures are likely to exert influence more on organizational strategy and culture than procedures and processes [27]. Thereby, organizations may assume the structural part of the legitimated design without the adoption of associated values [28].

Parliaments have developed staff structures shaped according to their own historical traditions and roles in their own political systems [29] and exerted influence on designing roles and mechanisms of governance between politicians and administrators along a continuum between separation, overlapping and complementary roles. Historically both increasing operational complexity of parliamentary staff and mimetic influences from Belgian and French models of parliamentary organization inspired the design of governance within the Italian parliamentary administration enhancing the authority of parliamentary bureaucracy and structuring the relationship between political apex and official coherently with a *hourglass* form. Since 1861 to 1876 low degree of control and level of independence could emerge; parliamentary staff was considered as mere appendix of political power unable to play a significant role with regard to professional competencies. Since Galletti was appointed as the Director General the political dominance of the Speaker was joint to and increasing operational complexity of parliamentary bureaucracy in terms of sources of information and technical competencies. Since Montalcini was appointed as the SG (1907) the professional independence of administrators in terms of asserting professional perspectives in policy formulation and adhering to professional standards in implementation increased. The SG could behave as *primus inter pares* among senior officials and act as *trait d'union* between political and administrative spheres.

Innovation processes in public organizations reshape the relationship between political governing body and administrators. The development of parliamentary administration from registration to consulting staff may affect the design of mechanisms of governance between politicians and administrators emphasizing managerial and organizational competencies of the SG in relation to increasing degrees of operational complexity of parliamentary administrations. Task of the SG may evolve from professional and advisory to management roles. Task of Bureau may evolve from management to control and political role.

Models of parliament (decisional or ratifying) and administration (consulting or registration staff) may redesign over time roles and mechanisms of governance between Bureau and Secretary General. Decisional parliament should improve tools and procedure for overseeing the implementation of public policies designing a consulting staff coherently with policymaking task and activities. This joint between decisional parliament and consulting administration should encourage the search for complementarity within relationship between politicians and administrators structuring roles and mechanisms of governance.

Managerial innovation should require the structuring of the relationship between politicians and administrators grounded on dialogue and cooperation implying the search for a shared partnership [30]. Strategic and organizational changes require mechanisms of governance bridging politics and administration in relation to increasing operational complexity. The organizational re-design of parliamentary staff may strictly depend on managerial development and rely on juridical-technical and managerial and organizational skills on the part of the SG in relation to increasing task to be performed.

This study is descriptive and may represent a necessary reflection on the place of historical narrative in organization studies [31] in order to understand trajectories and drivers of change within dynamics of governance and organization within modern parliamentary administrations. Future research should investigate historical and organizational evolution of Italian parliamentary administration after the advent of Republic and democracy.

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# Development of Organization

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**Abstract—** Development has become an important determinant for companies, but also necessity. In order to be organization successful, there is necessary to pay attention to different elements and factors, which positively or negatively influence the conditions for success and subsequent development of organization. The paper is based on primary and secondary research. One of the objectives of the primary research was to analyze and evaluate which factors have impact on the success of organizations in the years 2008 – 2011. From the questionnaire survey there were possible to point out areas that can have high impact on the success of the organization. Analysis and classification of these factors is object of this paper. The aim of the paper is also to summarize basic relations among the factors, to deduce partial findings and to attempt on formulation of some recommendations for entrepreneurial subjects.

**Keywords-** *development; innovation; performance; measurement; cooperation*

## I. INTRODUCTION

Management of business development is associated with four components, which is necessary to support, implement and improve. These are:

- Folder management, where are applicable authorities of the founding documents of the companies (General Meeting, Board), including classic and flexible organizational structure.
- A part of the executive, where it is the component responsible for ensuring and innovative activities.
- Folder initiation (development) and coordination, in which companies shape complementary management structure (local action group, working groups on projects, etc.), which are actually implemented steps leading to the development of enterprises (manager of changes, advisors, external consulting firm).
- Strategic folder, which is a structure of a broader cooperation of various entities and individuals with long-term planning and implementation of innovative activities, corporate innovation projects (entrepreneurs, customers, suppliers, schools, regions).

The paper points out the contribution of factors, which have a significant impact on the competitiveness and development of companies, or region.

## II. OWN RESEARCH

Department of Management and Business Administration of School of Business Administration in Karvina, Silesian University in Opava conducted surveys under the title „Adaptability of SMEs in the current economic conditions in the years 2008 – 2011“. The research took place in the summer semester of the year 2012 with the help of full-time and distance students. The questionnaires were completed by the students on personal meetings with managers of companies. The questionnaire survey included the following categories: A. Identification of the company (11 questions), B. Strategic and Project Management (9 questions), C. Risk and crisis management (11 questions), D. Personnel Policy (7 questions), E. Production, services and innovative activities (9 questions), F. Use of grants and subsidies (8 questions), G. Energy savings and renewable energy (6 questions), H. Identification and intermediate student opinion survey (6 questions) [8].

In order to evaluate the survey there was used SPSS 11.5 program. Outputs were achieved with using several methods, for the purposes of this study there were selected three methods: Rotated Component Matrix (factor loadings after rotation, arranged by size), Communalities (part of variability explained by variables common factors) Correlation Matrix (mutual dependence of two questions).

One of the objectives of the researches carried out by the Department of Management and Business Administration was to analyze and evaluate which factors have impact on the success of organizations in the years 2008 – 2011.

From the questionnaire survey conducted by the Department of Management and Business Administration there was possible to point out areas that can have a high impact on the success of organization.

Using SPSS program 11.5 there was found this structure of questions which attract the links with other questions and are most responsible for the results that came out after the evaluation of specified number (sample) of questionnaires. Questions correlation coefficient higher than 0.5 was found 27 times in the research of years 2008 - 2011, but in order to remained the contribution clear and concise, the table number 1 involved only 5 of the most important issues with a correlation coefficient higher than 0.8.

From the table 1 innovation, performance measurement, cooperation, strategic planning are categories which can have the greatest impact on the speed of adaptability of companies to changes and development.

TABLE I. THE MOST IMPORTANT QUESTIONS – TOP 5 (COMMUNALITIES), YEARS 2008 – 2011

	<i>Initial</i>	<i>Extraction</i>
Product and service innovation (E1)	1.000	0.879
Written strategy (C8)	1.000	0.855
Performance measurement (C9)	1.000	0.814
Cooperation (E5)	1.000	0.809
Measures in practice (C10)	1.000	0.802

### III. INNOVATION

When we pass through knowledge bases, it stands to reason, that there is no simple formula and that innovation are enormously different as for – range, type, sector, sort, order etc. Nevertheless it is possible to find out convergence to two crucial points [9]. Innovation is process, no separate event or action, and such as it has to be managed. Factors, which this process determines, can be influenced, also thereby we can influence result – otherwise process of innovation can be managed.

We also know that management of innovation is not issue of making one or two things well, but it is concerned to keep total good performance, which is conditioned by set of learned patterns of behavior. There are identified 4 behavior groups, which constitute particularly important routine. [9] Successful innovations have to go out from strategies and depend on efficient internal and external structures. Successful innovations require promotive mechanisms, which enable implementation of changes and are only realized in supporting organizational environment.

Association of Small and Medium-Sized Enterprises and Crafts of the Czech Republic (AMSP CR) conducted in the year 2012 research entitled "The position of the SME entrepreneurs to innovations and their financing" From the sample of 506 SMEs in the next 2 years there plan to devote 75% of companies in the SME to innovation. Entrepreneurs are planning to introduce new models, mostly in the area of product innovation (52% of companies) and the dynamics of innovation in comparison with the volume of innovations over the past two years is expected to decrease slightly according to the Association of Small and Medium Enterprises Czech Republic.

### IV. STRATEGY

In order to be SMEs (small and medium sized companies) successful in innovation, they should have a clear idea what direction they will take, they should set goals for innovation, which they will attempt to achieve and after that they should create innovative strategies which can help them to implement and achieve innovation activities. These strategies are then needed to link with particular substantive areas of business activities. The basic aspects of the innovation activities of firms are the areas such as: the uniqueness of product, marketing activities, market and customers, human resources management and innovation culture, project management and innovative

behavior, technological orientation and financial resources. These are aspects that should appear in each innovative strategy of SMEs.

Today it is convincingly argued that "the principle of corporate strategy lies in creating tomorrow's competitive advantages, but faster than competitors can imitate that which a company has today." The principle of strategy is to formulate an infrastructure which supports continuous innovation. Today's companies should be competitively better, cheaper, faster, more flexible, proactive, creative, and of course they should encourage continuous innovation. Entrepreneurs must first get rid of the belief that any convenience can hold their position and they have to begin with implementation of steps to start with continuous innovation based on modern strategic method of management.

Modern strategic management brings entrepreneurs many effective tools helping them develop their business and achieve better results. Some of them are basic and easy as SWOT analysis or SMART principles. Further methods are advanced, more complex and need to be thoroughly studied as f. e. MBO, KPI, BSC. Quality management systems as TQM, EFQM, LEAN, KAIZEN, 6 SIGMA, SA 8000 are very important [3].

Innovative strategies have be able to deal with complex and changing external environment which is characterized by uncertainty in future developments in technology, in competitive threats and market (and non-market) demand, and today's companies have to respect more and more the fact that the company will work in an open system of innovation, which can be connected with the cooperation factor.

There can be recommended the focus on the following areas, when company formulates innovative strategy:

- Based on the situation analysis it is important to make profiling of the product structure of competitors and consider options of using of outsourcing and benchmarking.
- Based on the profiling of companies it is important to focus the company on increasing innovation activity, development of new products, technologies in cooperation with universities, research institutions, companies, etc.
- It is important to create innovation culture and practically implement the process and project management.
- Uncovered dysfunctions in the area of innovation, including logistics, financial management, science and research are important to solve through cooperation with universities, research institutes, linking to the association, clusters, competition etc.

### V. COOPERATION

Not all companies, especially small and medium - sized, can allow to invest into own research and development. Cooperation of innovative firms inclines to cooperation in industrial networks (including knowledge networks). Information exchange but also outsourcing can initiate strategic

movement. Generally, inter-firm cooperation can be comprehended like critical factor of success in the process of innovation. Many studies single out cooperation importance for commercial success of small and medium sized companies from different perspectives. Cooperation of companies can become resource of obtaining access to some market or technological know - how or access to other activities. However it is possible to use alliance on learning of something – to obtaining new market and technological competence, or also to acceptance partner's know – how.

From the research of [6] there was found that only 13 % companies of selected sample (300 organizations) from the Czech Republic consider cooperation of small and medium sized companies as the main factor of innovation background in the company. As for SME's cooperation with other firms, only 34 % asked cooperate on new product or process development.

Association of Small and Medium-Sized Enterprises and Crafts of the Czech Republic (AMSP CR) which conducted the research entitled "The position of the SME entrepreneurs to innovate and their financing" involved into the research a question whether SMEs cooperate currently in the process of innovation with an external entity. Less than a third of companies (from the sample of 506 SMEs) in small and medium-sized enterprises are working with an external organization. [1] Association of Small and Medium Entrepreneurship of the Czech Republic found that most often it is a different company or tradesman. The most common areas for cooperation in the innovation process are the area of IT and web presentation. Another area for cooperation on innovation is marketing.

Cooperation between the public and the business sector in innovation activities can take many forms in the Czech Republic, listed below are the opportunities for cooperation that include the involvement of business, academia and the public sector. Areas of cooperation in innovation activities include: incubators, science and technology parks, technology transfer departments, Universities, Clusters, Spin-offs, programs of research and development support of entrepreneurs, the Enterprise Europe Network, Innovative Networking, regional innovation strategies, innovation vouchers.

One of the main barriers in the area of cooperation are retiring universities, the removal of retiring is a prerequisite for better and more effective cooperation between industry and universities. It is important that the university staff were more interested in the real problems of industry and offer their solutions (offer research). On the contrary, the state should its activities contribute to increased research demand. Although cooperation between the business sector and research and development sector in the Czech Republic exists, its contribution to innovation and economic growth is very limited, therefore there has been running the project "Development of Cooperation and Knowledge Transfer between Business and R & D Sector," which is part of the pillars of the "Innovation" International Competitiveness Strategy of the Czech Republic for the period 2012 - 2020.

The use of any kind of partnerships between the public and private sectors above mentioned is seen not only as one of the methods for attaining the objective lowest possible cost, but also as a tool for innovation activities. In certain situations, it is either the business or the public sector, which may have better resources, experience and opportunities for successful management of the issue, and therefore it is appropriate to develop cooperation and continue to look for new contingencies of its application, because it could be a way to improve the innovation system of the Czech Republic.

## VI. MEASUREMENT OF INNOVATION PERFORMANCE IN COMPANIES

Most of the broad empirical studies on the relation between innovation and performance provide evidence that this relation is positive ([Bierly and Chakrabarti, 1996], [Brown and Eisenhard, 1995 and [Caves and Ghemawat, 1992]; e.g. Damanpour, 1991; e.g. [Damanpour and Evan, 1984], [Damanpour et al., 1989], [Hansen et al., 1999], [Roberts, 1999], [Schulz and Jobe, 2001], [Thornhill, 2006], [Weerawardenaa et al., 2006] and [Wheelwright and Clark, 1992]). However, as Simpson et al. (2006) point out, innovation is an expensive and risky activity, with positive outcomes on firm performances but also with negative outcomes, such as increased exposure to market risk, increased costs, employee dissatisfaction or unwarranted changes. In addition, some studies arrive at conflicting conclusions. For instance, Wright et al. (2005), using a sample of small businesses, find that product innovation does not affect performance in benign environments, but has a positive effect on performance in hostile environments [2].

Literature attests of researches in the field of innovation capacity evaluation for a company or a country (Furman, 2003). These approaches are generally based on the evaluation of the innovation process outcomes and of the resources devoted to it. All these statements may be considered through three analytical levels setting aside the individual and collective cognitive level [5]:

- Level A: The permanent and global innovation management of the company. This level integrates all the strategic tasks, the organization of new projects launching and the improvement of innovation management practices.
- Level B: The outcomes or inputs of a particular project. This level is characterized by a limited period and is concerned with the transformation of an idea up until an innovative product.
- Level C: The material characteristics of the innovative product resulting from the new product development process. This level represents the artefact of Level B. This approach suits our special interest in establishing links between evaluation and operational management tasks. The evaluation of Level C is very common in engineering through the definition of the future specifications of the innovative product and its relating performances.

Literature is mostly concerned with Level B evaluation. Many authors propose approaches to determine the balance between the outcomes and inputs of innovation. Generally, financial and commercial variables are taken into account (Griffin and Page, 1996; Huang et al., 2004; Kangmao et al., 2005). Financial evaluations are based on classical ratio including financial margins and returns on investment (Crepon et al., 2000). Moreover, specific financial criteria dedicated to innovation resources are suggested: they generally measure time and cost development (Grant and Pennypacker, 2006). Marketing variables include qualitative and quantitative aspects, such as new market shares and customer satisfaction (this last example is dedicated more to product's Level C than to the project's Level B). Strategic considerations, such as competitive advantage, are integrated to evaluate the balance between outcomes and inputs. Several authors (Archibugi and Pianta, 1996; Abraham and Moitra, 2001) add technological criteria, such as the number of patents, to conduct this evaluation [5].

Innovative capabilities are a kind of background for the emergence of innovations. Measuring innovation capacity can then be done by measuring the assumptions that means inputs (factors of production) in the innovation process (associated with finding and collecting innovative ideas and ending with investment in staff training and in research and development). It is obvious that some conditions are relatively easily measurable (quantity), others very heavily (quality) [6].

For measuring inputs there are most frequently used operating costs, capital expenditures, number of employees allocated to specific activities related to innovation. The most common individual indicators measuring innovation capabilities are the research and development expenditures for a given period, investment in new equipment and employee training, percentage of employees trained in the area of innovation, capital invested into the innovation, percentage of staff time devoted to innovation and number of innovative ideas. For measuring process there can be used metrics of the duration of the change the idea in the idea realization that means the movement within innovation process from one stage to the next one and the costs connected with the stages. [6]

Innovation performance follows the innovative activities of the company but innovation activity it is not the property of the company. It is again the result of the innovation process and arises from interactions among competing firms in a given market situation. Innovation performance is generally considered as a crucial component of long-term competitiveness of countries and regions [7].

Innovation performance (evaluation of innovation implementation) stands up to the very end of the innovation process. For measurement it is necessary to understand and describe the whole innovation process and to identify factors that may affect the ultimate realization of innovation. Measuring output includes for example number of newly listed products, changes in market share, growth in sales and profit growth from sales of innovative products.

Measurement of innovation performance in a company should be connected with evaluation of these categories – realized innovation (number of implemented innovations

during a period), success of innovation (number of successful projects to the total number of initiated innovative projects), time of innovation (average time implementation of innovative projects), acquired patents (number of patents for a certain period), economic indicators (return of innovation, total expenditure on innovation as a % of sales, real contribution of the project to the overall cost of the project). [6]

## VII. CONCLUSION

The paper introduced areas which can influence the speed of the adaptability of the company to the competitors and can have influence on its development. There were introduced factors which specifically help companies to development based on primary and secondary research. High attention must be focused on innovation activities. The innovation process is nowadays without intensive cooperation with R & D organizations, universities and other innovative parts of the region (also known as an innovative process of "higher rank"). This cooperation, which is still not so used in the Czech Republic, is one of the characteristics of the knowledge economy and is a source of competitiveness of firms and regions. Most of today's successful innovation is a combination of innovation, where combined products are the output of joint innovation activities carried out by individual members of networks. The linear model of innovation is being replaced with an interactive model. All of these areas should be included in the development strategy, which will also include prerequisites for innovation and lead to performance measurement. The performance measurement should include measurable results, balanced cost of capital, it should include both qualitative and quantitative criteria, it is necessary to monitor the market position and create and develop a corporate culture which is opened to innovation.

According above mentioned there is possible to form model of organization success (figure 1).

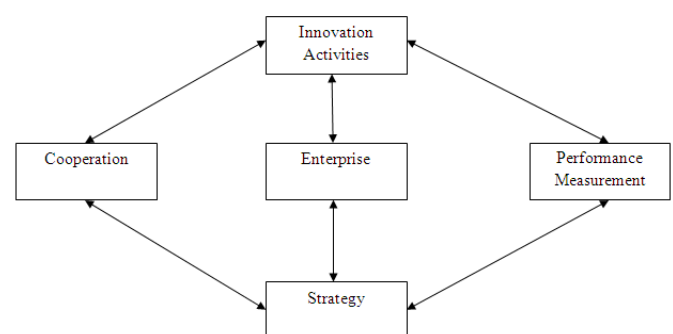


Figure 1. Model of Organization Success

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# Role and significance OF OPERATIONS managers in The effectiveness of COMPANIES

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**Abstract-**In large companies where there are a number of business sectors operation manager role is very important for the functioning of the entire system. There is no company in the world that could successfully operate without this man. Operations managers are responsible for managing staff with operations functions within which the transformation of resources.

The research used the following research methods: descriptive-critical method, quantitative method, method of comparative analysis, methods of induction and deduction; method of synthesis.

According to type, this research is empirical research. Empirical data used in the research of primary sources. The primary empirical data from questionnaires distributed to respondents (top managers and line managers) and the protocol of monitoring the work of the operations managers on the job.

The sample research covered part of the manufacturing and service organizations in the Republic Macedonia. Sampling is conditional on the subject of research that is to define the role and significance of the operational effectiveness of managers in companies.

Determination in the sample to include organizations of production and services is to include more activities, first, because of the possibility to draw some general observations regarding the subject of research at the national level and, secondly, through comparative analysis to see differences.

**Key words:** *operations managers, operations management, effectiveness.*

## I. INTRODUCTION

In the literature, researchers in the field of operations management increasingly suggest building the position of operations manager at the professional level. The ability to respond to challenges posed between the top (top) management and line management lies in building a number of competencies operating manager. Competences of operation manager are combination of personality, knowledge, skills and abilities. There are following indicators: ability for analyzing, organizing ability, ability to plan, to inspire others, ambition to realize, knowledgeable with economy, understanding society, ability to teach others, ability to gather and perform information, ability to solve problems and make decisions, ability to influence others.

Hamel and Prahalad (1994) defined core competence as 'the collective learning in the organisation, especially how to co-ordinate diverse production skills and integrate multiple streams of technologies' (Prahalad and Hamel, 1990: 82). From the perspective of a resource-based theory of the firm, sustained competitive advantage is seen as deriving from a firm's internal resources if these can add value, are unique or rare, are difficult for competitors to imitate and are non-substitutable (Cappelli and Crocker-Hefter, 1996; Ellestrom, 1992; Foss and Knudsen, 1996).

The virtue of the core competence approach is that it 'recognises the complex interaction of people, skills and technologies that drives firm performance and addresses the importance of learning and path dependency in its evolution' (Scarborough, 1998: 229).

## II. RESEARCH METHODOLOGY

### a) Research design

Unsatisfactory results in more organizations in the world, among other things, are due to inadequate management of human resources in terms of competencies and behaviors necessary for the efficient operation and effective implementation of organizational strategy. The main disadvantage of organizations in our region is the lack of a functioning system for operations management.

This research has three main practical goals:

- top management to indicate the importance of operations management and implications for the success of the organization;
- building a level of professionalism operational management;
- at the same time to justify the importance of investing in operational managers, which will result in high returns on invested capital.
- Results of this research can be used:
- The directors, management teams in organizations, operational managers, managers;
- Educational institutions, research institutes, researchers, consultants who study the issue of operational management;
- Undergraduate and graduate studies of operational management.

A basic lack of organization in the Republic. Macedonia is no (or no) functional system for managing operational even in circumstances where the organization has developed and defined competitive strategies, and the wider context of the environment. Today, all organizations understand the importance and necessity of managing the operations associated with the creation of products and services.

#### b) *The subject of the research*

The subject of the research is to define the impact of competence as an important factor for the successful execution of professional and operational functions in the relevant operational areas in manufacturing and service organizations.

#### c) *Research Results and analysis*

Unsatisfactory results of the work of many manufacturing and service organizations in Macedonia, among other things, due to the inadequate management of human resources in terms of competencies and work behaviors required for efficient and effective execution of organizational strategies.

Basic components of the operating management are: the development of products or services, design processes and managing them, and supplies the broadest sense of the word. Therefore, each operating manager must know what technology will propose organizational appropriate way processes are designed to produce goods or services.

Operations managers in different organizations can be found under different names and names, depending on the activity of the organization (manager of fleet distribution company, hospital administrative manager or store manager of the supermarket).

In relation to this generic competence approach, the development of an appropriate typology of competence of operations manager is important for integrating education and training, aligning both with the needs of the labour market and promoting mobility for individuals (vertical as in career progression, lateral as in movement between sectors and spatial as in geographically), especially for workers faced with job insecurity (van der Klink and Boon, 2002).

Hypothesis system fully confirm the address information obtained from the literature for operations management. After their deep consultation the relevant literature in this area, as basic scientific goal set to form a conceptual framework (model) which connects the common and specific competencies of operating managers in manufacturing and service organizations. The justification of scientific research is aimed at generating new scientific knowledge about the characteristics of the relationship of these two types of competencies.

The practical aim of the research is reflected in the offered range of applicability in the daily work of operational managers. Therefore, this study has three main practical goals:

Top management to stress the importance of operational management and implications for the success of organizations, building the professionalism of the operational

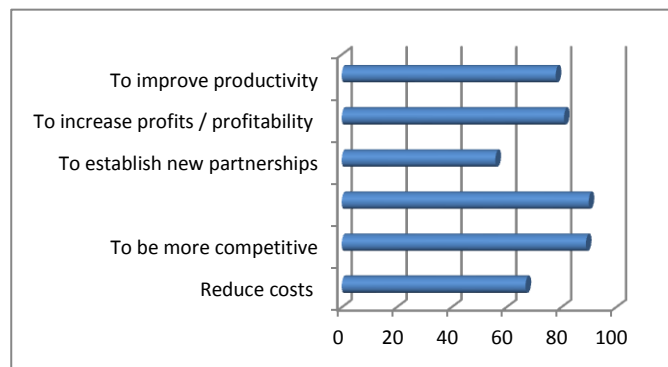


Figure 1. Significance of operations managers

level of management, simultaneously justify the importance of investing in the operational managers, which will result in a high level of return on invested capital.

This survey confirmed the common and specific competencies of managers operating in the country that are the basis for the establishment of national standards for operational managers. This research is realized in 48 companies in the region, of which 28 companies from the manufacturing business activity, and 20 of the service activity.

Proving the special hypothesis we came to the following results through surveyed managers at all levels. Operations managers in your business can help you:

- To improve productivity (often 78%)
- Reduce costs (always 67%)
- To be more competitive (always 89%)
- To increase the value of your brand (often 90%)
- To establish new partnerships (often 56%)
- To increase profits / profitability (often 81%)

Research has shown that most of the operating manager competencies are numerous:

- Making operational planning that is consistent with the global planning of the institution adopted by top management.
- Establishing a balance between top and line management
- Directing and coordinating activities
- Staffing, management and control
- Establish and implement policies supervising the operation
- Motivating staff and building organizational culture
- Designing the optimal organizational structure
- Managing projects in the organization
- Making important decisions

### III. CONCLUSION

The subject that is treated in the research is to define common and special competencies of managers operating in Macedonia, ie impact of competencies as an important factor for successful and professional execution of operational functions in the relevant functional areas in manufacturing and service organizations.

Productivity is one of the primary indicators of the economy, industry, organization and process. Productivity is the ratio between the value of what is produced and what the value is used during production.

Interestingly and surprisingly, how productivity can vary between service and manufacturing sector. For example, the U.S. is rapidly increasing the number of employees in the service sector as opposed to employees in production, but in terms of economic growth and overall productivity this condition tends to increase. Increased investment in information technology, especially in the services significantly increase productivity. If you increase productivity stagnates then stagnate and all other segments of everyday life.

Because productivity is so important, and every manager needs to answer the question: how can we measure the productivity of the process, whether it is a part a product or service operation? Famous are many ways to measure productivity and all are approximately correct. For example, the value of the finished product can be measured by the number of quantities sold or the number of services sold. The value of the cost of making the finished product can be shown by the number of hours required for it to produce. Usually managers use logical measurement instruments to locate opportunities for improvement. For example, a manager who works in the organization to ensure productivity can be measured by the number of policies sold per employee - per week.

Manager in an organization that produces carpets, productivity can be measured by the number of square meters of carpet produced per hour. And both these ways of measuring labor productivity show that an index of final value per employee or per working hour. Similar measurements can be made in relation to the productivity of the equipment where the basic unit on which the machine is being measured. But more commonly used factor productivity which in itself covers all resources used during production. Here are calculating all values pertaining to employees, materials, energy and other costs. The development of any instrument for measuring the end always have quantitative values to be displayed in the money.

Some Macedonian businessmen, who formed private companies after the process of transition, often tend to fall into a trap when the growth of the company exceeds their managerial and human capacity and then have trouble delegating tasks accountable to someone else, believing that no one would could do the job as they would have done. Even if you decide to appoint operations manager, always perceive it to be someone who previously worked in the company and which have enormous confidence. But even

more organizations understand the importance of operations management, as a direct and systematic control of the process through which the transformation of input resources into finished products or services.

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# SECTION 2.

*Marketing*

# The Marketing Mix Used by Yoga in Daily Life in Local and Global Contexts

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**Abstract** – This paper describes the local and global features of the marketing mix used by the organisation Yoga in Daily Life. In the introduction, I discuss the definition of new religious movements. However, analysis of the product, place, price and the communication style of Yoga in Daily Life is at the heart of the study. The spiritual nature of the product and the resulting unique features of the marketing mix of the group are given special attention. The study concludes that Yoga in Daily Life strives to present its clients with a complex product which targets the global spiritual marketplace while minimizing local differences. With this goal in mind, the organization adjusts other components of the marketing mix so that they all exhibit exemplary consistency.

**Keywords** – *Yoga in Daily Life; Maheshwarananda; marketing mix; new religious movements*

## I. INTRODUCTION AND THE AIM OF THIS STUDY

Today, even organizations targeting only the local market realize that the world is inter-connected and that their work has effects beyond the boundaries of their countries. The best examples are environmental groups which often use the slogan: "Think globally, act locally." They understand that although the world contains a great number of artificial borders and boundaries, it is so complex that it would be short-sighted to view these divisions as truly separating areas from one another. On the contrary, ignoring the interconnectedness of the contemporary world can have far-reaching negative consequences, in their opinion.

In my research, I did not study environmental groups, even though my topic is related. This paper examines new religious movements, which are similar to environmental organizations. First of all, both movements are non-profit and both religious and environmental groups represent the NGO sector. Secondly, the mission of these groups is to improve the quality of life rather than generate profit by appealing to individual citizens, whom they see as the most important agents of change. Thirdly, environmental and religious movements have an international impact in terms of their ideologies as well as activities. Religious groups, for example, may have branches that carry out missionary work in different parts of the world – their impact is literally international.

The primary goal of this study relates to this last point: to introduce the special features of the marketing mix used by Yoga in Daily Life at the global level and at the level of the

Czech Republic. I selected this organisation as a representative of new religious movements and used its website and books about Yoga in Daily as my primary sources of information. Naturally, these sources are limited and can only facilitate a partial understanding of the issue at hand, however, the topic is new and other relevant literature is not really available.

## II. NEW RELIGIOUS MOVEMENTS

The term new religious movements has raised heated debates among scholars. It is unclear and complicated partly because the phenomena it attempts to describe have not yet been defined by a single framework. Other terms used for new religious movements include alternative religious beliefs, new untraditional religions, new spirituality or new religions. Similarly, there is a range of ideas about the origins of new religious movements. Some of them have been widely accepted and authors of religious studies use them more often than others.

In sociological literature, new religious movements came into usage in the 1970's and it described new and controversial religious phenomena. In an effort to organize them, scholars developed many typologies. Luzny, for example, suggested a complex typology that sorts new religions according to the original sources they draw upon. The categories thus include new religions based on Christianity (Unification Church, Family), Judaism (The Rastafari Movement), Hinduism (The Czech Society of Hinduism, The Hare Krishna Movement, Transcendental Meditation), Sikhism (Eckankar, Mise Boziho svetla), Buddhism (Karma Kagyu school of Tibetan Buddhism, Kwan Um School of Zen and Soto Zen), occult movements (The Grail Movement, UFO cults, Satanism), movements combining religion and psychotherapy (Family Constellations, Scientology, Silva Method) and the New Age Movement [7].

In this typology, the meaning of the word new refers to being new in a specific time period or being new in a specific place. Similarly, Horyna understands newness in terms of the areas in which new religions develop and where they find their audiences. As well as Melton, Horyna believes new religious movements are not literally new [3]. Most of these movements are merely "new versions of old ones, [...] which have taken hold in places where only a few decades ago nobody would have been able to find them" [8].

Although this typology has many distinct benefits (it includes obscure phenomena, for instance), it is not ideal, as no

single typology can adequately organize the incredibly diverse field religious life represents. However, it is suitable for the purposes of this study because it enables us to categorize the group it studies: Yoga in Daily Life. Obviously, the roots of the movement can be traced to Hinduism. The group also acknowledges its Hindu origin through membership in the Czech Society of Hinduism.

### III. GLOBAL VS. LOCAL MARKETING MIX USED BY YOGA IN DAILY LIFE

The way churches and new religious movement use marketing is complicated due to the high levels of abstraction. These movements offer no product in the traditional sense of the word even if we view them as providers of spiritual services.

Alternative religions are generally difficult to grasp with the help of the conventional instruments of marketing communication. However, the long tradition and the institutional structure of Yoga in Daily Life make it easier to apply the conventional framework of 4 Ps. Product, Price, Place and Promotion represent the four cornerstones of the marketing mix and they will help us understand all the points of contact between Yoga in Daily Life and its customers [6].

#### A. Product

Scholars do not agree on a definition of what the products of religious movements really are. Some scholars even avoid the question. On one hand, the product is the philosophical concept shared across a religious community, whose members 'share their faith' [2]. On the other hand, the product of religion may be loosely defined as the meaning of life and the ability to understand ourselves and the world around us [13]. Faith and the meaning of life are related and both represent the ultimate purpose of religious philosophies. In his book *Nova naboženska hnutí a jak jim porozumět*, Vojtisek gives no clear definition of their products either although he does imply it.

In my study, I view the complex activities of religious groups as their products. The essence of the product is the ultimate goal of all our efforts, the meaning and the reason for the existence of each religious movement. This essence is then closely linked to a philosophy that charts the way towards the ultimate goal. In addition to this primary spiritual content, alternative religious communities usually perform a range of activities, which vary from charitable work to educational, cultural or sport events. Some groups even engage in political life. From the perspective of marketing, we can consider these activities to be the brand extension effects or additional services. A product which contains an essence, the product itself and extension effects is sometimes called a complex product [9]. For the sake of clarity, I will continue to use these terms in the context of marketing mix throughout this paper, with the following exception: I will substitute brand extension effects with the term extended product [6].

When we examine the product of Yoga in Daily Life, we see a complex inter-connected whole. Let us say that the essence of the product of Yoga in Daily Life is yoga practice: maintaining bodily and spiritual health and realizing the God within through spiritual growth and self-realization. The

product equals this philosophical concept. The system of Swami Maheshwarananda is based on the tradition of Patanjali, Shankar and other yoga teachings. It includes Hatha yoga (physical exercise), Pranayama (breath control) and other spiritual practices such as meditation, Yoga-nidra (mind control) and Mantra Yoga (a spiritual journey using repeating mantras). This system is closely tied to yogic practice guided by a number of principles and values, which give the product and its essence meaning. The extended product, including flower arrangement or art courses, is also a part of the system; although the course titles do not sound original, they might have gained a distinct style over time, typical for Yoga in Daily Life. The actual significance and role of these courses in the context of the whole product is therefore difficult to assess.

The fact that the cornerstone of Yoga in Daily Life is its product makes it difficult to discern the differences between its local and global versions only with the help of the available information sources. However, even though the product is unified in the global context, its author had to adjust it to the needs of the target group – people in the West. Maheshwarananda discovered that in contrast to Indians, people in the West are less fit and they have a very different mentality. For these people, he created<sup>1</sup> the system of Yoga in Daily Life because he was not able to use the form of yoga he knew. He could not globalize his yoga practice for the entire population of the world [18]. Besides this initial process of product adjustment, we can assume that different versions of the extended product can be found across different countries although they would all share the fundamental Yoga in Daily Life philosophy.

#### B. Place and Distribution Routes

Members of traditional religious organizations usually meet in churches, temples, chapels or shrines. These sites carry spiritual meaning and believers use them to come together and share their faith. Members of new religious movements meet in a range of alternative places of worship. Depending on the size and character of the community, they meet in public spaces, educational or cultural institutions, tea houses, health food stores, ethnic stores selling Eastern arts and crafts, bookshops with esoteric and spiritual literature, vegetarian restaurants, massage centres or even households. Living rooms or tea houses are suitable for small informal groups, for example. Some new religions also distribute their products via alternative medicine outlets or counseling centres.

Due to the high number of followers and the well-established infrastructure of Yoga in Daily Life Czech Republic, the group is no longer small or informal. The organization has 52 registered branches<sup>2</sup> and people practice in almost every bigger city. The headquarters are based in the Mahaprabhu Deep Ashram in Strilky in Kromeriz County. The ashram is the second largest centre of Yoga in Daily Life in

<sup>1</sup> Specifically, he combined existing philosophies and created a new system.

<sup>2</sup> Data as of March 1, 2013.

Europe.<sup>3</sup> In addition, Yoga in Daily Life Czech Republic boasts probably the highest number of followers in the world. Already in 2004, tens of thousands of people attended at least some of the group's programmes and the number of Maheshwarananda's students who have been formally initiated had reached several thousand [12]. Globally, the organization provides yoga instruction via over 4,000 yoga, medical or education centres [14].

Despite this well-developed infrastructure, Yoga in Daily Life shares some the features of other alternative religions. The followers meet in a variety of locations: kindergartens, art centres, educational institutions (Prague), health centres (Blansko), city council premises (Lucina), leisure centres (Havírov), youth centres (Hranice na Morave), gyms (Stramberk), hospitals (Caslav) or assisted living homes (Liberec). Practitioners of Kwan Um Zen Buddhism use similar meeting points, for instance, and other countries show corresponding trends.

Interestingly, the patterns of consumption of the more usual physical products differ from the patterns of consumption of the complex product of Yoga in Daily Life both in the Czech Republic and around the world – there is no guarantee consumers are interested in the complex product. This imbalance is related to the diverse nature of the target group. The levels of motivation among Yoga in Daily Life practitioners vary dramatically. Some wish to improve their physical or spiritual health; others merely seek a place of refuge from their busy lives (which they find in the physical exercises of yoga). Yet others use yoga as a mediation technique, like Tai-Chi. To meet these needs, people can simply attend yoga classes but do not need to understand the essence of the product; the extent to which this added value is integrated into the lessons depends on individual instructors. The other category of followers includes Maheshwarananda's pupils, who receive their personal mantras and understand the product from a broader perspective. In contrast to the former, these "responsible" practitioners take the Yoga in Daily Life system more seriously. In sum, there two basic distribution routes of product in the Czech Republic: the activities of yoga centres and the Mahaprabhu Deep Ashram represent the complex product. Specialized vegetarian restaurants (such as Prashad in Zlin) and health food shops fulfil the same role in a smaller scale. The distribution systems in other countries are similar but they have their specific features. Sri Deep Madhavananda Ashram Fellowship, founded in 1990 in Vienna, serves as the umbrella organization for the international activities of the Yoga in Daily Life system. There are 23 large communities of this kind around the world, three of which are located in India.<sup>4</sup> Because of the expansive activities of the founder, the impact of the organization is far-reaching. Correspondingly, the portfolio of distribution outlets is growing. In Austria, a new educational institution emerged

called The Ayurveda Academy of Yoga in Daily Life that shares the values and the ethical principles of the Sri Deep Madhavananda Ashram Fellowship. The Sri Swami Madhavananda Austria Hospital Project in Austria and the education and research centre Om Vishwa Deep Gurukul – Om Ashram in Maheshwarananda's hometown in Rajasthan, India also represent new distribution opportunities.

### C. Promotion/Communication

Some scholars have noted a difference between the communication style of traditional churches and alternative religions. The former are critiqued for their inability to communicate with the younger generations. Members of alternative religious communities are well-versed in contemporary communication technologies, on the other hand, and they are more familiar with marketing methods [2]. Vaclavik suggests we try to understand the situation in its historical context and remember that the Catholic Church has been supervised and systematically repressed by the Communist government since the 1940's [11]. Although 1989 brought a sense of relief, the experience of the Church with the Communist regime may have contributed to the rigid nature of the institution and may be of the reasons why it cannot sell its product to younger generations. Obviously, new religions that came to the Czech Republic after 1989 have never needed to struggle with the same problems.

Yoga in Daily Life strives to unify the local and global versions of its product in this part of the marketing mix as well.<sup>5</sup> In the context of the Czech Republic, the organization markets the effects of yoga upon physical and mental health rather than the essence of its spiritual product. This message is central to the project Yoga for Health, for example. It is a project of Yoga in Daily Life whose aim is to demonstrate the positive effects of regular yoga practice on health and their application in the curing and prevention of lifestyle diseases. The secondary aim of the project is to provide inspiration for medical doctors and their patients. Thanks to the well-established presence of Yoga in Daily Life around the world, the group's communication efforts use two major distribution methods: viral marketing (word-of-mouth) and direct marketing mainly by direct mail. These two distribution channels carry information about the activities of the organization and information related to healthy lifestyle. In this context it is important to mention the Segmented Polycentric Integrated Network method or SPIN. It is a way of networking people with shared interests (who have exchanged e-mails or other contact information, for example) and it usually leads to more than just sharing newsletters. This way of networking often results in new contacts and ways of cooperation within and across groups.<sup>6</sup> Yoga in Daily Life also uses sophisticated posters, which include the dates and schedules of different levels of yoga courses. These posters are posted in public spaces in the majority of bigger cities in the Czech Republic

<sup>3</sup> This information was obtained via an oral interview with a pupil of Maheshwarananda, conducted at a seminar for instructors held in Strlky in July 2012.

<sup>4</sup> Besides India, Yoga in Daily Life ashrams are located in Austria, Australia, Bosna and Hercegovina, Croatia, France, Great Britain, Italy, South Africa, Canada, Hungary, Germany, Netherlands, New Zealand, Poland, Slovakia, Slovenia, Spain, Switzerland, Ukraine and USA [4].

<sup>5</sup> In contrast to other organisations, Yoga in Daily Life makes an obvious effort to do so.

<sup>6</sup> By providing her or his email address, an individual can join a broad social network, whose members are interested in spirituality and different methods of spiritual growth (meditation, Tai-Chi, therapy techniques etc.)

and often they are reproduced in the form of advertising in local newspapers and bulletins.

International networks and new communities emerge under the auspices of Sri Deep Madhavananda Ashram Fellowship, which was founded to unite all the local yoga centres of Yoga in Daily Life internationally. It reaches this goal with the help of an internet platform, which pools all the available information about the Yoga in Daily Life system, its founder, major international projects and initiatives as well as links to other multimedia platforms while keeping a multilingual character to enable users to access information in their native languages. Among the representatives of new religions, Yoga in Daily Life has become a leader in electronic communication. The organization seems to have understood the importance of the internet and successfully uses it as a communication tool.

At the global level, internet IP TV Swamiji.tv operates in a similar way. The station offers practically nonstop online broadcasts from lectures, Satsangs and meditations usually led by Swami Maheshwarananda. The broadcasts are intended for international audiences so they are typically presented in English. Depending on the country, they may be simultaneously translated into the local language. Finally, Yoga in Daily Life utilizes corresponding methods on social networks – YouTube, Facebook and Twitter – sharing over 800 videos on YouTube only. The content published on these channels is related. Internet TV broadcasts are available on Facebook as well as on YouTube and information about the activities and quotes of Swami Maheshwarananda from Facebook can be found on the Yoga In Daily Life websites as well as on the web pages of local yoga centres. The website of the Czech branch also has a comprehensive listing of all these international links.

Yoga in Daily Life is international in two other regards: in the nature of its humanitarian initiatives and in respect to Swami Maheshwarananda's personal reach. The wide portfolio of current international projects includes development of educational and research centres, hospitals, animal shelters, forestation of desert schemes, delivery of education to children from impoverished families, planting trees etc. Many of these projects take place in India with the help of indirect support gained by Maheshwarananda's international influence. To the international public, this Indian man is a celebrity Hindu monk and a missionary rather than the founder of Yoga in Daily Life. He seems to apply the organisation's product in practice. With the help of his pupils he holds seminars and conferences and participates in multi-faith dialogues with the representatives of other churches. The world peace summits, which Swami Maheshwarananda has held since 2002 in different parts of the world, have earned wide acclaim.<sup>7</sup> The guru has also conducted over 40 missionary trips around the world.<sup>8</sup> Thanks to his frequent contacts with political and cultural icons, Swami Maheshwarananda attracts media attention. In the Czech

<sup>7</sup> 2002 – Vienna (Austria), 2003 – Sydney (Australia), 2004 – Brno (Czech Republic), 2005 – Zagreb (Croatia), 2006 – Lublana (Slovenia), 2007 – Bratislava (Slovakia), 2008 – Wellington (New Zealand), 2009 – Szombathely (Hungary) [4].

<sup>8</sup> Information was shared as a part of a public lecture held to commemorate the 40th anniversary of Yoga in Daily Life in Czech Republic on March 1, 2013 in Besedni Dum in Brno.

Republic, for instance, his public appearance on the occasion of planting the World Peace Tree in Vysehrad in 2008 was broadcast by the Czech TV.

#### D. Price

The largest registered churches in the Czech Republic receive state subsidies.<sup>9</sup> This source of income partially covers the costs of administration, operation and property maintenance as well as the wages of the clergy and membership needs. The primary source of these subsidies is the state budget [10]. Another source of church income includes gifts from companies and private individuals, sale and rent of property, business activities and additional services [5].

We can look at this section of the marketing mix from the perspective of the service user – the client. Many new religious movements, whose product includes services such as psychotherapy, personal development courses or other educational programs, do not provide them free of charge. Weekend seminars, lectures, meditation sessions or counselling are provided in exchange for fees which are used to cover the operations. Material or monetary income is supplemented by immaterial inputs such as people's time and energy. This type of support might sometimes lead to a loss of personal autonomy, privacy, friends, employment, values etc. Negative aspects of involvement with new religious movements, including psychological effects, have been discussed by scholars such as Abgrall (2000).

In respect to charging for services, Yoga in Daily Life works like any other non-profit groups. Public courses of yoga are the primary activity and represent the most obvious source of income.<sup>10</sup> All the contributions for Czech and international projects are processed by the Zivouci Svetlo Mahaprabhu Deep Satsang Foundation, which is responsible for all the fundraising collections, administration and accounting. The foundation is based in the ashram in Strilky, along with the headquarters of Yoga in Daily Life and the Czech Hinduism Society. The foundation supports many international projects mentioned above in the chapter on Communication as well as local initiatives which include the upkeep and renovation of the Mahaprabhu Deep Ashram, reconstruction of the garden pavilion, new meditation spaces and other infrastructure [4].

Besides course fees, gifts from sponsors and volunteers are the main sources of income for the organization. The system of Yoga in Daily Life integrates volunteering in the form of karma yoga (selfless action for public good, helping others in need), which represents one of the four yogic paths.<sup>11</sup> Even though the value of volunteering is not easily expressed in numbers, volunteers work in the spacious premises of the

<sup>9</sup> Roman-Catholic Church, Czech Evangelical Church, Czecho-Slovak Husite Church.

<sup>10</sup> In the Mahaprabhu Deep Ashram in Strilky there are many events every month, which often go beyond the usual yoga courses. People can attend programs about cleansing, vegetarian cooking, art, flower arrangement, children's camps, trips or educational lectures on healthy lifestyles and yoga and others [4].

<sup>11</sup> 2nd path = Bhakti Yoga (worshipping one form of God); 3rd path = Radja Yoga (practice and self-discipline); 4th path = Jnana Yoga (path of knowledge).

ashram and the adjacent park on an ongoing basis; there are even weekend karma yoga courses for interested members of the public. Now and then Yoga in Daily Life also succeeds in obtaining a grant. In 2012, the Zlin County Culture Foundation awarded a grant to the organization to help restore the castle roof and the roof frame, for example. A network of specialized shops usually located near yoga centres (such as the Prague centre) also helps Yoga in Daily Life make additional income.

All the abovementioned income-generating activities also take place at the global level and just like the other components of the marketing mix, they are extremely consistent and interconnected. The income received from individual gifts and raised at public events always goes to in part to support local humanitarian initiatives and the operation of yoga centres and in part to support large international projects aimed at alleviating poverty, environmental causes or education programmes, all of which take place in India. So far, the activities of Yoga in Daily Life resemble those of environmental groups. The audio-visual programmes offered via the internet, however, make Yoga in Daily Life unique in the global context. Besides the information freely available on the organization's website and the IP TV Swamiji.tv, both media offer programmes that can be downloaded for a fee. These often include older recordings of Maheshwarananda's lectures or conferences and of other public events held by the group. The website also links to a specialized bi-lingual online shop with a wide range of products. Although I was not able to find information on how the profit of this shop is used, we can assume it supports international activities as well.

#### IV. DISCUSSION

This paper attempted to describe the local and global features of the marketing mix used by a representative of new religious movements – Yoga in Daily Life. Along with literature in the fields of religion studies and marketing communication, the organisation's Czech and international websites were used as the primary source of information. Despite the limited amount of available information, the research clearly shows that the marketing mix used by religious groups is intricate.

The product of Yoga in Daily Life offers extensive added value and extra services, which help widen the range of potential target groups and communication channels. Whether the organization maximizes these channels is not clear. It is generally assumed that all the components of the marketing mix need to be unified as much as possible at both the local and global levels, while the most flexible variables usually are the communication style and the price. Given that the product value is actually perceived in the same way around the world (such as products of humanitarian non-profits), there is no obvious reason why the product should be localized. The only

exception might be additional services but that can only be determined with the help of results of further field research.

This paper hopes to inspire more research on groups offering spiritual products using field studies and possibly qualitative interviews. The specific features of communication styles of religious groups in respect to fundraising might be another interesting topic. Because this type of data would be difficult to obtain, however, a research of this kind would be best carried out at the local rather than international level.

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# The Demographic Segmentation in Arts Marketing

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**Abstract**—The role of culture in society can be seen from a purely pragmatic positions: The relationship of people to culture and cultural products is of a marketing nature. The essence of marketing is a connection between the product and its target groups, in other words, between sellers and buyers. Every product, whether commercial or non-commercial, is interesting for any (albeit small) target group. Every target group has some buying motivations, but it can also have some barriers (of time, information, space, or even will) of their consumption. Thus, marketing research plays a key role in marketing because it can help to solve some of these problems. This study comments on the results of two marketing researches of the Czech Republic inhabitants' relationship to art and cultural products.

**Keywords**—culture, art, theatre, cinema, movie, museum, fine arts, gallery, marketing, marketing communication, marketing research, segmentation

## I. INTRODUCTION

The beginning of a theoretical reflection of the arts marketing phenomenon can be dated to the late 1960s, the greater popularization of this theme occurred during the 1970s [4]. There are many different definitions of what arts marketing is, what goals it has and what features it should fulfill. The key issue is whether arts marketing should just look for the markets for existing cultural products or whether the products themselves can be created on a marketing base. For example Tajtáková [13] writes: "When applying marketing in the cultural organization, we rely on several principles. The first is the subordination of art marketing goals. Marketing should help to the cultural organization in fulfilling its mission but should not defend it in reaching them by commercialization of its supply. The role of marketing in the culture is not to adapt the product to market, but to attract the audience to the current product. This means that the product occurs first and consequently it is placed to the market."

Other authors are facing this problem somewhat milder. For example, Diggle [5] says that "The aim of arts marketing is to bring an appropriate number of people, drawn from the widest possible range of social background, economic condition and age, into an appropriate form of contact with the artist and, in so doing, to arrive at the best financial outcome that is compatible with the achievement of that aim." One of the newest definitions states that "Arts marketing is an integrated management process which sees mutually satisfying exchange relationships with customers as the route to achieving organizational and artistic objectives" [6].

Summarizing these definitions we can conclude that the arts marketing task is to harmonize the interests of all stakeholders - the interest of cultural organizations and the interested public in the production of artistically valuable goods, the public demand for leisure time activities, the interest of the public sector in a production of public goods and the interest of funders (e.g. commercial sponsors) in promotion of social activities, self-presentation and reaching relevant target groups [2].

## II. RESEARCH METHODOLOGY AND RESULTS

The comparison of the public's relationship to cultural products is based on the results of two surveys undertaken by the author of this study. These surveys aimed to identify the attitude of the Czech Republic inhabitants to theaters, cinemas, museums and galleries as kinds of cultural facilities, or to the theater, film and fine arts as the forms of art. The aim of the surveys was to determine the importance of various influences on the respondents' attitudes to these cultural products and their buying behavior on particular markets. The quantitative research method of interviews with a standardized questionnaire was used. The first survey, concerning attitudes to the theater and film, took place in 2010 and 2011. The second survey dealing with museums and fine arts was held in 2011 and 2012. In the first survey there were 4782 and in the second one 4622 completely filled questionnaires from the Czech Republic inhabitants aged 12-80 years.

In both samples there was a sufficient amount of respondents from various demographic groups defined by parameters of gender, age and education, as well as residents of different sized settlements and regions. Because the samples composition did not match the demographic composition of the population profile of the Czech Republic, the individual sample groups defined by gender, age and education were given a percentage weight depending on what part of the Czech Republic population they are from. Moreover, each respondent in the sample was given a unique index by weight referring to his/her sample group and the total number of respondents in this group, so that the weighted composition of the sample was representative to the Czech Republic population according to these three demographic criteria. The detailed information about the research methodology and evaluation can be found in two monographs commenting in detail the results of both surveys [1,3]. In the following text the overall results of both surveys are discussed and followed by a detailed discussion of the meaning of the particular segmentation criteria monitored in the research evaluation.

### A. Cultural facilities attendance frequency

The data presented in the Table I. respond to the question "How many times have you been in the theater/cinema/museum/at the fine arts exhibition in the last 12 months?" The options listed in the left column of the table were offered; the line "13 +" represents the sum of the three options - "13-20", "21-30" and "31 or more times." The data in the Table 1 are percentages (%), the sums in all columns are always 100 % (similarly in the next tables). As we can see in the table columns reporting on various types of cultural facilities, the population's largest part attends cinemas (Cin), followed by museums (Mus), theatres (The) and fine arts exhibitions (Gal - gallery). However, the proportion of frequent attenders (at least three times) is very similar in case of theatres, museums and fine arts (in case of cinemas is significantly higher).

TABLE I. CULTURAL FACILITIES ATTENDANCE FREQUENCY

	The	Cin	Mus	Gal
<b>0</b>	43.6 %	27.4 %	34.3 %	47.6 %
<b>1 – 2</b>	33.6 %	30.5 %	45.9 %	34.0 %
<b>3 – 5</b>	15.1 %	28.0 %	15.1 %	13.1 %
<b>6 – 12</b>	5.9 %	10.9 %	3.9 %	4.3 %
<b>13 +</b>	1.9 %	3.3 %	0.7 %	1.0 %

The responses were further categorized according to several demographic and behavioral criteria. There were demographic criteria of gender (men and women), age (five or ten-years age groups were defined), education (secondary level with and without graduation, higher professional, undergraduate /Bachelor's/ and graduate /Master's/ university education), settlement size (five size groups of municipalities plus separately evaluated responses from the three largest Czech cities, Prague, Brno and Ostrava), economic activity (students of different levels of schools, employees, entrepreneurs, unemployed, homemakers, on maternity leave, pensioners), occupation (e.g. managers, clerks, teachers, professionals in services and technical jobs, manual workers, working in creative and media professions), family status (here the effect of whether the respondent lives alone or with a partner, and whether he/she lives with minor children was investigated) and art education (in various disciplines - dramatic, music, dance, visual and literary) used.

Behavioral segmentation criteria used in the evaluation were his/her art activities (past or present, professional or amateur, in the same fields as above), whether the respondent attended cultural facilities in childhood with his parents or other relatives (often, sometimes, never), whether the cultural facilities are attended by the respondent's friends too (attending together, attending, but not together, talking about that kind of art together, certainly not attending; in case of museums this question has not been implemented) and finally, the cultural facilities attendance frequency (often, sometimes, never).

This study focuses on three demographic segmentation criteria, age, gender and education. Each question deals with differences in responses of individual demographic segments defined on the basis of these three criteria.

TABLE II. SEGMENTATION ACCORDING TO AGE

		Age (%)							
		15	20	25	30	40	50	60	70
		0	1/2	3+	0	1/2	3+	0	1/2
The	0	18,9	45,2	42,5	40,3	44,2	43,0	50,9	65,5
	1/2	52,0	33,7	34,2	36,5	31,5	30,6	28,3	20,1
	3+	29,1	21,2	23,3	23,2	24,2	26,4	20,8	14,4
Cin	0	3,2	5,9	12,3	16,2	16,9	29,1	60,8	79,2
	1/2	17,2	22,7	27,7	33,1	40,9	41,8	24,9	15,8
	3+	79,5	71,4	60,1	50,7	42,2	29,1	14,3	5,0
Mus	0	19,2	33,0	31,4	32,0	33,8	39,1	32,8	57,1
	1/2	57,1	43,5	44,5	48,6	48,1	40,3	46,8	30,6
	3+	23,7	23,5	24,1	19,4	18,1	20,7	20,5	12,3
Gal	0	34,4	35,4	41,7	46,7	49,1	50,8	49,6	66,7
	1/2	44,8	35,9	34,5	34,9	34,8	29,2	33,7	23,0
	3+	20,8	28,8	23,8	18,4	16,1	20,0	16,7	10,3

The Table II. describes the differences in particular segments' behavior. The numbers in the second row of Table II. define the lower limit of each age segment; that means that the segments of 15-19 years, 20-24, 25-29, 30-39, 40-49, 50-59, 60-69 and 70-80 years are compared here. As can be seen in Table II., the differences in responses of particular segments defined by age are somewhat different in the case of individual cultural facilities. In the case of theatres the first attendance peak can be seen in the group of 15-19 years. The reason can probably be the school attendance. The second major peak can be observed in the group of 50-59. In the case of cinemas the attendance peak can be seen in the youngest age group, while in further groups the ration of frequent attenders diminishes. In the case of museums the highest proportion of frequent attenders can be seen in groups between 15 and 29 years, while in other groups the proportion is basically average. Fine arts exhibitions have the most frequent visitors among people aged 20-24 years, and similarly as in the case of museums there is a second smaller attendance peak in the group of 50-59 years.

TABLE III. SEGMENTATION ACCORDING TO GENDER AND EDUCATION

		Gender (%)		Education (%)					
		M	F	SW	SG	HP	BC	MA	
		0	1/2	3+	0	1/2	3+	0	1/2
The	0	50,7	36,6	62,3	34,9	27,0	25,5	21,7	
	1/2	31,1	36,0	25,4	38,8	37,8	36,9	33,7	
	3+	18,2	27,4	12,2	26,3	35,2	37,7	44,7	
Cin	0	27,1	27,7	40,3	18,8	17,0	6,6	14,7	
	1/2	32,3	28,6	31,3	35,3	36,7	28,7	32,4	
	3+	40,6	43,6	28,3	45,9	46,3	64,7	52,8	
Mus	0	37,8	31,0	48,0	25,2	18,9	17,0	15,4	
	1/2	45,1	46,8	42,2	50,6	45,5	48,4	48,9	
	3+	17,2	22,3	9,8	24,2	35,6	34,6	35,7	
Gal	0	55,3	40,3	64,1	38,4	26,3	23,1	22,9	
	1/2	30,2	37,6	27,1	39,1	45,0	43,5	40,2	
	3+	14,5	22,1	8,8	22,5	28,6	33,4	37,0	

In all four cases mentioned above we can observe that more frequent attenders are among women (F) than among men (M, see Table III. columns). The smallest differences in the responses of both genders can be observed in the case of cinemas where the ratio of frequent attenders is almost the same. The differences are slightly bigger in the case of museums. The biggest differences between both genders can be observed in the case of theaters and fine arts exhibitions (their results are similar in this respect).

The results of segmentation according to the education are similar too. In all cases, the proportion of frequent attenders is increasing together with the education level. However, in the case of cinemas the most frequent attenders are among people with a bachelor's degree (BC), in the case of museums even among people with a higher professional education (HP). In all other cases the most frequent visitors are among people with a master's degree (MA). Completely mediocre results can be seen in the case of respondents with secondary education without graduation (SW), while the proportion of frequent attenders among secondary school graduates (SG) is nearly the average.

The question we should answer is the statistical significance of the demographic segmentation criteria we have analysed above. In other words, the question is whether the segmentation according to age, gender and education is more statistically significant than the segmentation according to other demographic and behavioral criteria stated above. In order to evaluate the statistical significance of each segmentation criteria the chi-squared test was used. Chi-squared test was calculated with the help of Microsoft Excel as a comparison of results of all sub-segments within the defined criteria (see above) with the results of the entire sample. Chi-squared test results are shown in Table IV. (similarly in further chapters). The statistical significance of selected individual criteria (the numbers represent percents, %) are provided in rows. Individual columns refer to particular cultural facilities. The last column (Ø) represents an average of the chi-squared test results for all cultural facilities. This figure suggests whether the segmentation criteria in general can be considered to be statistically significant.

TABLE IV. STATISTICAL SIGNIFICANCE OF THE SEGMENTATION CRITERIA

	The	Cin	Mus	Gal	Ø
<b>Gender</b>	33.082	97.991	96.563	55.745	<b>70.845</b>
<b>Age</b>	0.000	0.000	7.799	18.636	<b>6.609</b>
<b>Education</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Settlement size</b>	0.601	0.148	19.960	0.334	<b>5.261</b>
<b>Economic activity</b>	0.000	0.000	0.025	0.000	<b>0.006</b>
<b>Occupation</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Family status</b>	0.273	0.000	20.162	0.008	<b>5.111</b>
<b>Art education</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Art activity</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Childhood attendance</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Friends attendance</b>	0.000	0.000		0.000	<b>0.000</b>
<b>Average</b>	<b>3.087</b>	<b>8.922</b>	<b>14.451</b>	<b>6.793</b>	<b>7.985</b>

The last row presents the average of chi-squared tests regarding the individual cultural facility (Average). This figure indicates whether the results related to the facility vary more (low values) or less (high value). The general statistical rules are used here, i.e. the high value of chi-squared test near 100% level indicates that the segmentation criterion is not significant as a whole (the answers of each segment are not significantly different). Significantly different (independent) result is understood to be below the 1% or 5% level of significance.

All behavioural segmentation criteria can be considered as statistically significant - art activities, childhood attendance and friends attendance (attendance frequency is not evaluated here) where the significance level (chi-squared test) is 0.000%.

Among the demographic criteria the same can be said about art and general education (higher educated people attend cultural events more often), and occupation (e.g. teachers, people working at creative professions or media attend more often, while manual workers attend less often - see [1,3] for details). Economic activity appears to be a significant segmentation criterion too (e.g. college students are most active in the majority of the cases, entrepreneurs are more often active than employees, the least active are unemployed). The same can be argued in some cases about family status (a barrier to attendance could be whether people have minor children, this is less true e.g. in case of museums), settlement size (not statistically significant segmentation criterion in case of museums) or age (not significant in case of fine arts and museums). Gender is an insignificant segmentation criterion in all the cases, although the specific data presented above show that women are more frequent attendees of all types of cultural productions than men (especially in case of theatres).

### B. Spontaneous attractiveness of the attendance

The attractiveness of cultural events was monitored by the question "Imagine you have a free evening today (you have no obligation) and someone offers you a free ticket to the theater/cinema/museum/fine arts exhibition." There were five response options: "I would definitely go there" (in the table as Definitely yes), "I would think about it, but I guess I would go" (Probably yes), "Maybe I would go, maybe not" (Do not know), "I probably would not go, I have other entertainment" (Probably not) and "I certainly would not go" (Definitely not).

TABLE V. ATTRACTIVENESS OF CULTURAL EVENTS

	The	Cin	Mus	Gal
<b>Definitely yes</b>	37.6 %	46.7 %	36.4 %	29.7 %
<b>Probably yes</b>	26.5 %	25.0 %	28.6 %	25.9 %
<b>Do not know</b>	11.3 %	11.4 %	16.1 %	14.6 %
<b>Probably not</b>	13.7 %	9.2 %	12.9 %	17.7 %
<b>Definitely not</b>	10.9 %	7.7 %	6.0 %	12.2 %

The results are similar as in the previous case. The most attractive are cinemas again. Theatres and museums follow with similar results which are in contrast to the previous question where a bigger part of public attends museums than theatres. It suggests that some people attend museums, although they are not too attractive for them, while theaters may have untapped potential.

In the Table VI. the differences in answers of the particular segments are analyzed. The answers are summarized to three lines - Yes (Definitely yes, Probably yes), 0 (Do not know) and No (Probably not, Definitely not). As we can see, a theater attendance is the most attractive for people aged between 20-39 years. That is the difference compared with the previous question where the attendance peak was noted in the group of 50-59 years. In the case of cinemas the results correspond to the previous question because the attendance is the most attractive for people under 25. In the case of museums the proportion of respondents who would attend is relatively balanced, the peak can be seen in the group of 25-29 years. Slightly more significant peak in the group of 20-24 years can be seen in the case of fine arts. In all cases it is possible to

observe a noticeable decrease of attendance attractiveness in the two oldest age groups. This conclusion is consistent with the results of the previous question as well as with the actual attendance frequency.

TABLE VI. SEGMENTATION ACCORDING TO AGE

		Age							
		15	20	25	30	40	50	60	70
The	Yes	67,9	71,5	66,5	74,8	64,2	63,2	57,2	48,6
	0	11,4	10,2	9,7	9,9	11,5	12,3	13,4	8,4
	No	20,7	18,3	23,8	15,3	24,3	24,5	29,4	43,0
Cin	Yes	91,9	93,8	84,2	84,9	77,8	64,1	47,8	27,4
	0	5,5	4,1	8,2	8,5	12,0	18,1	15,5	12,3
	No	2,7	2,1	7,7	6,6	10,2	17,8	36,7	60,4
Mus	Yes	57,6	66,9	69,2	73,3	66,3	65,4	63,1	56,6
	0	19,6	19,5	16,8	12,9	16,7	14,0	18,9	10,5
	No	22,9	13,6	13,9	13,8	17,0	20,7	18,0	32,9
Gal	Yes	52,2	63,4	62,7	62,6	55,2	55,8	51,9	44,1
	0	21,4	17,3	12,6	13,2	14,9	11,8	15,0	11,7
	No	26,4	19,2	24,7	24,2	29,9	32,5	33,1	44,2

The attendance of all monitored cultural facilities is more attractive for women (see Table VII.). The differences between answers of men and women are even in all cases (including cinema) higher compared with the previous question (attendance frequency). We can also notice that in all observed cases there is smaller proportion of those who "Do not know" among women. This confirms the often discussed fact that men attend cultural events more often on their partner's initiative. The attendance attractiveness of most of cultural facilities grows linearly with the respondent's education level (this trend can most notably be observed in the case of fine arts exhibitions). However, this is not true in the case of cinemas where the proportion of respondents who would attend them is relatively balanced. The attractiveness peak can be observed in the case of people with a bachelor's degree (BC). The results of respondents with the secondary education without graduation (SW) are in all cases below-average and close to the average in the case of museums.

TABLE VII. SEGMENTATION ACCORDING TO GENDER AND EDUCATION

		Gender		Education				
		M	F	SW	SG	HP	BC	MA
The	Yes	51,3	76,8	51,3	74,1	70,5	75,3	80,8
	0	15,1	7,5	13,4	10,0	11,9	12,7	8,7
	No	33,6	15,7	35,3	15,9	17,6	12,0	10,5
Cin	Yes	67,7	75,6	60,7	78,6	73,1	85,8	81,4
	0	15,0	7,8	15,0	10,0	15,5	8,3	8,0
	No	17,3	16,6	24,3	11,4	11,3	5,9	10,7
Mus	Yes	55,3	74,3	57,7	76,6	72,9	80,8	83,5
	0	20,0	12,3	18,7	13,3	18,7	11,4	9,9
	No	24,7	13,4	23,6	10,1	8,3	7,8	6,6
Gal	Yes	43,1	67,5	43,0	69,3	68,1	75,7	78,6
	0	17,3	12,0	15,1	13,2	14,0	11,9	9,3
	No	39,6	20,6	41,9	17,5	17,9	12,3	12,1

As shown in Table VIII., behavioural criteria play a significant role again of which the art activity has a relatively minor importance (especially in case of cinemas). The greatest average statistical significance among demographic criteria to be seen is in case of an economic activity, occupation, family

status, art education (more significant than art activity, although the results are very similar) and also education and age. Gender plays a statistically significant role only in the case of theatre's and museum's attractiveness (more attractive for women in all cases), while the settlement size is a statistically significant factor only with regard to museums (which are more attractive for Prague's inhabitants and less attractive for inhabitants of Ostrava). On the other hand, the attention can be drawn to opposite result of previous question where the settlement size criterion was statistically significant elsewhere except museums.

TABLE VIII. STATISTICAL SIGNIFICANCE OF THE SEGMENTATION CRITERIA

	The	Cin	Mus	Gal	Ø
Gender	0.163	43.040	2.665	11.639	<b>14.377</b>
Age	0.001	0.000	0.144	0.247	<b>0.098</b>
Education	0.043	0.455	0.010	0.127	<b>0.159</b>
Settlement size	89.793	86.170	0.582	49.298	<b>56.461</b>
Economic activity	0.000	0.000	0.000	0.000	<b>0.000</b>
Occupation	0.000	0.000	0.000	0.000	<b>0.000</b>
Family status	0.000	0.000	0.006	0.009	<b>0.004</b>
Art education	0.000	0.042	0.000	0.011	<b>0.013</b>
Art activity	0.000	1.396	0.000	0.349	<b>0.436</b>
Childhood attendance	0.000	0.000	0.000	0.000	<b>0.000</b>
Friends attendance	0.000	0.000		0.000	<b>0.000</b>
Attendance frequency	0.000	0.000	0.000	0.000	<b>0.000</b>
Average	<b>7.500</b>	<b>10.925</b>	<b>0.310</b>	<b>5.140</b>	<b>5.962</b>

### C. Genre preferences

Another question in the questionnaire was: "What kind of theatre/cinema/museum/fine arts do you prefer?" The question was semi-open. The list of options was different for each cultural branch which does not allow us to make a comparison, thus, only the order of all genres is presented. Concerning the theatre it was comedy (62.5% of respondents), musical (40.5%), drama (24.2%), opera (15.0%), ballet (12.4%), tragedy (12.3%), operetta (11.1%), cabaret (9.9%), expressional dance (9.5%), absurd drama (5.3%), puppet theatre (5.1%), cool drama (4.3%) and pantomime (3.5%). Regarding the film a comedy "won" too (60.5%) and was followed by a historical film (29.6%), action film (26.1%), drama (23.2%), thriller (20.0%), sci-fi (18.8%), musical (16.0%), fantasy (15.9%), documentary film (14.9%), fairy tale (14.6%), horror (13.5 %), animated film (13.0%), western (9.6%) and erotic film (5.6%). With respect to museums and monuments the order was as follows, a castle (41.5%), technical museum (24.9%), natural history museum (23.7%), museum of film or music (23.6%), cars (23.5%), crafts (19.8%), ruins (19.8%), museum of aviation (19.3%), architecture (18.1%), clothing and footwear (17.2%), military or police (17.2%), folk culture (15.9%), glass (15.5%), toys (15.2%), personalities (12.5%) and sacral monument (10.9%). Concerning the branch of fine arts it was an exhibition of photos (54.1%), classical paintings and drawings (35.9%), modern paintings, drawings and graphics (25.1%), modern objects (15.0%), classical sculptures (14.2%) and performances (8.1%).

TABLE IX. STATISTICAL SIGNIFICANCE OF THE SEGMENTATION CRITERIA

	The	Cin	Mus	Gal	Ø
<b>Gender</b>	1.924	0.000	0.000	34.617	<b>9.135</b>
<b>Age</b>	0.000	0.000	0.002	0.000	<b>0.001</b>
<b>Education</b>	0.000	0.050	0.000	0.026	<b>0.019</b>
<b>Settlement size</b>	81.571	98.736	40.087	5.998	<b>56.598</b>
<b>Economic activity</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Occupation</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Family status</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Art education</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Art activity</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Childhood attendance</b>	0.000	0.120	0.001	0.000	<b>0.030</b>
<b>Friends attendance</b>	0.000	0.000		0.000	<b>0.000</b>
<b>Attendance frequency</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Average</b>	<b>6.958</b>	<b>8.242</b>	<b>3.645</b>	<b>3.387</b>	<b>5.482</b>

In Table IX. it can be observed that almost all the segmentation criteria monitored here play a statistically significant role. Certainly this is true in case of behavioural criteria. Gender is statistically significant within the demographic criteria only at the 5% level in case of theatres and statistically insignificant in case of fine arts. On the other hand, a completely statistically insignificant segmentation criterion is the settlement size which has a relatively higher level of significance approximating to the 5% level only in case of fine arts.

#### D. Cultural events attendance accompaniment

The question "When you were last time in the theater/cinema/ museum/at fine art exhibition, who were you there with?" describes an accompaniment of cultural events attendance. From a methodological point of view, we are asking about the last attendance to a given cultural event, we would not necessarily get the same results in the case if we asked with whom respondents attend them usually.

TABLE X. ATTENDANCE ACCOMPANIMENT

	The	Cin	Mus	Gal
<b>Self</b>	3.0 %	3.5 %	5.3 %	6.8 %
<b>With partner</b>	27.7 %	39.7 %	26.3 %	23.7 %
<b>With parents, children</b>	11.6 %	13.8 %	22.7 %	13.4 %
<b>With friends</b>	17.8 %	21.9 %	16.7 %	17.8 %
<b>School, work</b>	16.2 %	2.4 %	9.9 %	11.8 %
<b>Do not know</b>	19.2 %	18.2 %	18.0 %	20.9 %
<b>Never attended</b>	2.3 %	0.6 %	1.3 %	5.6 %

The results of the particular cultural facilities are in this case very similar. Respondents most frequently visited them with their partners, as well as with parents or children (a little more in the case of museums), friends (more in the case of cinemas), as school or work activity (more in the case of theaters) and finally by themselves (Self). About one-fifth of the respondents cannot answer this question (Do not know) and a small portion of them claim that they have never attended those cultural facilities.

TABLE XI. SEGMENTATION ACCORDING TO AGE

		Age							
		15	20	25	30	40	50	60	70
<b>The</b>	<b>Pa</b>	8,5	26,2	30,7	37,5	32,9	32,3	23,3	17,7
	<b>Fa</b>	17,0	12,2	7,8	8,4	11,6	10,0	11,6	15,5
	<b>Fr</b>	15,7	17,5	17,4	21,8	23,1	17,5	14,0	13,4
<b>Cin</b>	<b>Pa</b>	28,5	48,7	59,8	51,9	49,4	36,8	25,5	15,3
	<b>Fa</b>	12,8	4,2	4,6	17,2	14,5	16,9	13,1	12,0
	<b>Fr</b>	45,4	39,2	23,6	17,8	20,3	17,3	14,0	10,4
<b>Mus</b>	<b>Pa</b>	4,8	21,9	31,4	31,4	26,2	25,3	22,7	19,4
	<b>Fa</b>	13,8	7,8	6,8	13,5	13,6	11,8	15,9	11,9
	<b>Fr</b>	16,0	23,8	21,0	17,5	15,0	19,7	20,6	13,7
<b>Gal</b>	<b>Pa</b>	6,7	22,7	39,3	33,8	31,1	28,8	25,4	14,4
	<b>Fa</b>	26,0	12,9	12,6	24,0	24,2	23,4	22,9	19,8
	<b>Fr</b>	11,8	24,7	20,4	16,1	15,3	15,6	19,8	15,9

In Table XI. the proportion of three key answers "With partner" (Pa), "With parents, children" (Fa) and "With friends" (Fr) are compared. As we can see the proportion of responses "With partner", "With friends" increases together with an increasing age of respondents. By half more men than women report that they attended the cultural event with a partner. This confirms that men attend cultural events rather as an accompaniment of their partners, while not all women are able to persuade their partners to the attendance. Therefore, they have to look for other possibilities of accompaniment among their friends or relatives. Regarding the segmentation according to the education, people with lower levels of education often stated that they do not remember their last attendance, they never attended the cultural facilities or that they attended them within school activities (these three answers are not included in Table XII. where therefore can be seen lower figures in the cases of the answers included).

TABLE XII. SEGMENTATION ACCORDING TO GENDER AND EDUCATION

		Gender		Education				
		M	F	SW	SG	HP	BC	MA
<b>The</b>	<b>Pa</b>	34,3	21,3	25,6	31,7	39,0	39,5	46,3
	<b>Fa</b>	7,2	16,0	10,0	13,5	11,2	10,2	7,7
	<b>Fr</b>	11,7	23,8	13,7	22,8	18,9	19,8	22,0
<b>Cin</b>	<b>Pa</b>	44,6	34,9	41,0	43,0	39,7	51,0	50,0
	<b>Fa</b>	10,0	17,4	14,6	14,0	14,1	7,8	11,6
	<b>Fr</b>	18,8	25,0	15,1	23,5	24,4	31,1	19,7
<b>Mus</b>	<b>Pa</b>	25,5	22,0	18,1	31,1	33,4	34,8	38,8
	<b>Fa</b>	9,5	17,1	12,1	12,5	13,9	10,9	13,1
	<b>Fr</b>	12,3	23,0	15,8	21,1	20,6	28,6	17,4
<b>Gal</b>	<b>Pa</b>	28,1	24,6	25,0	34,6	27,6	34,4	39,3
	<b>Fa</b>	19,0	26,1	20,9	20,6	26,7	19,4	21,8
	<b>Fr</b>	13,0	20,1	15,4	19,7	23,6	26,0	18,1

The statistical significance of differences in individual segment's responses is more variable in this case than in previous questions (see Table XIII.). All the behavioural criteria are significant, except art activity which is not significant in the case of cinemas. The demographic criteria significant in all cases are those of age, economic activity, occupation and family status. The criterion of education is statistically significant at the 5% level in case of cinemas where the criterion of art education is not significant at all. The settlement size criterion is statistically significant only in case of museums and fine arts. Gender is not a significant segmentation criterion in any of the cases. However, a

relatively higher level of significance (approximating to the 5% level) can be seen in case of theatres.

TABLE XIII. STATISTICAL SIGNIFICANCE OF THE SEGMENTATION CRITERIA

	The	Cin	Mus	Gal	Ø
<b>Gender</b>	5.215	60.458	56.308	12.842	<b>33.706</b>
<b>Age</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Education</b>	0.001	1.483	0.002	0.000	<b>0.372</b>
<b>Settlement size</b>	83.808	96.383	0.048	0.000	<b>45.060</b>
<b>Economic activity</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Occupation</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Family status</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Art education</b>	0.000	12.383	0.000	0.000	<b>3.096</b>
<b>Art activity</b>	0.009	19.475	0.001	0.000	<b>4.871</b>
<b>Childhood attendance</b>	0.000	0.002	0.021	0.000	<b>0.006</b>
<b>Friends attendance</b>	0.000	0.000		0.000	<b>0.000</b>
<b>Attendance frequency</b>	0.000	0.000	0.009	0.000	<b>0.002</b>
<b>Average</b>	<b>7.419</b>	<b>15.849</b>	<b>5.126</b>	<b>1.070</b>	<b>7.259</b>

### E. Cultural events attendance initiators

This view is complemented by the question "When you were last time in the theater/cinema/museum/at fine arts exhibition, who initiated this attendance?" We are asking about the last attendance to cultural event again.

TABLE XIV. ATTENDANCE INITIATORS

	The	Cin	Mus	Gal
<b>I</b>	25.4 %	37.5 %	18.1 %	18.4 %
<b>Someone else</b>	44.9 %	34.0 %	28.9 %	29.9 %
<b>Together</b>	5.9 %	9.8 %	27.6 %	20.0 %
<b>Do not know</b>	19.2 %	18.2 %	24.2 %	26.1 %
<b>Never attended</b>	2.3 %	0.6 %	1.3 %	5.6 %

Theoretically, the response rate of "I" and "Someone else" - with regard to the answer "Together" - should be balanced. This is approximately true in the case of cinemas, but not in the case of other cultural facilities where many people think that their last attendance was initiated by someone else. It might perhaps suggest that in many cases when partners attend them together, both have a feeling that they are giving a pleasure to the other or that they "have to" go there.

TABLE XV. SEGMENTATION ACCORDING TO AGE

		Age							
		15	20	25	30	40	50	60	70
<b>The</b>	<b>I</b>	17,4	26,7	28,8	28,3	30,8	27,7	21,5	17,0
	<b>SE</b>	71,8	57,5	47,0	48,5	45,8	36,2	30,7	28,3
	<b>To</b>	0,7	4,6	5,7	8,1	6,0	8,3	4,6	6,0
<b>Cin</b>	<b>I</b>	49,9	42,8	43,6	48,2	45,4	31,1	21,5	13,2
	<b>SE</b>	38,3	41,5	33,1	29,6	36,2	39,1	28,5	22,4
	<b>To</b>	5,4	13,8	15,3	15,7	9,3	7,6	5,9	4,8
<b>Mus</b>	<b>I</b>	7,4	16,5	22,2	18,3	22,1	18,6	19,1	20,0
	<b>SE</b>	56,8	32,4	26,6	22,8	23,5	26,7	26,9	20,6
	<b>To</b>	14,8	27,0	30,9	38,1	30,5	27,0	25,2	17,4
<b>Gal</b>	<b>I</b>	9,8	19,7	21,1	21,3	22,3	19,6	16,1	15,6
	<b>SE</b>	47,9	35,1	32,9	29,5	27,1	22,9	24,7	23,8
	<b>To</b>	17,4	20,3	20,0	22,4	18,4	22,3	22,4	15,9

In Table XV. three key answers are included - "I", "Someone else" (SE) and "Together" (To). In the case of

theaters an above-average proportion of initiators can be found in the age group of 40-49 years, in the case of cinemas in the youngest age group and (perhaps surprisingly) among people aged 30-49. In the case of museums the initiators are mainly in the groups of 25-29 and 40-49 years, while in the case of fine arts exhibitions in the group of 25-49 years. In all cases, the proportion of initiators significantly decreases in the two highest age groups.

TABLE XVI. SEGMENTATION ACCORDING TO GENDER AND EDUCATION

		Gender		Education					
		M	F	SW	SG	HP	BC	MA	
<b>The</b>	<b>I</b>	17,7	33,0	16,3	31,5	41,3	36,9	40,7	
	<b>SE</b>	48,8	41,2	45,7	43,4	33,2	41,6	39,0	
	<b>To</b>	6,5	5,4	5,4	7,2	7,4	6,9	8,4	
<b>Cin</b>	<b>I</b>	35,1	39,7	31,4	41,5	43,1	44,7	42,3	
	<b>SE</b>	35,6	32,4	34,0	33,7	31,3	36,0	34,4	
	<b>To</b>	9,5	10,1	9,9	10,9	10,5	15,2	11,8	
<b>Mus</b>	<b>I</b>	14,9	21,1	12,2	23,1	32,9	30,2	32,4	
	<b>SE</b>	31,0	26,9	27,0	26,4	20,6	25,9	19,4	
	<b>To</b>	25,2	29,9	29,4	31,6	29,6	31,5	34,6	
<b>Gal</b>	<b>I</b>	14,6	22,0	10,2	24,1	33,0	31,6	39,7	
	<b>SE</b>	31,2	28,6	29,9	27,6	24,1	25,9	24,1	
	<b>To</b>	15,8	24,0	16,1	24,7	27,4	24,8	22,7	

In Table XVI. we can see that women are in all cases more frequent initiators than men. The biggest differences in this respect can be observed in the case of theatres, the smallest in the case of cinemas. Regarding the education segmentation we can say that more frequent initiators are people with higher education levels; in the case of cinemas people with a bachelor's degree (BC), in the case of museums people with a higher professional education (HP). It is possible to highlight the significantly below-average portion of initiators among people with a secondary education without graduation (SW), which is not true in the case of cinemas where the portion is average.

TABLE XVII. STATISTICAL SIGNIFICANCE OF THE SEGMENTATION CRITERIA

	The	Cin	Mus	Gal	Ø
<b>Gender</b>	12.039	96.567	60.959	17.749	<b>46.829</b>
<b>Age</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Education</b>	0.000	3.738	0.000	0.000	<b>0.935</b>
<b>Settlement size</b>	77.107	70.560	0.022	0.203	<b>36.973</b>
<b>Economic activity</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Occupation</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Family status</b>	0.000	0.000	0.000	0.005	<b>0.001</b>
<b>Art education</b>	0.000	0.140	0.000	0.000	<b>0.035</b>
<b>Art activity</b>	0.000	0.176	0.000	0.000	<b>0.044</b>
<b>Childhood attendance</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Friends attendance</b>	0.000	0.000		0.000	<b>0.000</b>
<b>Attendance frequency</b>	0.000	0.000	0.000	0.000	<b>0.000</b>
<b>Average</b>	<b>7.429</b>	<b>14.265</b>	<b>5.544</b>	<b>1.496</b>	<b>7.068</b>

As seen in Table XVII., all the behavioural segmentation criteria and most of demographic ones are statistically significant. The education is statistically significant only at the 5% level with regard to cinemas. The settlement size is insignificant in case of theatres and cinemas. Gender is an insignificant segmentation criterion for any of the examined cultural productions (a relatively higher significance can be

seen in case of theatres and fine arts, but in fact it is very far to the 5% level of significance).

### III. RESULTS AND DISCUSSION

This study examines the significance of three demographic segmentation criteria, age, gender and education, in the arts marketing. The aim was to demonstrate whether these three criteria play bigger, the same or smaller role than other demographic criteria, such as an occupation or a family status, and behavioral segmentation criteria, such as an relationship to the organization, a cultural facilities attendance frequency, an influence of friends or family or own artistic activities. As we could see, in most cases the significance of the age, gender and education is smaller than the significance of the behavioral criteria, but in some cases also than other behavioral criteria.

The main issue is what all these findings can mean for marketing and marketing communication of different types of the cultural facilities and the arts marketing in general. In arts marketing literature the importance of segmentation by gender is often discussed because women generally tend to seek the cultural events more often than men, who are rather their accompaniment (they are therefore not often initiators; see e.g. [6,8,9]). This is the conclusion that we can find in many other segmentation studies dealing not just with the arts marketing. This fact certainly has a great importance for the selection of specific media types (see e.g. [13]) or for the formulation of specific marketing communication messages (see e.g. [7]) addressed to these two groups, one of which has a clear interest in the culture and needs more information about the date and place of cultural events, while the second one may need rather a long-term image-building communication.

The findings regarding the segmentation according to the age are significant too. Marketing literature usually points that the relationship of young people to culture and arts is quite strong, but rather in fields of the popular culture, such as popular music or film. This study shows that this target group can have an above-average interest in theaters, fine arts as well as in museums. The literature often talks about the second peak of interest in the culture occurring after the fortieth year of age. People with grown-up children start attending cultural events again, this time more often in the fields of theater, dance, fine arts or classical music. These conclusions were confirmed only partially in this study. It seems that the interest in the culture is rather stagnant in this age group, however, it is still above-average. The overall interest in culture decreases after the sixtieth year of age, the most probably in the context of a retirement and reduced financial possibilities of this group. On the other hand, there are many people with a strong interest in culture in this age group, many of whom began to be interested in culture after their retirement. Nevertheless, the segmentation according to the age offers many marketing opportunities for targeting mainly due to media preferences of the particular age groups.

Finally, the segmentation according to education provides clear conclusions about the greater interest in the culture of people with the higher education. However, the marketing usability of this fact is quite low. It could be more appropriate

to consider other segmentation possibilities related to the education, for example the segmentation according to the occupation. People with a certain level of education typically do certain jobs connected with specialized media through which it is possible to communicate appropriate marketing messages.

However, the other possibilities of influencing related to age and gender segmentation should not be omitted, particularly the influence of family and social groups. There is an evidence that the cultural events attendance is influenced by the childhood attendance together with parents or other relatives and by the fact whether the friends or acquaintances also attend the cultural events nowadays and talk about it together (see [1,3]).

It is certainly possible to create cultural products for families with children. In terms of public relations it is possible to attempt to build an image of the "family theater" or other cultural organization that is welcoming to all generations and that is perceived by the community members as a "neighbor" who has a relationship with his/her parents and grandparents, and therefore, it can have the same relationship with him/her and his/her children. In this case it is certainly a long-term reputation building which should anyway become a part of the social responsibility of non-commercial cultural institutions (see e.g. [10]). It is of course an activity that is even more important in today's rather short time-oriented times.

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# Integer Programming Model for Marketing Programmes Optimization

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**Abstract** – The increased extent of marketing in companies dictates the need to apply optimisation methods to ground planned marketing decisions. The research made is the basis for the suggested method of integer programming to be applied for optimisation of marketing programmes. The model of planning marketing activities is prepared on this basis. The possibilities for adaptation of parameters are provided in view of the practical situations characteristic of companies and markets. The practical acceptability of the suggested model was tested by experimental modelling on the basis of one of commercial banks.

**Keywords** – marketing programme, marketing efficiency, return on marketing, optimization, integer programming, correlation-regression analysis.

## I. INTRODUCTION

The markets of the beginning of XXI century are characterised by the rapidly growing competition and the changing factors of a competitive advantage. As the possibilities to compete with technologic advantages decreased to the melting-pot, more efforts are made to search for management reserves for this purpose. This explains the increasing focus of business on marketing. The research confirms that the relative share of financial resources allocated for this purpose in the business expenses is rapidly increasing [1].

The relatively high extent of financial resources allocated for marketing makes the entrepreneurs to look for ways to use these resources more efficiently. For this purpose larger companies more and more often prepare and implement specialised and complex marketing programmes, carry out the costs-benefits analysis of the marketing programmes to be implemented, and organise researches on customer behaviour [2]. The entrepreneurs show an increasing interest in the possibilities to apply optimisation methods for marketing decisions, especially for forming marketing programmes.

The academics also responds to the situations in practice. Within the recent decade, various international scientific journals and conferences had more discussions on application of quantitative methods, including optimisation, to ground marketing decisions. Some of the researches provide a completed model intended for optimisation of a company's marketing programme or of some of its components. The practical suitability of some of the suggested models which

had the same purpose were tested by empirical research. Following the results thereof, the authors of the research provide preliminary estimates of marketing decisions optimisation with rather significant positive effect on companies' operating results [3, 4, 5].

Despite a certain methodical potential of the optimisation of marketing decisions developed by researches, rather convincing benefit of decisions optimisation, and even the interest from the entrepreneurs, application of optimisation methods for marketing programmes is still a challenge to companies [4, 5, 6, 7, 8, 9]. This collision led to the choice of the subject of our research, i.e. optimisation of marketing programmes. The goal of the research is to prepare the optimisation model of marketing programmes and to test its practical suitability.

The methods of search for analogies, logical abstraction, integer programming, and correlation-regression analysis were used in the research as well as heuristic procedures, and also a series of experiments were carried out.

## II. COMPOSITION OF THE MARKETING PROGRAMME OPTIMISATION MODEL

One of the main preconditions for successful modelling of socio-economic phenomena is proper description of the investigated subject. It is therefore of particular importance to distinguish the most significant factors for the problem to be solved and to specify them as adequately as possible. The set of such factors established for the investigated marketing programmes optimisation is the following:

- variety of marketing activities in terms of nature, content and application, their dynamics, application of several tens of activities in parallel, uneven intensiveness of application;
- variety of customers by different characteristics (social, economic, status, loyalty, behaviour, geographical, etc.), their abundance and dynamics;
- the need to work with data of various aggregation levels to perform different managing functions dictated by the abundance of marketing activities and customers which presupposes the necessity of the model flexibility in respect of these factors;

- restricted marketing budget usually related to the planning periods characteristic of the company's practice;
- the company's interest to prepare and implement the planned marketing decisions most beneficial thereto by traditionally expressing the usefulness in the categories of profit and expenditures;
- acceptability of preparation of the planned marketing decisions in terms of labour costs, obtaining the required data and staff qualification.

Besides the requirements dictated by the practical situation, which is the basis for developing of the model, another important circumstance is the existing methodical assumptions. The latter, based on the results of the analysis carried out [1], in respect of the analysed subject are as follows:

- in various countries of the world the suitability of the integer programming method was applied to research in this area and tested by at least several empiric researches to solve problems of this type [8, 10, 11, 12];
- the prevailing opinion of the researchers grounded by the results of a number of empiric researches in relation to efficiency dependancies of nonlinear marketing activities [7, 13, 14, 15];
- the distinction of return on marketing in terms of scale and dependence form by marketing activities and customers, dependence of the return parameters on the customer characteristics [16];
- restriction in space in relation to searching for the problem solutions, which was tested by modelling experiments and proved efficient, through the parameters of financial resources in view of the marketing budget [7, 9, 17].

Thus, in the context of the above indicated practical requirements and methodic assumptions, an optimal marketing programme is drawn up on a company level, although in separate cases where a company is divided into more independent business units by specific activities, drawing up of marketing programmes for such units separately might also be advisable.

The set of marketing activities is basically varying, however a finite set thereof is drawn up for each case of the programme ( $i=1, 2, \dots, m$ ). The marketing activities comprising the set may be of various levels of specification but they should not include any of those which could be treated as partially overlapping sets.

The set of customers for each case of drawing up an optimal programme is also finite ( $j=1, 2, \dots, n$ ) enabling for two categories of elements: active (actual customers) and passive (potential customers). The customers may be of various aggregation levels – from individual customers to amalgamated segments thereof. The elements in the set of

customers are also subject to restriction due to the partially overlapping sets.

The above indicated specifications of the basic conditions for drawing up a programme determine the requirements for other elements of the optimisation model. This is, first of all, related to the parameters of evaluating the efficiency of the decisions. They must correlate with the set of marketing activities and with the set of customers, i.e. they must contain attributes of the marketing activities and customers ( $C_{ij}$  matrix). In terms of content, among the possible alternatives to evaluate the efficiency the priority is given to the profit ratio as the typical indicator to evaluate the economic activity of a company and most corresponding to the business practical interests. This parameter is subject to a specific requirement resulting from two other interrelated factors: the selected integer programming method and the defined nonlinear dependancies of return on marketing activities. Due to this specification the profit generated by each of the marketing activities ( $C_{ij}$  matrix elements) must be calculated in absolute values.

The space of search for answers to the programme optimisation together with the aforementioned finite set of the marketing activities ( $i=1, 2, \dots, m$ ) and the finite set of customers ( $j=1, 2, \dots, n$ ) is restricted by marketing budget amount within the planned period ( $P$ ). This restriction is related to possible answers through the marketing activities costs ratio ( $S_i$  vector). To take proper account of this restriction, there must be compliance between the cost items of marketing activities and the expenses items of marketing budget (e.g. in case the marketing budget is drawn exceptionally in view of the direct expenses, then only direct costs of marketing activities are calculated respectively).

The model for drawing up an optimal marketing programme discussed above has the following formalised expression:

$$\text{Target function} \quad \max \sum_i \sum_j \sum_e C_{ije} z_{ie}, \quad (1)$$

$$\text{Restrictions} \quad \max \sum_i \sum_e S_{ie} z_{ie} \leq P, \quad (2)$$

$$z_{ie} = \{0, 1\}, \quad \sum_e z_{ie} = 1, \quad (3)$$

$$i=1, 2, \dots, m, \quad j=1, 2, \dots, n, \quad (4)$$

where:  $C$  – return on marketing activities;  $S$  – costs of marketing activities;  $P$  – marketing budget;  $i$  – marketing activities index;  $j$  – customer index;  $z$  – dichotomous variables;  $e$  – variable attribute.

Adapting of the model (1–4) to various cases relating to a company and market conditions is possible in respect of the following model elements:

- marketing activities, both their number and specification level;
- customers, both their number and aggregation level;
- content of the target function – return on marketing may be expressed in various ratios;
- content of costs of marketing activities – various combinations of the costs items are possible.

When adapting the model it must be remembered that each case of the model implementation (application) requires the compatibility among the model elements. Otherwise, the business logics of the description of the situation will be distorted resulting in a distorted optimisation result.

In discussing the model elements, it is worth mentioning one more circumstance. When designing the model it was assumed that companies apply rational marketing activities, i.e. the ones with the content and parameters are pre-motivated in a certain way. These ways may vary from practical experience to application of optimisation methods, however this is a separate task which is not subject of our research.

In view of the initial information required for optimisation of the marketing programme by applying the suggested model, establishing the return on marketing activities is of utmost concern. The problem is that in common practice of companies this ratio is not calculated in the sections provided for by the suggested model. The situation is complicated also by the fact that the common accounting documents used by companies do not contain data that could be used to directly calculate the return on marketing activities. This situation determined our decision to supplement the analysed optimisation model with the component of defining the return on marketing activities, thus making realistic assumptions for applying the suggested model.

### III. ESTIMATING THE RETURN ON MARKETING ACTIVITIES

The parameter of return on marketing activities integrated in the target function (1) of the submitted optimisation model determines the need to have respective initial information to apply the model, i.e. the ratios of return on marketing activities. The conditions dictated by the model (1–4) for these ratios as initial data of marketing programme optimisation may be formulated as follows: the return must be calculated in the marketing activities section and in the customer section and expressed in absolute values. In other words, the matrix of return on marketing activities ( $C_{ij}$ ) with potential application within the planned period for possible customers is needed.

Our investigation of the methodical potential of the analysed area [1] allowed groping after the prevailing trends of the researches and the applied principal decisions which may be treated as methodical assumptions for the problem solving. These are the following:

- 1) return on marketing is expressed in various ratios, of which more popular are sales revenues [14, 17, 18], net return on marketing [15], profit generated by the

company from customers [19], customer attracting benefit [13], customer life-cycle value [13];

- 2) multiple regression analysis is used in most cases as the basic method to define the return on marketing activities [15, 17, 18, 19, 20], together applying the paired correlation analysis method and factor analysis method, as auxiliary methods, the application of specific varieties of regression analysis such as logistic [14, 19, 20], Probit [13], Tobit [13], double logarithm [3, 17] proved to be efficient;
- 3) in most cases the research begins from the dependences of linear form and only if no acceptable results are obtained, decisions are searched for by applying more complex (nonlinear) forms of dependancies [7, 13, 14, 15, 17], most frequently analysed nonlinear forms are the following: polynomials of second and third degree, radical, logarithm, as well as exponential dependancies;
- 4) the methods of expression applied to the prevailing independent variable in the research, i.e. to marketing activities, are the costs of these activities [7, 14, 17, 18] and estimates of the respondents on the impact of marketing activities on customers [20, 21, 22], characteristics of technical and economic nature applied to express other market factors analysed in the researches as independent variables [13, 15, 17, 19].

The investigation of defining return on marketing performed by various researchers [16] revealed that the factors analysed in this context are related with the base market elements, in most cases with marketing activities, customers, manufacturers (service providers), and competitors. Thereby drawing the initial list of factors was based on the works carried out by various researches by testing the suitability of each factor by two criteria: frequency of application in empiric research and the values of their quantitative estimates for impact on return. After this assessment the following factors remained on the list: marketing activities, products held by the customer, the customer's product portfolio, the customer's turnover via bank accounts, marketing intensiveness.

The impact of the selected factors on return on marketing was estimated quantitatively by carrying out a paired correlation analysis [16]. The factors as independent variables in the set drawn for the purpose in view of the formal requirements set by the method of correlation-regression analysis were specified as follows: marketing activities ( $x_1$ ) expressed in costs, products held by the customer ( $x_2$ ) – number (units), the customer's product portfolio ( $x_3$ ) – value, the customer's turnover via bank accounts ( $x_4$ ) – turnover within a period, marketing intensiveness ( $x_5$ ) – marketing costs within a period of time. The ratio of the company's profit generated from customers by applying marketing activities was chosen to express the dependent variable, i.e. return on marketing.

The obtained results of the paired correlation analysis [16] gave quantitative estimates based answers to both essential questions in this stage of the research. One of them, i.e. the impact of each of the analysed factors on the return on marketing ratio, is rather significant. The other, i.e. quantitative estimates of the significance of interaction, shows that the double logarithm dependence is the most suitable (to all factors).

Given the multicollinearity of the independent variables stated by the authors of the investigated researches in this field [14, 17, 21, 22], the data taken in the previous stage of the research used to test the intercorrelation of the independent variables. The intercorrelation of the independent variables was tested by using the best defined forms of dependence among the respective variables (double logarithm). By applying R programmes package [23] the results of the analysis carried out by the method of paired correlation [16] revealed the significance of correlation of the following independent variables:  $x_2$ ,  $x_3$  and  $x_4$  (the interval of correlation coefficient values 0.682–0.763),  $x_2$  and  $x_4$  with  $x_5$  (the correlation coefficient values 0.564 and 0.504).

In solving the multicollinearity problem, to be more specific, when deciding as to which factors should be eliminated, we additionally took into account the significance of factors defined during the paired correlation analysis [16]. Thereby,  $x_2$  and  $x_4$  factors were eliminated from further research while  $x_1$ ,  $x_3$  and  $x_5$  factors remained as the combination of independent variables. The following polynomial dependence was obtained:

$$\ln C_{ij} = f(\ln x_1, \ln x_3, \ln x_5) + \varepsilon. \quad (5)$$

When performing the polynomial regression analysis under this type of dependence (5) with various samples of statistical data a considerable dispersion of significance of the combination of dependent and independent variables and the estimates of the equation reliability was obtained [16]. This determined our decision regarding the necessity for permanent actualization of such dependancies.

#### IV. EMPIRIC TESTING OF THE MODEL

The practical acceptance of the marketing programmes optimisation model was tested by the experimental modelling under the example of  $Z^*$  bank. To have the possibility to evaluate the modelling results by the benchmarking method, the period of 2012 was selected whereof preliminary operating results were obtained before the experiment. The horizontal analysis of the obtained data showed that the internal specialisation of the bank's business and the managing organisational structure corresponding to it allow for a presumption of a rather natural distinguishing among several business segments of the bank. This allowed narrowing the

area of the experiment by restricting to the segment of small and medium-sized enterprises and thereby reducing the time costs of the experiment.

Based on the obtained accounting data, the preliminary overall marketing ratios of the SME segment in  $Z$  bank in 2012 are as follows:

- 68 marketing activities were applied within the range of costs from 42 to 1680 thousand EUR;
- approximately 40,000 customers (individual customer level) were addressed;
- relative return on marketing (straight profit per unit of marketing costs) – 0.64.

The experiment was carried out in the following three stages:

- 1) the received information was transformed into the sample of initial data dictated by the optimisation model (1–4);
- 2) the dependence of return on marketing activities (5) was actualized and ratios of return are calculated;
- 3) the variant of optimal marketing programme was modelled.

1. The obtained information on the SME segment was reorganised in the following way when preparing the initial data for experimental modelling:

- a two-level scheme was applied to divide the customers by segments, first of all, by applying a combination of three criteria (the customer's annual turnover via bank accounts, number of staff of the customer (company), profit amount generated by the bank from the customer) the customers were divided into three segments (A, B, C) where the customers in each of the segments are differentiated in the second step following the criterion of the their turnover amount via the bank accounts, thereby 10 customer segments of lower level are obtained (A1, A2, A3, B1, B2, B3, C1, C2, C3, C4);
- 68 marketing activities in view of their common content were transformed into 20 positions;
- the factual marketing costs of 2012 were transformed into the restricted marketing budget in the experimental modelling;
- the costs of marketing activities ( $S_{ij}$ ) were calculated following our algorithm [16].

2. To obtain the equation required for calculation of the return on marketing activities, the regression analysis was performed in the second stage by dependence (5). The results of this analysis (Table 1) leads to two essential conclusions: the value of multiple regression determination coefficient ( $R^2$ ) indicates a significant connection between the dependent variable ( $C_{ij}$ ) and the collection of independent variables (

\* The bank considers some of the submitted data as commercial data, therefore the bank name is changed into a letter symbol in the paper

$x_1, x_3, x_5$ ); positive values of validation of the hypothesis relating to the reliability of the obtained equation are to be considered the methodical assumption for practical application of such equation.

TABLE I. THE RESULTS OF MULTIPLE REGRESSION ANALYSIS

Criteria	Values		
Determination coefficient	0.601		
Adjusted determination coefficient	0.591		
Standard error	1.607		
F value	29.415		
F significance	~0		
Regression equation coefficients		p value	Mean
Intercept	-12.172**	0.003	
$\ln x_1$ coefficient	0.545**	~0	10.338
$\ln x_3$ coefficient	0.367**	0.004	11.531
$\ln x_5$ coefficient	0.656*	0.043	17.792
$\ln C_{ij}$			14.801

\*  $p < 0.05$ ;

\*\*  $p < 0.01$ .

Based on the results of the analysis (Table 1) the following equation of polynomial dependence was formed to calculate the return on marketing activities:

$$\ln C_{ij} = -12.172 + 0.545 \ln x_1 + 0.367 \ln x_3 + 0.656 \ln x_5. \quad (6)$$

The equation (6) was used to calculate the return ratios for each marketing activity projected in the first stage. They were calculated in the section of customer segments (A1, A2, A3, B1, B2, B3, C1, C2, C3, C4).

3. By using the data prepared in the first and second stages, the package of R programmes [23] was applied to form the optimal marketing programme for the SME segment following the prepared integer programming (1–4) model. The obtained overall parameters of the experimental variant of the marketing programme are shown in Table 2. And also, for comparison purposes, the bank's preliminary factual marketing ratios of the SME segment 2012 are submitted there as well.

The results of the experimental modelling are optimistic. When comparing the obtained optimal marketing programme variant to the traditional one the advantage of the former is obvious by the efficiency criterion (Table 2) – the overall return on marketing in the SME segment is higher by 15 percentage points, and, depending on the segment (A, B, C), varies from 7 to 25 percentage points. Besides, the reserves for increasing the return on marketing revealed in the section of customers in lower levels (A1, A2, ..., C4) vary within even a wider range, i.e. from 3 to 39 percentage points.

TABLE II. SYNTHESIS OF THE OPTIMAL MARKETING PROGRAM INDICATORS

Ratios	2012 year		
	Optimal variant	Factual (preliminary)	Difference
Number of marketing activities, of which by segments:	16	20	-4
A	14	20	-6
B	16	20	-4
C	13	20	-7
Relative return on marketing, overall, by segments:	0.79	0.64	+0.15
A	1.11	0.86	+0.25
B	0.54	0.46	+0.08
C	0.36	0.29	+0.07

Anyway, despite the revealed reserves for increasing the marketing efficiency, which are relatively considerable, and the tested practical suitability of the prepared model, we believe it is advisable to broaden the boundaries of the experiment covering more companies of a higher business variety in order to provide more grounded recommendations relating to the application of the model.

## V. CONCLUSIONS

The investigation of the problem of increasing marketing efficiency lead to the conclusion that the highest reserves in this field are in the marketing planning, and the most suitable way to use them is optimisation of marketing programmes.

The integer programming method was applied to prepare the marketing programmes optimisation model. The possibility of the parameter adaptation thereof was provided in view of the practical demands in the following aspects: the criterion of decisions efficiency (target function content), the number and level of marketing activities, number of customers and level of their segmentation, actualization of the model parameters to define return on marketing activities, costs of marketing activities and composition of marketing budget.

The practical applicability of the suggested optimisation model for marketing programmes was tested by experimental modelling. The results of the experimental modelling allowed establishing that the model is suitable in terms of the efficiency of planned decisions (marketing programmes) and of the time costs required to prepare these decisions.

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# Key Factors for Successful B-to-B Branding

## Required Steps, Responsibilities and Typical Pitfalls

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**Abstract**—Strong brand names are an important success factor in all business models. This fact is obvious in business to customer market but it is often not so visible in business to business (also known as B2B) environments. Brands in this market are often less successful than they could be. This document gives an overview of the required steps to set up, place and maintain a brand successfully and also shows which typical mistakes should be avoided.

**Keywords**—B2B Brand; Business to Business Brand; Brand Strategy; Brand Placement; Brand Controlling;

### I. INTRODUCTION

Undoubtedly a strong brand name is an important success factor in selling goods or services to consumers. But also in business to business environments the effects of a strong brand name cannot be neglected. Therefore firms and researchers are investigating branding concepts in the B2B environment, focusing on the question how a strong B2B brand can be established and maintained. This summary briefly shows why strong brands are important in B2B environment, which special characteristics have to be considered there and how a brand can be managed successfully under this circumstances.

### II. IMPACT AND MEANING OF BRANDS IN BUSINESS-TO-BUSINESS ENVIRONMENTS

When discussing the meaning and importance of brands most people were focussing on consumer markets during the past decades. Just recently in the last few years the focus was shifted more towards brands and their equity in the business-to-business (B2B) field. The main reason for shifting the focus to this area is that suppliers find themselves more and more in a commodity trap. Although the complexity of products and services is increasing due to systems solutions and reduced manufacturing depth of big OEMs the differences of the offered goods and services are diminishing more and more. Globalisation of markets and virtual markets reduce the impact of vicinity between customer and supplier. Higher job fluctuation on both sides and an increasing amount of non-personal communication reduces the meaning of personal relationships more and more. With almost identical goods and services and diminishing significance of closeness and personal relations the suppliers need to find different approaches to become silhouetted against their competitors.

Despite of the increased activities in science and a higher attention in the companies many problems can be found in the practical set up and maintenance of brands in the B2B area.

The major flaws can be found in the brand controlling and in a continuous, generally binding brand placement but also in the involvement and participation of the company employees. These shortfalls can be avoided if the major success elements shown in this article receive a sufficient amount attention. The major success elements are different in the B2B field and the distinctive feature of this environment need to be considered carefully. Maintaining the Integrity of the Specifications

### III. PECULIARITIES IN B2B ENVIRONMENTS

Business-to-business environments are characterized by some special peculiarities which result from the market processes, the prospective customer behavior and the offered goods and services [1]. While the brand policies are related to homogenous offerings in consumer environments they need to be adjusted to the heterogeneous goods and services of the B2B field. Goods and services in the B2B context include mass products as well as very individual solutions, low priced but also very exclusive services, easy to understand standard offerings and on the other hand highly complex products that need a lot of explanations.

In B2B environments the prospective customer is always an organisation as opposed to consumer markets. Some examples for such organisations are public or private owned companies, governmental organisations and non-commercial organisations like the *Red Cross*. Purchasing processes within such organisations are much more formal, much more rational and the purchasing decisions are very often made collectively, not by a single individual. Depending on the type of organisation and their field of operation the significance of these mannerisms is largely different. Selling a simple standard product like a screw is very different when the customer is a mid size tool maker in one case or the NASA in the other case.

Another difference can often be the low number of prospective customers in the B2B environment and the resulting better market transparency. On the other hand B2B demands are mostly derivative. The demands are indirectly caused by demands in the consumer markets. Often the market processes are based on long term business relationships and individual market contacts. Because of these peculiarities the brand policies cannot just be inherited from the approaches in the consumer market.

### IV. MANAGING BUSINESS-TO-BUSINESS BRANDS

To further explain the brand management the most important elements are shown in a sequential order. This is a handy

simplification for easier understanding but we have to keep in mind that in reality there are of course many dependencies between the different elements.

#### A. Brand Relevance Analysis

Setting up and managing a brand is a complex and costly task. Therefore it is mandatory to check upfront how relevant a brand name is for the own business. Empirical studies prove the general relevance of a brand name. They are available from the supplier's point of view and from the customer perspective. A good overview is given in [2] and [3]. There are also recommendations for brand relevance analysis approaches for specific industries and single firms available. In industries, where other established brands are already present, especially the conjoint method is well suited to analyse the relevance of a brand. Good examples can be found in [4]. The potential brand relevance from the supplier's perspective can also be roughly estimated using check lists as proposed by Kemper [1]. He proposes a process in two steps. In the first step it is checked whether a brand concept is possible at all. If it is possible then it is checked in the second step if it is economically reasonable to set up a brand.

#### B. Brand Concept

In cases where the brand relevance analysis shows that a brand should be placed, a closed brand concept needs to be set up. This concept mainly comprises of a brand strategy and a brand placement.

#### C. Brand Placement

Common characteristics of a good brand placement include relevance, concentration, differentiation, sustainability, flexibility, continuity and credibility. A typical weakness in B2B brand placement is that the placement arguments are focused on functional aspects like price or technical product advantages [5]. Another huge problem is that very often competitors are using identical and spiritless arguments like reliability, quality, tradition, innovation which cannot provide real differentiation. Most companies also tend to use too many placement arguments. Using many different and unintelligent placement arguments does not make a sharp profile and does not support the communication about the brand. To avoid the major pitfalls requires a lot of discipline and the use of a brand model can be very helpful [6]. Figure 1 shows an example of such a brand model. The innermost level is the brand core. This core defines the base of the brand in a short and sharp form. The definition is based upon the history, skills and expertise of the company. The brand core should combine a functional and an emotional statement with a definition of the products and services of the company [7]. If a company only carries only one significant brand, this brand core often is very similar to the definition of the company mission.

The second level represents the brand focus. This includes the strategic target customer description, the price level and the placement compared to the competitors.

The third level describes the tangible brand assets. This includes the so-called points of parity which are also fulfilled by the competitors but also the points of difference which can be split into established and communicative assets. While the established assets are already recognised and linked to the

brand by the prospective customers the communicative assets are not linked to the brand in the minds of the customers and require future communication effort.

The total number of brand assets shall be kept as low as possible in order to become accepted internally and also externally. A good practical approach to fix the brand placement is to make a market and competition analyses followed by management workshops. During the workshops one out of different alternatives is nominated and written down in a way that makes it authoritative and controllable.

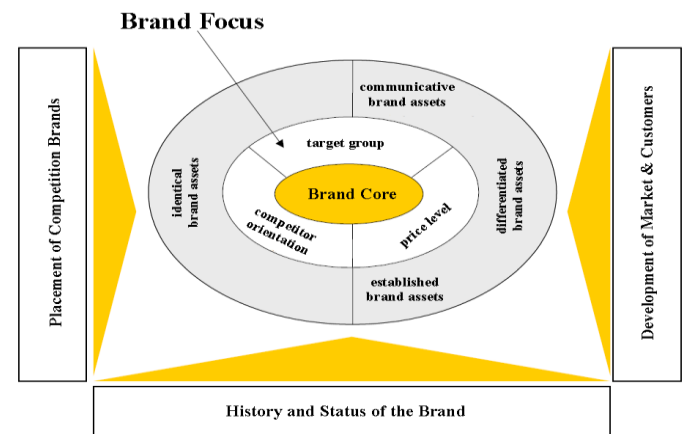


Figure 1.

#### D. Brand Strategy

The brand strategy links the brand to the products or services. We need to distinguish between corporate brands and product brands. While a product brand is focused to target the sales market the corporate brand is also targeted towards employees, investors and other groups of interest. In the product strategy it needs to be defined which products or services are offered (width of the brand), how many brands are place in an area (depth of the brand) and how far the brand shall reach in the market (coverage).

Regarding the width of the brand three categories can be defined. There are roof or program brands, group or family brands and single or mono brands. Good examples for roof brands are Siemens, ABB, GE or LG. Those Brands reflect the company instead of a single product or product group. They stand for a big variety of products in different fields. Roof brands make it much easier to place new products or services and these new products or services can participate from the well known brand immediately. The major problem with roof brands often is that the brand placement is much too generic and interchangeable because it has to fit so many different products and services. Nevertheless roof brands dominate the B2B markets [9], [10]. On the other end of the scale a single product brand can position a product or service very precisely and sharp. These focused brands can address specific target customers much more precisely and effectively and allows highlighting the innovation in the new product much better. The major back draw of a sharp and narrow product brand is that the brand owner can not easily take advantage of his famous brand for new products or services. A good example is the brand "Tempo" who are famous in Germany for there

tissue handkerchiefs. Virtually nobody knows the brand owner SCA from Sweden who bought the brand from Procter & Gamble. The strong brand did not also help much to make other tissue products a success. The brand “Tempo” is linked to handkerchiefs and the consumers do not favour it regarding toilet paper or cosmetic tissues.

The depth of a brand describes the number of brands in a certain range of services or products. Either a single or multiple brands can be chosen. A multiple brand strategy means that several different brands are established, that cover basically the same products or services but are different in some of their significant features and are recognized as different products by the market participants. A very clear example is the detergent manufacturer Henkel with their independent detergent brands Spee, Persil, Weißer Riese, Terra, Perwoll and Fewa. The consumers are typically not aware that all those brands belong to the same manufacturer and do not compete with each other.

Multiple brand strategies are very complex and typically expensive. They are not typical for the B2B market but there are some exceptions such as AGCO, who use quite a few different brand names in the farming machine market, such as Fendt, Massey Ferguson, Valtra, Fella, Laverda, Willmar and Challenger to name only a couple.

The coverage or range of a brand is relevant if products or services are offered in multiple level markets such as with chemical products or automotive components. A brand can accompany the product through all processing steps to the end customer [11]. Good examples for this kind of “Ingredient branding” are Shimano and Gore-Tex. The end customer prefers to buy a product, because it contains components from these brands and therefore the brand owner’s customer prefers to buy the branded components over other alternatives.

While accompanying brands are kept through all stages of the production of the end product, manufacturing brands do not cover all levels of the market system but typically end at the OEM. Typical examples include automotive component suppliers like GETRAG or Continental. These brands are well known at the OEM level but fairly unknown by the end users. While bicycle makers willingly put a Shimano logo in their advertising, no car manufacturer will put a GETRAG logo anywhere. Not to be known by the end customer has the benefit of protecting the supplier from bad reputation in case of problems by a certain extent. The end customer will blame the OEM, not the component supplier. On the other hand, the end customers will not ask for specific components if he does not know the brand.

Especially in the automotive supplier market there are discussions whether ingredient branding is possible [12] but OEMs today are not willing to support it.

#### E. Systematic Design of Brand Perception

Based on the brand concept the desired contact points between the brand and the target customers need to be defined, designed and transported into the market. The major instruments during that task are branding and communication. Branding includes all means of highlighting the product or service. Important branding elements in the B2B field are [13]:

- Name (e.g. Siemens)
- Logo, Symbol, Colours (e.g. Typical Kärcher Yellow)
- Slogan (e.g. Metabo: Work. Don’t play )
- Employee dress code (e.g. Brown UPS dress )
- Product Design (e.g. Still forklifts )

A good branding provides originality and independency, is consistent and easy to remember, supports the brand placement and can be transferred to other countries or products [14]. Additionally the branding shall link all single elements together [15].

Brands are mainly driven by external communication which should be consistently on the branding concept as a backbone. The significance of communication channels is different in B2B environments than in B2C situations. While TV spots for example can be used very effectively to place a B2C brand they are not popular in B2B environments. Nevertheless there is some movement in that area also. A good example is EVONIK who actually uses TV spots to improve their degree of brand awareness because they are pretty unknown compared to BASF and other competitors in the chemical industry. ThyssenKrupp also used some TV spots, trying to get rid of their steel maker image and place themselves into the light of a high tech company but with little success.

To set up a clear communication concept it is helpful to identify the different possible points and methods of contact between the brand and the prospective customers. Two major approaches are the phase oriented *Customer Buying Cycle* and the organisation structure based *Buying Center* method [16].

Phase oriented approaches help to identify the different channels of contact in the certain phases of a B2B buying and using cycle. They also help to weight the meaning of each channel in the different phases.

Organisation structure approaches help to identify the decision makers in the customer’s organisation and also helps to find their communication desires, so that they can be targeted more effectively.

Once the different means of communication are identified and weighted, a structured communication concept can be set up, considering the already mentioned integrative branding approach, differentiation against competitors and a good fit to the brand placement. The integrative communication concept is based on the widely accepted and proven assumption that the efficiency of communication depends upon the quality of matching the individual instruments [17].

The bare minimum matching requirements are a formal match, based on corporate design guide lines and a content match, so that different media always broadcast the same message. The differentiation compared to competitors and other companies in a similar business environment is an important success factor. Without differentiation, the messages that are intended to be transferred to the audience are easily lost in ambient noise of the multitude of other similar messages. The importance of differentiation is often neglected and this often is the root cause for mediocre success. Figure 2 shows a

selection of different advertisements form the industry magazine *Maschinen Markt* for metal components. This collection is a perfect example of completely missing differentiation. Design and content are absolutely interchangeable. These ads are not getting any of the reader's attention and even if they would, no message is transported to the reader. There is not a single element that stays in the mind of the reader.



Figure 2: Uniform Advertisements without Differentiation

### F. Promoting the Brand Internally

Especially in the B2B environments the market success of a brand greatly depends upon the brand acceptance of the brand owner's employees and their behaviour in representing the brand to the world. The roles of managers and non-managing employees are different and can be clearly distinguished.

Managers have many important functions and liabilities during the implementation and the management of a brand strategy [18] and are responsible for the strength of a brand at first. The managers often have the best market knowledge and know much about the strengths and weaknesses of the company. Knowledge about the identity of a brand is very important while setting up the brand placement.

After the brand has been established, they are the guardians for the brand who protect the brand from being changed unintentionally over time. But they are also the change agents who guide the brand through intentional changes to keep it modern and in line with the market development. Of course they always consider the core values of the brand and keep them and they actively communicate the brand contents inside by the use of corporate identity methods and outside the company in speeches or press conferences. The first and most important task for the marketing is to convince or "infect" the management with the ideas behind and the contents of the brand.

Also the non-managing employees of the company affect the appearance of the brand at the target audience by verbal and non-verbal communication. The more often and the more intense an employee's contact to the target customers is, the higher the employee's impact is on the brand image. In B2B oriented companies the sales people have the biggest impact [19]. In order to make the employees promote the brand actively they need to get all required information and they must

identify themselves with the brand. Internal promotion of the brand is as important as external promotion and there are some proposed models available for this task [20]. Unfortunately the strong requirement for internal promotion is neglected in many cases. This causes the branding to be rather ineffective.

### G. Supervising the Brand

The last step in implementing a new brand is to set up a controlling and supervision process for the brand success and brand placement.

There is a huge variety of instruments available to measure and control the brand and many of them are specialised for B2B environments [21] but here are also some basic requirements that are common for all methods.

First of all it is mandatory that a brand controlling shall not be limited to results like revenue, price and current brand strength. With such limitations only a short term picture is possible and threads to the brand strength cannot be identified. The controlling should therefore also include image attributes, communication and internal strength of the brand. If a brand is weak internally, the external strength is very likely to erode over time. Only a broad controlling approach can help to identify weaknesses and shows opportunities for improvement.

Second, the controlling shall use a standardised, systematic approach. As in many areas it is barely possible to earn much knowledge from a one time snapshot. Only the comparison of the current status to previous results can show the development and the true value of the brand. Therefore the results should be comparable and the assessment methods should not be changed remarkably. It is also helpful to monitor not only the own brand but also some important competing brands in order to get a relative measurement of the brand development in the market.

Third request to a controlling system is that it needs to be reasonably simple. The relevant employees have to be able to understand and interpret the results and of course the timely and financial efforts for the controlling process must be fairly low. Only simple controlling instruments will be used on a regular basis and will survive over time. Unfortunately very often the responsible managers are looking for a perfect solution that gives them a huge number of results but as in many other cases the key to success in brand controlling is simplicity.

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# Western Switzerland Ski Resorts Marketing Intelligence Case Study

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**Abstract**—This paper presents the results of a longitudinal study of marketing intelligence aimed at tourism stakeholders in the French speaking part of Switzerland. Based on a benchmarking study for the period of 2012-2013, this research aims to provide avenues for development of mobile applications for ski resorts with the goal of retaining customers and building customer loyalty. The first comparison group consisted of 52 regional destinations. The second group was composed of a single foreign operator with transferrable elements. The results of the study provide two main contributions: the identification of an innovative technology in the context of regional tourist attractions as well as a practical illustration of a method of marketing intelligence that can be reproduced in other situations. All the information used in this study comes from open and free sources available from the internet and smartphones.

**Keywords :** *marketing, marketing intelligence, benchmarking, mobile applications, Swiss French, ski resort destinations*

## I. INTRODUCTION

In order to raise the level of competitiveness of the ski resorts in the French speaking part of Switzerland (Western Switzerland), our study presents a case of marketing intelligence concerning the use of mobile applications with the goal of retaining customers and building customer loyalty. This longitudinal study was conducted in order to present the evolution between the winter seasons of 2011-2012 and 2012-2013.

Marketing intelligence consists of acquiring and using information about events, trends and relationships in the external environment of an organization. It helps management gain the knowledge necessary to plan future courses of action. [1]

The results of this study (Marketing Intelligence) are intended primarily for Directors of Communication working in tourist destinations in Western Switzerland as well as entrepreneurs with a capacity to adapt to new business opportunities. [2]

The methodological contribution lies in the adaptation of a strategic business benchmarking method to tourism marketing on a regional scale. We will present our research objectives in addition to the methodology used before presenting the main findings of this research. In conclusion, we will present the limitations of this study and propose possibilities for future research.

## II. STATE OF THE ART

Our approach consists of two dimensions: comparative analyses of ski resorts and comparative analyses of mobile applications. Previous studies have been made in ski resorts' benchmarking [3] aiming to identify drivers of competitiveness. Other comparative analyses of ski resorts focus on marketing management practices [4], on customer satisfaction [5], on service quality [6], on tourist image [7], on hospitality elements [8] or on economics, infrastructure and frequency indicators [9]. The second dimension about the comparative analysis of mobile applications led us to identify studies about the evaluation of usability, such as [10]. However, no focused study assessing the level and the typology of purposed features of the mobile applications were identified. Moreover, our literature review was not able to highlight any previous study regarding the competitiveness of a group of resorts taken in the field of marketing intelligence.

## III. OBJECTIVES

This research is part of a marketing intelligence case study aiming to enhance the competitiveness of tourism operators in Western Switzerland. We will present a method for processing and analyzing marketing intelligence information as well as our main results.

Our study is fundamentally exploratory. Our research question is the following: are there innovative technologies that can be adopted by ski resorts in Western Switzerland?

This case focuses on a comparative analysis of the mobile applications offered by Western Switzerland ski resorts in order to propose possible developments to aid in customer retention and increase customer loyalty.

## IV. METHODOLOGY

According to the French Association for Standardization<sup>1</sup>, marketing intelligence is used to actively monitor the environment in order to anticipate changes, in an ongoing and largely repetitive way [11]. Marketing intelligence is based on a process for simplifying properties to map the main stages of the activity, the "intelligence cycle" [12].

- *Step 1:* the general direction of the monitoring activity is based on defining the organization's needs at the beginning of the cycle, and evaluating the adequacy of

<sup>1</sup> Internet access : [<http://www.afnor.org/>]

the needs according to the responses given at the end of the cycle in the feedback following the dissemination of information to the identified targets;

- *Step 2:* research and information gathering activities are based on a research plan, a predefined plan for collecting the information and the sources of relevant information;
- *Step 3:* the use of information includes verifying, processing, analyzing and synthesizing in order to convert raw data into useful knowledge;
- *Step 4:* interpreting and reporting findings to the relevant recipients, as well as storing the monitoring results, to constitute the memory of the organization.

Benchmarking is a method used in business to analyze key aspects of another entity from which lessons can be learned and implemented depending on capabilities. Benchmarking can be used for nearly anything: an advertising campaign, a product, service, practice, process, strategy so that the element can be compared with the organization conducting the comparison. [13] The main steps of benchmarking in the context of business are:

1. identifying a process that needs improvement,
2. identifying performance measures,
3. assessing the capabilities of our own organization,
4. identifying a benchmarking organization,
5. conducting research on selected organizations,
6. analyzing collected data and preparing an action plan.

As our research does not fit into the context of business, we have adapted the methodology in our case by taking the following steps:

1. identifying an innovative process,
2. assessing the capabilities of our own organization,
3. conducting research on the selected organization,
4. identifying the performance measures,
5. analyzing the collected data and preparing an action plan.

The data from the benchmarking was analyzed in terms of visual thinking [14] to promote strategic thinking and highlight the innovative nature of the organization's offers compared to the state of the local offer. Indeed, the principal of visual thinking is based on using simple methods of visualization to solve complex problems.<sup>2</sup>

Identifying the mobile applications proposed by the selected ski resorts was achieved through a review of Apple Store<sup>3</sup> platforms for iPhone apps and Google Play Store<sup>4</sup> for Android apps.

The development of the comparison grid comes from a compilation of various functions identified through all the applications tested during the period from 27 January 2012 to 10 February 2012.

To achieve the longitudinal study, we completed our first data sample with a second series of data collection conducted between 25 March 2013 and 8 May 2013. This second series of collections led to a modification of the comparison grid established during the first phase of data collection. Furthermore, in order to remove any ambiguity from certain movements identified while collecting the documented information, different interviews were conducted with the providers who developed the applications.

The results were completed by findings from observation and the analysis of supplementary documents to further enrich the conclusions and input for policy makers of the tourist destinations in the region studied.

## V. RESULTS

### A. Identifying an innovative technology

The use of gamification via mobile applications to increase customer retention and loyalty to a ski resort destination was identified as a potentially innovative technology during a conference on the themes of communication and events<sup>5</sup>.

A literature search on Google Scholar<sup>6</sup> has determined that gamification can be defined as a strategy to influence and motivate the behavior of any class of people – customers, employees, students, fans, patients, members, etc. The target can be any person that we wish to influence a repetitive, loyal and committed behavior. Experts in gamification such as Jesse Schell, professor of entertainment technology and game design at Entertainment Technology Center (ETC - Entertainment Technology Center) at Carnegie Mellon University (USA) argue that gamification "is capable of revolutionizing every aspect of our lives, from the influence of our habits, to improvements in education." [15] According to Deterning [16] [17] gamification lies in the "use of game design elements in non-play contexts". Specifically, it is rewarding certain behavior by obtaining badges and virtual points, which are rarely attached to real awards.

### B. Comparing the protagonists

This section presents the assessment steps of the capacity of the regional destination groups (2.1) and the research on the comparison organization (2.2).

#### 1. Assessment of the capacity of the regional destination groups

##### a) General situation

The group includes 52 regional resort destinations in Switzerland. 50 destinations located in the Western Switzerland and 2 German-speaking destinations located in the Valais. The selected destinations are located mainly in Valais, but also in the cantons of Vaud, Geneva, Neuchâtel and Fribourg (see detailed list in Annex 1).

<sup>2</sup> Internet access : [http://www.danroam.com/]

<sup>3</sup> Internet access : [http://store.apple.com/ch-fr]

<sup>4</sup> Internet access : [https://play.google.com/store/]

<sup>5</sup> Internet access : [http://www.europecristalfestival.com/fr]

<sup>6</sup> Internet access : [http://scholar.google.ch/]

This group is located in the Alps, which accounted for 46% of global skier visits in 2012 compared to 23% for America. [18]

For its part, the canton of Valais was composed of 48 ski resorts in 2012 for a total of 2,400 kilometers of ski slopes. According to the Observatory Valais Tourism, this canton captures nearly 30% of the Swiss ski lifts, with attendance approaching 8 to 10 million skier visits per year. [19]

Furthermore, 50% of skier visits in Switzerland were made by Swiss nationals in 2011.[19] When considering mobile solutions, it is clear that 50% of users are then likely to use foreign calling plans. Therefore, the access costs can be a barrier to the adoption of solutions offered by destinations. Solutions distributed through other channels should then be preferred including Bluetooth, RFID chips or NFC. RFID technology is used in particular by the comparison group but has, however, not been evaluated in this study.

### *b) Mobile application situation*

Here we will present the situation identified in the two survey periods: 2012 and 2013.

#### *b.1) Situation in 2012 during the first survey*

Of the 52 local destinations analyzed, only 20 of them offered a mobile app for iPhone or Android systems. Among the 50 French speaking resorts, 19 applications were identified, including 15 iPhone apps offered by 12 different destinations.

From all of the applications of the 52 locations, we selected the free applications available for the iPhone in order to analyze the features. In total 17 applications were selected: Torgon CH, Champéry AnniviersSki, Crans-Montana Crans-Montana Tourism MyCMA, Portes du Soleil, Maya-Mont-Noble, Verbier, Verbier Mobile Verbinet, Veysonnaz, Les Diablerets, Valley Joux, Villars-Gryon, Zermatt Matterhorn, Zermatt Mobile.

#### *b.2) Situation in 2013 during the second survey*

Over the period of 2012-2013, the structure of our panel changed due to:

- the disappearance of four applications: Champéry, Anniviers Ski, Verbinet and Les Diablerets;
- the appearance of 4 applications : Sierre Anniviers, Nendaz 4 Vallées, Loèche-les-Bains, Les Diablerets - MyCity.

Certain applications replaced already existing applications. This is particularly the case of:

Les Diablerets – MyCity - an application developed by the Les Diablerets Tourism office which appeared during the course of the study, and which replaced by chance the Les Diablerets application which was withdrawn from the market and was developed by the Diableret ski lifts;

- Anniviers Ski, replaced by Sierre Anniviers. The first application in 2011 regrouped the following resorts: Zinal, Grimentz, Vercorin, St. Luc and Chandolin. The new application offers information and features on Zinal, Ayer, Grimentz, St. Jean, Vercorin, St. Luc and Chandolin in addition to Vissoie and Sierre,

Salgesch and surroundings which are not ski resorts but are part of the same economic region and have unified their marketing efforts with all destinations included in this application.

Certain applications made new appearances in our study:

- Loèche-les-Bains developed a new application in July 2012, in the interval between the two tests;
- Nendaz 4 Vallées was recorded in 2012 but was not analyzed due to its non-availability during the period of our investigation.

Some applications have disappeared due to consolidation of information and functionality in other applications such as "network stations" or availability via other applications. These are:

- Champéry is part of the area of the Portes du Soleil, which has an application with functions on the network stations in the area;
- Verbinet was addressed to the resort of Verbier, which has two other applications presented in our panel.

The results of these structural changes to the mobile application offer has no impact on our basis for calculating frequency of appearance of the features because the basis used for 2013 is equivalent to that used in 2012, i.e. 17 applications.

## **2. Research on the comparison group**

### *a) General Situation*

Established in 1997, Vail Resorts is an American group owning and operating six ski resorts throughout Colorado (Vail, Beaver Cree, Breckenridge, Keystone) and the region of Lake Tahoe in California / Nevada (Heavenly, Northstar).

The group had a turnover of \$1,167 billion in 2011. Mountain destinations account for 65% of turnover, compared to housing (18%) and real estate (17%).

It should be noted that Vail Resorts own the ski lifts, buildings, luxury accommodations, ski schools and catering establishments. The group also provides procurement services and ski equipment rental [20].

During the 2010/2011 season, the American ski resorts welcomed 61 million skiers from the United States and 80 million from North America. For their part, the Vail Resorts facilities captured 11.5% of their visitors from the United States and 9% from North America. [20]

### *b) Mobile application situation*

We will present the situation identified in the two surveys periods: 2012 and 2013.

#### *b.1) Situation in 2012 during the first survey*

From the 2008-2009 winter season, the group launched the operation of the RF technology (RFID) cards for accessing the ski lifts. This technology allows access control without the skiers having to submit their pass (easy scanning process).

The EpicMix mobile application, based on RFID technology to capture user activity (elevations, slopes covered),

was introduced in six resorts in the group during the 2010-2011 season. Different versions of the application were successively introduced in December 2011 (version 2.1 in the Apple Store) and January 2012 (version 2.1.1 on the Android Market).

This particular application allows users to share their experience with friends or family members by sending data or photos on social networks. Badges and points are combined based on user activity in the destination.

### *b.2) Situation in 2013 during the second survey*

Since May 2013, Vail Resort has extended its range of ski packages in Europe through partnerships with Arlberg in Austria and Verbier in Switzerland.

The EpicPass now provides access to destinations across the group as well as a destination for our local panel. We have no information on the use of the EpicMix application in the European destinations. However, this use remains conditional on the sine qua non for the presence of RFID terminals on the slopes.

### *C. Identification of performance measures*

To evaluate the local offer, we developed a grid based on the options offered by the comparison group increased by additional functions provided by all of the applications evaluated. A total of 23 features were identified in the first survey that formed the basis of this categorization.

The subsequent grouping of functions into categories helped to highlight the different types of information available and the interactivity proposed to the user. The 2013 longitudinal study permitted the possibility to highlight three new functions, which are numbered [A-C] in the table below.

TABLE I. LIST OF SELECTED MOBILE APPLICATION FUNCTIONS

Cat.	Theme	n°	Functions
<b>Local</b>	<i>Resort</i>	1	Network station (information)
		2	Weather report
		3	Traffic info
		4	Events
		5	Services: bathrooms, restaurants, ski equipment, etc.
		A	Augmented reality panorama
		B	Commercial video clips
		C	Commercial photography
	<i>Slopes</i>	6	Slope condition
		7	Live webcams and/or regularly updated photos
		8	Map of slopes
		9	Lifts status
<b>Personal</b>	<i>GPS</i>	10	Number of lifts
		11	Altitude of user
		12	Slopes covered
	<i>Performance</i>	13	Distance from lifts
		14	Course information
		15	Elevation traveled (Vertical Feet)

<b>Social</b>	-	16	Maximum speed reached
		17	Distance traveled
		18	Professional photos
		19	Find friends
		20	Share information on Facebook/Twitter
<b>Game</b>	-	21	Share user photos to the Facebook page of the resort
		22	Badges
		23	Points

### *D. Results of the analysis of the Western Switzerland resorts' offer*

The results of the analysis of functions are presented by category: Local (1) Personal (2) Social (3) and Game (4). The results for each category are presented successively for each survey period: 2012 and 2013. A summary of results for comparing the two periods together is then presented in the form of a graph in the next section.

Generally, the functions offered through the mobile applications tested has increased by more than 30% from 99 functions in 2012 to 133 in 2013, for a total of applications tested which remained stable.

#### *1. Category "Local" functions*

The functions of the "Local" category provide information on the general environment of the user and the destination: the number of lifts and their status, map and slope status, location of services (catering, rental, etc.), weather information, etc...

This category consisted of the functions which were most often found in mobile applications of local destinations examined in 2012, thus 76 of the 99 total functions identified. In 2013, we identified three new functions grouped in this category (augmented reality, photography and commercial videos). This category remains the most present in the range of functions of local mobile applications.

#### *2. Category "Personal" functions*

The functions of the "Personal" category provide information about location and user activity: distance, speed, distance to lifts, photography service of the user on the slope, etc.

This category consisted of functions that appeared 18 times from the 99 identified functions of the group of local applications in 2012. From our longitudinal study, the functions from the "Personal" category have declined appearing 14 times out of the 133 functions identified.

#### *3. Category "Social" functions*

The functions of the "Social" category provide interactivity functions to the user. These include functions related to social networks such as options to meet friends on the slopes or to share information online.

This category consisted of functions that appeared five times out of the 99 identified functions of the group of local applications in 2012. From our longitudinal study, the functions from the "Social" category have decreased due to the structural change of the panel. This decrease in the total

number of occurrences of the function of sharing photos on Facebook is now found in the applications which regrouped several resorts together.

#### 4. Category "Game" Functions

The "Game" category includes gamification functions. No features of this category appeared in the review of applications in the local destinations during the 2012 and 2013 studies.

#### E. Results of benchmarking and longitudinal analysis

The summary of results is presented in the form of a comparison of the frequency of occurrence of functions in the local application group compared to the functions offered by the comparison group. The frequency was calculated using the following formula: (number of occurrences of the feature) x 100 / (Number of selected applications).

The figure presented in the Annex 2 summarizes the comparison of the offer of the functions proposed by the Western Switzerland applications (curves) and the functions offered by the comparison group (functions in gray). This kind of visualization can identify the differences between the mobile applications proposed by the different groups studied in 2012 (dotted curve) and in 2013 (solid curve). It should be noted that the functions with the white background emerge from local applications and are absent from the comparison group. Apart from the "Local" functions, which are often found in applications in the Western Switzerland, many of the other functions are underrepresented. These differences are therefore potential development opportunities.

## VI. CONCLUSIONS

Our research has identified an innovative technology not currently exploited to its fullest potential by the ski resorts in the Western Switzerland. Furthermore, we analyzed the evolution of the penetration of this technology in our region compared to a best practice identified abroad over a period of two consecutive years. Our results show a clear trend for digital artifacts that could improve destination attractiveness, tourists' accompaniment and experience. Another deep trend has been identified such as collaboration and information sharing between several close resorts, *i.e.* the development of a unique application for a group of destinations. This paper also presents a method of information processing as a result of practical marketing intelligence that can be reproduced in other case studies.

The major limitations of this research include the following points:

- The amount of information analyzed was limited to free mobile applications;
- The quality of information was limited to public data;
- The mobile operating system used to carry out the collection was iOS4.3.3 (OJ\*) on an Apple iPad device.

Finally, the rate of change of the analyzed market and therefore, the speed of expiry of the findings are very high and thus, the results need to be considered carefully. However, the method of marketing intelligence remains transferrable to other

research questions in the context of an organization or a group of regional operators. The basis of the identified functions and the results in 2012 and 2013 may also be used for further analysis of these products in the future to monitor the local offer and its adaptation to the international best practices identified.

Future research may also be done by duplicating the methodology described in other comparison groups. It could include the Compagnie des Alpes, a French company consisting of 41 leisure destinations across Europe (26 sites for winter sports for 56% of turnover in 2011, and 15 parks for 44% of turnover in 2011). Reference publications of the group indicate that it has achieved approximately 8% of turnover from the ski area market in Europe in 2011, with 6% of total skier visits. [21]

Other avenues of research could be considered concerning the real impact on customer loyalty and retention through the use of mobile technologies on the economic activity of ski resort destinations in Western Switzerland.

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#### Annex 1: Detailed list of regional destinations selected

##### A. List of the 50 regional destinations in Western Switzerland (French speaking and bilingual)

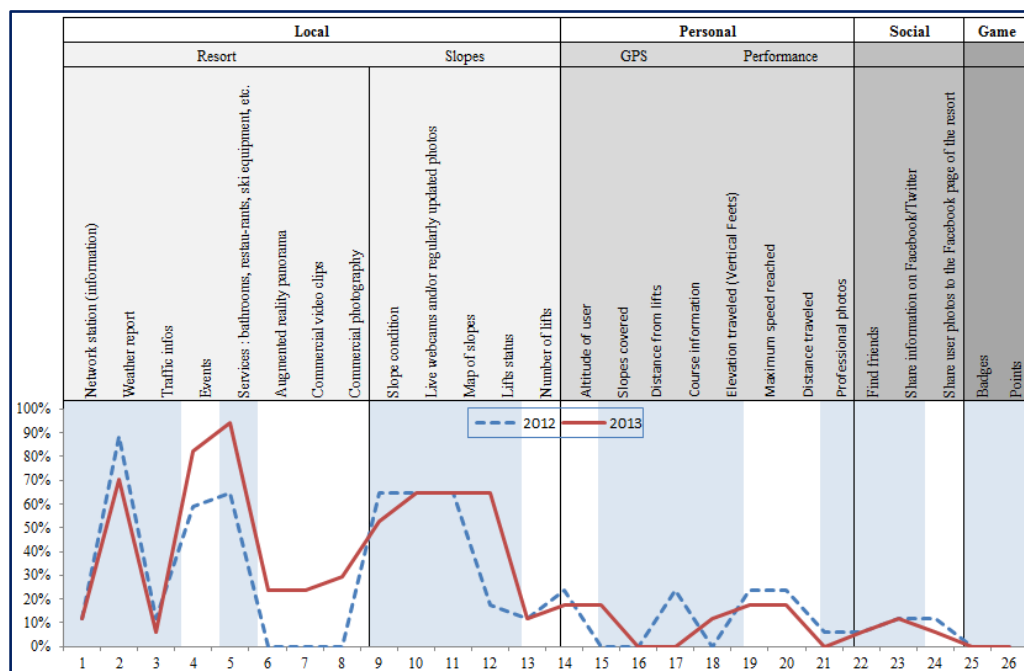
1	Anzère	2	Arolla	3	Bruson
4	Champex-lac	5	Champéry	6	Chandolin
7	Crans-Montana	8	Evolène	9	Grimenz

10	La Fouly	11	La Tzoumaz (Mayens de Riddes)	12	Les Marécottes
13	Liddes-Vichères	14	Morgins	15	Nax
16	Nendaz	17	Ovronnaz	18	St-Luc
19	Super St-Bernard - Bourg St-Pierre	20	Thyon-Région	21	Torgon
22	Verbier	23	Vercorin	24	Veysonnaz
25	Zinal	26	Saillon	27	Le Bouveret
28	Les Diablerets	29	Leysin	30	Les Mosses
31	Les Pléiades	32	Rochers-de-Naye	33	St-Cergue/La Dôle
34	Ste-Croix/Les Rasses	35	Vallée de Joux	36	Villars
37	Lavey	38	La Berra	39	Charmey
40	Lac Noir	41	Moléson	42	Les Paccots
43	Les Buttes/La Robella	44	Les Verrières	45	La Vue des Alpes/ Tete de Ran
46	Les Breuleux	47	Les Genevez	48	Les Savagnières/ les Bugnenets
49	Tramelan	50	Loèche-les-bains		

##### B. List of the 2 German speaking destinations

51	Grächen	52	Zermatt
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Annex 2: Figure: Benchmarking results and longitudinal analysis



# Added Value Model

## Corporate Communication Model in Social Media

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**Abstract—** In the circumstances of attention economy, companies fight for the audience's attention. This is the moment when social media become useful for them. Meanwhile, the popular corporate communication theories and models were created at the time when social media did not exist yet therefore they cannot reflect the specific nature of communication in this environment. It drives the need for a new corporate communication model. By analysing communication patterns among social media users and brands, as well as the existing corporate communication models, the 'Added Value Model' was developed – it illustrates the existing corporate communication process. According to this model, the process of corporate communication in social media is continuous; it takes into account the objectives of both the company and its target users, emphasises the choice of social media on the basis of the message and demands to enrich communication with an added value. The element of added value indicates that social media have the potential of becoming not only a channel for communication, but also a platform, which partly or completely enables the provision of services, support and satisfaction of users' needs. The given model may serve both as a point of reference for corporate communication in social media and a measurement tool, which is crucial in organising a company's communication in this environment.

**Keywords-** corporate communication; social media; model

### I. ATTENTION ECONOMY

The origins of attention economy are found in 1971, when Simon [1] wrote that we have reached attention economy, when the abundance of information in the information-rich world creates information consumption deficit. Consequently, it causes attention deficit in people. According to Simon, information is time spent creating interaction with somebody. Attention economy is viewed as a new stage in the development of information society. Attention within this concept is a restricted unit whereas information is in abundance. In corporate communication the target audience's attention is what corporate communication experts fight for in order to reach their company's objectives.

This theoretical approach was developed further in the 90s of the 20th century along with the development of social media, when there were more and more discussions about the consequences of modern technologies and the resulting enormous information flow. This theoretical approach was developed extensively by Goldhaber and Franck and their subsequent followers.

In 1997, Goldhaber [2] wrote that we no longer live in information economy, but rather in attention economy. We are drowning in information by constantly generating it. And in such circumstances people's attention becomes crucial and turns into a commodity. This commodity may bring income to the company. The media sell the audience's attention to advertising providers, thus monetizing the attention. In fact, companies exchange their information against the audience's attention.

Franck [3] follows up the idea that attention has become the main deficit in information society emphasising that today both companies and individuals wish to achieve publicity. The author describes attention as a new business currency assuming that attention creates a new kind of capital – 'attentive capital', as well as a new type of remuneration – 'attention remuneration', which is earned through popularity and fame. He argues that industrial capitalism is replaced with mental capitalism. Franck writes that, as opposed to money, it is not possible to accumulate attention, but it is possible to accumulate esteem.

Davenport and Beck [4] continue the topic of attention economy defining attention as mental focusing on a particular information object. This resource is restricted, which means that if an individual directs his attention at a particular message or channel, he does not direct it at anything else. The authors maintain that it is necessary to minimize the factors that divert the audience's attention, as well as to involve the audience in the company's activities.

In his turn, Falkinger [5] outlines four major factors, which influence the development of attention economy: 1) information technologies; 2) increase in income; 3) international integration; 4) powerful media development. Each of these factors facilitate a more extensive and intensive communication by the company with respect to its audiences. In order to reach the desired audiences, companies are forced to constantly increase the intensity of their communication, which puts even a greater strain on the fight for attention.

Berman [6] emphasises that the circumstances of attention economy influences corporate communication. In addition to competition based on prices or innovation, companies also fight for the audience's attention in the environment, which is rich in choices. If previously a company had to initiate a research and then continue with the product development and production, distribution and marketing using the *push* strategy, now, with the attention as the ultimate power, the *push* strategy

loses its appeal and is replaced by the *push-pull* strategy. The experts 'allure' the audience to create a design or produce and deliver a product or service, which it desires. The authors call this phenomenon 'attention loop' because the audience is involved both in the creation and consumption of the product or service.

The attention economy is expressly inter-disciplinary as the business processes in this case closely interact with the communication processes. The advertising providers purchase the attention of the desired audience or attempt to attract its attention online using social media marketing techniques and creating a valuable and freely accessible content [7].

## II. DEFINITIONS OF SOCIAL MEDIA

Komito and Bates [8] define social media as Internet applications, which provide a greater interaction among Internet users via user-generated content. This content may vary and includes photos, videos and textual comments. Berners-Lee, Hendler and Lassila [9] define social media as a software tool set, which enables individuals share information, interact and create communities. Bonsón and Flores [10] emphasise that the use of this software does not require an extensive technical knowledge.

Henderson and Bowley [11] define social media as a set of Internet applications, which focuses on participation, connection, user-generated content, information sharing and interaction. According to the authors, these technologies have shifted the focus of Internet-based services from consumption to interaction, creating new opportunities for interaction among organisations and audiences.

As a synonym to social media, O'Reilly's [12] concept Web 2.0 is used – it involves user participation in content creation and updating. Some of the examples include blogs, Internet encyclopaedia – Wikipedia.

Another type of social media are social networking sites or social networking platforms, which are defined as Internet sites that facilitate social interaction through profiled user accounts [13]. Social networking platforms increase users' interconnection opportunities with two main characteristics: 1) the ability to organise and demonstrate connections among people; 2) publicising of the status and activity updates [14]. For the purposes of this paper, social networking sites will hereinafter be called 'social networks'.

The concepts 'social media', 'Web2.0' and 'social networks' are related and sometimes even describe identical resources. As a synonym, the term 'new media' is also used. In this work, social media is used in a broader sense, which includes Web 2.0 resources with the potential of creating user-generated content, as well as social networks, which organise users' connections and simplifies communication. In this paper, social media mean Internet resources, which are based on user-generated content and allow organising interaction and communication among users. This work focuses on such social media as blogs, social networks (e.g., *Facebook.com*), micro blogs (*Twitter*), wikis (*Wikipedia*), forums and content communities (*YouTube*, *Flickr*).

## III. RESEARCH OF CORPORATE COMMUNICATION

P. Argenti and J. Forman [15] define corporate communication as a company's voice and image, which the company builds on the global stage consisting of various audiences. P. Argenti [16] writes that corporate communication serves as a new and important management function because the Internet development has taken off, the information speed has increased, society has become more sceptical with regard to a company's intentions and attempts to provide information in an 'attractive packaging', as well as companies have become more complex structurally. P. Argenti believes that it is crucial for companies to communicate 'strategically', which means harmonising communication with the company's overall strategy to facilitate its strategic positioning.

P. Argenti emphasises that, thanks to the development of social media, the possibilities of corporate communication also expand. However, he remarks that due to this control over corporate communication shifts from the company management to the company's stakeholders. Social media make the company change its strategy from the *push* type to the *pull* type, as well as convert the stakeholders into company evangelists – people who gather around themselves people, among who they promote a certain product, service or idea [17].

C. Van Riel [18] defines corporate communication as the orchestration of all identity instruments of an organisation (communication, symbols, participants' behaviour) in an attractive and realistic way to build and improve the organisation's reputation from the perspective of the groups, on whom its operation depends [19]. Van Riel's approach to corporate communication, formulated in 1992, is based on three communication platforms: 1) management communication; 2) marketing communication; 3) organizational communication [20]. The author also talks about the Mirror Function, which requires to follow the developmental trends and to predict the influence on the audience.

M. Bruhn [21] emphasises that the majority of corporate communication theories requires an integrated approach to various communication activities. However, he criticises the lack of focus with regard to the structure of the corporate communication work. The author has defined integrated corporate communication as a planning and organisation process targeted at creating a single body from various sources of internal and external communication provided by the organisation. According to the author, it is the only way of ensuring a consistent social appearance of the company. With regard to the integration of social media in corporate communication, M. Bruhn does not regard it as a revolutionary development, emphasising that the company's strategy and the profitability principle are the basic principles, which prevail over corporate communication in the social media era as well [22].

K. Karagianni and J. Cornelissen [23] proposed their approach to corporate communication on the basis of the functional management theory. They define corporate communication as a management function, which offers the means for effective coordination of elements in order to build

and improve a favourable reputation from the perspective of the stakeholder groups the organisation depends on. The essential component in these authors' definition is the concept of stakeholders. Furthermore, authors describe the processes of corporate communication, which are crucial in the context of social media. Thus, if an organisation does not reveal its opinion, certain stakeholder groups may soon start dominating in a particular communicative environment joining in a movement against a certain type of the organisation's activity.

J. Grunig [24] uses 'public relations' as a basic concept, which he defines as communication management between an organisation and its publics. *The Excellence Theory in Public Relations* formulated by J. Grunig emphasises that public relations enhance the organisation's efficiency, when they help to harmonise the organisation's goals with the strategic audiences' expectations. As part of this approach, public relations have to be a good-quality long-term process [25].

On the basis of the development of public relations paradigms, in 1980s J. Grunig defines four public relations models: 1) press agency/publicity model – one-way communication and a propagandic style of communication; 2) two-way asymmetrical model – uses research to find out how to convince the audience to act according to the organisation's expectations; 3) public-information model – one-way communication, when, predominantly, positive information about the organisation is disseminated; 4) two-way symmetrical model – research and dialogue are used to bring about the change in both the organisation's and audience's ideas, attitudes and behaviour.

J. Grunig [26] believes that social media do not influence the corporate communication theory, but directly facilitate the application of the previously formulated principles.

#### IV. METHODOLOGY

The empiric research was carried out in several stages. Initially, 13 active social media users, as well as social media experts and company representatives were interviewed using partly structured interviews. The data was processed using Glaser's and Strauss' Grounded Theory, which has the potential of providing an original insight into the processes [27].

In order to find out the reasons for choosing particular media and to establish media communication patterns in social media, 420 company representatives were surveyed. In turn, to find out the users' habits with regard to the brand-related communication in social media, 624 social media users were surveyed.

At the stage of developing the theoretical approach and the model of corporate communication in social media, the Multi-Grounded Theory (MGT) was used, where both the empiric justification and theoretical justification were used. The aim of MGT is to combine the inductive aspects found in empirical studies with the deductive aspects found in theory-based studies [28].

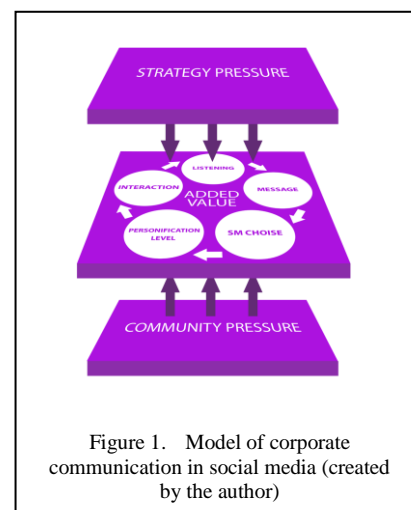
On the basis of the Multi-Grounded Theory, the empirical justification was performed using the interviews with social media users, companies and experts, as well as the results of the users' and company representatives' surveys. It was

followed by the theoretical justification using various corporate communication theoreticians' approaches, as well as the internal justification by formulating the elements of the model and creating the model itself, which reflects corporate communication in social media. After presenting the model in scientific conferences and receiving recommendations from the reviewers, the model was recast to have a non-linear and multidimensional structure.

#### V. ADDED-VALUE MODEL

On the basis of the study of theoretical sources and empiric data and by using the Multi-Grounded Theory, new elements of the model were formulated (see the Table 1). The model, which reflects corporate communication process in social media, is provided below (see Figure 1).

Listening involves monitoring of the social media content and the analysis targeted at finding out users' opinion about the company or brand, product or service, or a particular event or situation. At this stage, it was also important to consider the



*Mirror Function* formulated by Van Riel, which allows to predict the impact on audience. The research showed that 80% of users regard positively the situation when a company answers questions in social media and 71% appreciate the situation when a company responds to criticism in social media. The

implementation of these practices is possible if a company analyses the content of social media. Besides, a company can also use the users' opinion for generating or testing ideas. This element should be the first step both at the stage of the situation analysis in social media and before active involvement. The circular structure of the model indicates that the listening element has to be constantly re-used in the communication process, as well as the continuous nature of communication. The analysis of the situation is not limited to the analysis of the communication between the company and its customers, but also includes the analysis of non-customers, other stakeholder groups, employers and competitors.

On the basis of the outcomes of the listening stage and the goals of communication, a company formulates its strategic message. The message a company plans to communicate has to be the basis for choosing a particular social media. The research showed that the company's and users' interests coincide if the message is about the company's services or products, the latest developments in the field or contains answers to users' questions.

TABLE I. THE CODES OF THE INTERVIEWS, SURVEYS AND THEORIES AND THEIR RECODING INTO THE ELEMENTS OF THE MODEL

Codes found in the users' interviews	Codes found in the interviews with companies and experts	Codes found in the users' surveys	Codes found in the company surveys	Codes found in the corporate communication theories	The elements of the model created by the Author
Listening	Passive presence, image monitoring	Give a positive evaluation to the situations, when companies monitor the environment and respond to critical posts	The importance of evaluating content quality: comments, the number and quality of discussions	Van Reil's <i>Mirror function</i>	Listening
Difficulties to be accepted at online communities	The necessity of creating followers'/friends' communities	Give a negative evaluation to following one's profiles	Attempts at creating their followers' circle	Cornelissen's concept of stakeholders	Community pressure
The spread of fake, anonymous comments	More trust in personified profiles. The spread of fake profiles and commentators	Give a positive evaluation to personified communication by companies in social media	Anonymous vs. personified areas - the selection of channels for communicating various messages	Argenti: Creating the company's 'evangelists' by changing the strategy from pressure to alluring	Personification level
The need for strategic communication	Various aims possible: sales, building relationships, customer support.	Give a positive evaluation to communication in social media.	The most popular objectives: Informing the user about the latest developments in their field, informing the consumer about their product or service, sales	The significance of Argenti's strategic communication; Van Reil's centralized coordination of communication; Bruhn's integrated approach	Strategy pressure, formulating the strategic message
Integrity principle: communication matches action	The necessity of helping people, continuous conversation.	The need for added value: practical consultations about the field; readily-accessible information; the possibility to receive bonuses and rewards.	A comparatively frequent communication to provide answers to the users' questions. Comparatively rarely readiness to create a dialogue about topics that are not related to the specific business, but are of interest to the target audience	Grunig's paradigm of strategic management	Added value, interaction
Fragmentation of the audience	Fragmentation of the audience	More often communicate in social networks	More often communicate in microblogs	Bruhn's integrated approach	The choice of the social medium

The choice of Social Media. Next, specific social media, where the message will be communicated, are selected. The choice depends both on the specific functionality of social media and users' habits with regard to using this media. At this stage the technological aspect is important. Social media are technological platforms, the use of which may require technological knowledge. This is the stage when the communication strategists' and technology experts' knowledge unite. The study revealed that companies choose different social media for communicating different messages. For instance, to inform users about the latest development in their field, companies tend to choose the micro blog, to find out users' opinion about their competitors – forums, and to communicate with their employers – blogs.

Personification Level. Each company also has to decide if their message will be communicated in social media through identifying the user's relation with the company or anonymously. The Internet and the concerned social media provide the opportunity of publishing information both through

personification – in the company's official social network profile, and anonymously – in forums, wiki resources and elsewhere. A personified and an anonymous environment exist in parallel. On the other hand, in this position a company representative also has to decide if his or her message is targeted at a certain user or an anonymous user group. The

study showed that 90% of users have a positive attitude to the practice when a company communicates in social media through a personified profile.

Interaction with the audience, its involvement in the corporate communication through social media helps to achieve a more extensive audience and to test or generate new ideas. However, interaction should be based on the audience's interest and readiness to cooperate.

The communicative added value is a very significant element of the corporate communication process in social media. It influences all other elements as, in the process of implementing each stage of communication, company representatives should assess what value this activity will be able to give to the target social media users. By communicative added value I mean the value, which the communicating party integrates into its communication and which helps users to satisfy their needs, improve their standard of living and simplify their everyday life or communication processes. The necessity for added value is indicated by the following research findings: users predominantly point out that they are particularly motivated to follow corporate profiles if they can receive valuable information and practical advice, and in situations, when they can choose the company representative to communicate with, they tend to choose an expert, who can provide some specific and useful information. Furthermore,

two-thirds of users admitted that they regarded positively the situation when a company communicates about topics, which are important to users, but are not directly related to business. The existence of added value is the factor, which determines whether the company's communication will be successful in social media.

In the same way as the economic added value reflects what financial value a company has added to a commodity or service, the communicative added value shows how much more effectively this communication helps to achieve the company's goals through communication instruments.

Each element of the model is subject to two types of pressure. On the one hand, by communicating in social media the company representatives are forced to integrate themselves in the general communication flow of the company and submit to the general corporate communication strategy. The company's aim and interests influence all elements of the process, thus making the communication process meaningful from the company's perspective. It is the strategy pressure. Here, we can see Argenti's, Grunig's, Bruhn's and Van Riel's positions, where the major part belongs to the strategic communication, which is harmonised with the company's goals.

On the other hand, in social media a company also feels pressure from user communities, which are unwilling to accept companies and promptly disseminate scandalous information. This pressure is also created by the user-generated content, which may be created at any moment and disseminated in any social medium. It is the community pressure. The characterisation of social media includes not only a company's target audiences, but also communities, which may be influenced by these target audiences. In this aspect we see the significance of Cornelissen's concept of stakeholders, when one has to count not only with the existing or potential customers, but also those, who may influence them.

This means that the company representatives, who communicate in social media on behalf of the company or brand, always have to count with both sources of pressure as, by ignoring any of them, the company may suffer - either communication will not comply with the company's interests or will cause antipathy in users.

The proposed model presumes that the communication process occurs in social media continuously, taking into account both the company's and users' interests and goals, choosing specific social media for the respective message and adding the communicative added value to communication.

This model also shows the potential of social media to serve not only as a channel of corporate communication, but also as a particular platform, where, partly or entirely, services and service support are provided and users' needs satisfied. The social media become a business component helping to achieve the company's goals more effectively. Thus, the proposed model could serve as a reference point for starting or improving corporate communication in social media.

## ACKNOWLEDGMENT

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# Online shopping adoption factors

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**Abstract—** This paper<sup>1</sup> finds out factors which have defined consumers' adoption of electronic grocery shopping in Finland. Using the data of a large survey, we define six factors, which affect the adoption of electronic grocery shopping. The factors can be called high standard of service, social interaction, convenience, negative prejudices of service, physical barriers, and brand name. Also demographic characteristics and overall perceptions about Internet were found to have some effect on the adoption.

**Keywords-** *Electronic Grocery Shopping, Retailing, Innovation Adoption*

## I. INTRODUCTION

Electronic grocery shopping still plays only a marginal role in total grocery shopping. Main reasons for engaging in systematic electronic grocery shopping refer to time saving and convenience. Purchasing groceries via the Internet allows consumers to shop fast and without leaving their homes or workplaces. Thus, the key benefit with electronic grocery shopping is that someone else picks the order and delivers to the home [1]. This is especially the case where the groceries are delivered to a locked reception box located in the customer's yard [2]. Morganosky and Cude (2000) list physical constraints, avoiding standing in line, buying for a business, avoiding impulse buying and hating grocery stores in general as secondary reasons for use of Internet to shop for groceries [3].

## II. IDENTIFYING ELECTRONIC GROCERY SHOPPING FACTORS

Limited analysis by the authors suggests that Internet grocery prices in Finland are at the prices charged by the highest priced supermarkets in a capital area of Finland. But the customer may have to pay a delivery fee, which raises the overall price of electronic grocery shopping a little above the physical store prices. An important issue here is whether or not the consumer perceives some "economic cost" for her time, or for the cost of operating a car on a specific shopping trip. In fact, in Europe online shoppers perceive low prices of online shopping as one of the key drivers of their electronic shopping [4].

Shopping via the Internet, the consumer gives up the physical environment of the store and therefore the ability to see, touch and smell the merchandise. Consumers shopping

over the Internet cannot talk to store personnel, nor ask any specific product information. Consumer often runs into a series of technical glitches with Internet shopping. This makes electronic grocery shopping seem even less tempting in the eyes of consumers who already deter all kinds of technology-based services. In the most serious cases it's not even a question of web-page operation but a question of how to use computer in general. In the case of Internet banking, one of the biggest barriers of adoption has been the lack of computer itself [5].

Several studies have drawn upon theories about innovation adoption and risk behavior measuring perceptions about Web-based security, and then comparing perceived Web security with other relevant constructs to assess their relative impact on intent to engage in Web-based purchasing. Security concerns are still claimed to be the major barrier of Internet shopping adoption (see for example [6][7][8][9]). However, at least in Finland in the case of electronic banking, security concerns have been found to be minuscule [10].

Hiser, Nayga and Capps (1999) claim that the number of people living in the household, the presence of children, and gender are not significant determinants of interest in using a grocery shopping service [11]. However, they go on postulating that age and income affect the adoption of electronic grocery shopping.

Besides the consumer's individual factors, product type classification has been found to significantly influence the consumer choice between a retail store and Internet shopping mall. Products that have intangible value proposition are more amenable to be purchased via the Internet as well as products that are relatively high on differentiation [12][13]. Frequently purchased products with low outlay, tangible or physical such as groceries have been found to be more unsuitable for selling through the Internet [14].

## III. POTENTIAL ONLINE SHOPPING GROUPS

Consumers engaging in electronic grocery shopping often seek convenience and time saving. According to a study made by Wydra and Martin (1997), a large proportion of electronic grocery shoppers have a negative attitude towards traditional grocery shopping, particular toward the hassle [15]. In banking industry, where online banking has a steady position, ease-of-use, speed, freedom of time and place, and consistent standard of low-cost service were been found to be the primary factors affecting the adoption of electronic banking. Consumers' positive attitude toward technology is said to impact on the adoption of online services, see e.g. [16].

Two consumer groups of "hi-tech baby boomers" and "older/physically challenged" have been defined as potential

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grocery shoppers [17]. The first one were interested in electronic shopping for the convenience and novelty and the latter one preferred electronic shopping because of physical difficulty in going to the store. Both groups were satisfied with the delivery but frustrated with mistakes in orders. Both groups expressed also concerns about security and trusting the supermarket to select perishable groceries.

A study conducted by the Consumer Direct Cooperative identified six major groups of potential online grocery shoppers. The results from this Andersen Consulting led consortium of 31 organizations have been presented e.g. in [18] and [19]. The groups differ in their attitudes toward time, shopping and technology and thus perceive value in different ways. The “shopping avoiders” dislike grocery shopping while “necessity users” have limitations that make going to a store difficult. “New technologists” are young and comfortable with technology while the “time starved” will pay extra to free up their ever so busy schedules. “Responsibles” get enchanted sense of self-worth from shopping while “traditional shoppers” genuinely enjoy even more shopping in a store than responsibles. White and Manning (1998) have defined consumer segment, which shop online to buy items not available locally. This group of potential online shoppers buy items that appear to be significantly higher in quality than similar products available in physical stores [13].

#### IV. POTENTIAL ONLINE SHOPPING GROUPS

This study may be placed within the framework of innovation research. Internet retailing has been interpreted to be at the innovation stage of the retail life cycle [20]. This paper is particularly relevant to this field in explaining how and why an innovation is adopted. The current research study was set up to investigate how consumers use electronic grocery shopping, how easy they find it to use, whether they like using it and in particular how they compare it to shopping in a physical store. Additionally, deeming electronic grocery shopping to be an innovative product, we wanted to assess how likely it was to be accepted or rejected by the target market. By assessing individuals' problems and preferences, we hope to offer recommendations for how the product could be further developed and marketed.

As a basis for analyzing our findings, we used Rogers' (1983) classification of the characteristics of innovations, which directly affect their commercial success [21]. To Rogers' classification Bauer (1960) and Ostlund (1974) have added a dimension of perceived risk [22][23]. In Rogers' classification the term “relative advantage” refers to how the product is perceived by consumers in terms of its superiority over those already available. Internet seems to offer relative advantages to alternative methods in terms of price and convenience. However, Internet's performance over alternative methods may be speculated.

“Compatibility” refers to the extent that the new product is consistent with the consumer's existing values and past experience. Here one needs to consider how familiar or at ease the customer is with using technology-based services and whether it fits in with her existing pattern of behavior. For example, if a person is not familiar with using vending

machines, she may not wish to use Internet for shopping. “Communicability” is the ease with which a product can be communicated to potential customers i.e. the more easily customers can observe the positive effects of adoption, the greater its chances of success. With Internet, customers can e.g. observe immediately the results of their information search or investment.

“Complexity” refers to how the customer judges the innovation in terms of its ease or difficulty to use. It has been argued that in Finland customers have sufficient understanding of the computer and computer-related technology. However, especially the negative technology attitudes, computer illiteracy, and total lack of computers seem to be the biggest adoption barriers of Internet usage e.g. in the field of Internet banking. [16].

“Trialability” is the degree to which a product may be tried before being purchased. Within the concept of Internet it is relatively difficult to try out a new Internet-based solution and the costs related in the trial use are high. Three out of four customers (71.2%) in Finland access Internet from home [5]. Installing new Internet connections such as ADSL or digital television Internet at home entail high initial costs. There are also differences in their performance depending on the geographical area of usage, which may cause even product malfunctions despite a successful demonstration at the point of buying decision-making.

#### V. METHODOLOGY AND RESULTS

The data was collected by means of a questionnaire mailed to 2 500 households in the capital region of Finland. The sample of 2 500 households was stratified so that one third of them was statistically Non-users of electronic grocery shopping, on third was New users of electronic grocery shopping who had just recently started shopping online, and one third was Old users of electronic grocery shopping who had shopped online for the past two, three years all the while. After a follow-up mailing a total of 1210 usable responses were received (response rate 48.4%). The survey results were further confirmed with 20 in-depth interviews. The following steps suggested by Churchill (1995) and Dorsch, Swanson and Kelly (1998) [24][25] were done to increase the response rate. As stated, a follow-up mailing was done, in which the consumers not responding in the first round were given a new possibility to participate in the survey. Second, the questionnaire was sent with a cover letter that informed the respondents about the content and purpose of the study as well as guarantee that the replies would be kept confidential. No financial incentives were used.

Non-response bias was estimated comparing responses from the first round to those from the follow-up. A chi-square test was conducted to examine the differences. Comparisons between demographic characteristics of the respondents between the first round and the follow-up revealed no statistical differences. On the basis of this, no non-response bias was detected in the sample [26].

The data was analyzed using a factor analysis and correlation techniques. In addition, a typical profile of electronic grocery shopper is described and compared to a non-

user. The results are addressed only partially in this paper. The demographic profile of the respondents is shown in Table one. As can be seen, the Table displays profiles of all respondents compared to actual electronic grocery shoppers. Of the all respondents, 71.8 percent were female, between 35 and 49 years of age (47.8%), married (60.3%), had a secondary level education (45.0%) and high household income. A major proportion of the respondents was white-collar workers (65.8%).

A typical electronic grocery shopper can be defined as a female belonging to the age group 35-49, a married person with secondary level of education or university degree with high household income and a good job. There were 16.5 percent of electronic grocery shoppers among the respondents. Moreover, 8.3 percent of the respondents had tried using electronic grocery shopping once or twice, and 1.3 percent informed that they had never even heard about a possibility to shop online. Electronic grocery shopping frequency was low among users as a majority of them (63.8%) shopped online less than once a month. Only 7.7 percent purchased groceries online weekly.

Results of the chi-square analysis were in all cases except marital status non-significant (at  $p < 0.05$  level). Marital status seems to be important variable differentiating electronic grocery shopping users from nonusers ( $\chi^2_{(16)} = 30.902$ ,  $p < 0.05$ ). This is to say that most of the electronic grocery shoppers were married (67.5%) compared to all (60.3%). Previously Hiser, Nayga and Capps (1999) have found also age and income significantly affecting the adoption of electronic grocery shopping [11].

A majority of the respondents were using computers daily (73.2%) and had an Internet connection (71.2%). Only 1.3 percent reported that they never use computers. The Internet was mostly accessed from home or from work. Only 9.8 percent were without an Internet connection. Many used the Internet each day (50.4%). On the basis of these results, the sample represents a highly networked sample of consumers.

Electronic grocery shopping adoption factors were studied through an analysis of total 33 statements. These were first examined through a frequency analysis, where we looked at the mean scores of each statement inquiring consumers' perceptions of different factors impacting on their electronic grocery shopping intention and behavior. Questions queried why consumers do not use, use or could imagine using electronic grocery shopping on a seven-point Likert scale ranging from one (Strongly disagree) to seven (Strongly agree).

When examining the mean scores of each variable, the expert grocery shoppers informed that they use electronic grocery shopping because it offers freedom from time and place (mean value 5.95), and saves time and effort in terms of not having to travel to a shop (mean value 5.96). The Non-users, on the other hand, expressed their willingness to try electronic grocery shopping if it would offer a wide range of brands to choose from (mean value 6.18), a large range of different product lines (mean value 6.17), and familiar brands to them on the website (5.89). The consumers found having disabilities (mean value 1.87) and other external constraints

such as not owning a car (mean value 2.37) the least significant reasons of their non-usage of electronic grocery shopping.

In addition, on the basis of the frequency analysis, a factor analysis was carried out. Six factors were identified using the eigenvalue criteria that suggest to extract factors with an eigenvalue of greater than one [27]. The six-factor solution explained 63.4 percent of the total variance. The extraction method used was principal axis factoring with varimax rotation. Both the Kaisers-Meyer-Olkin (KMO) measure of sampling adequacy score (0.809) and the Bartlett's test of sphericity ( $\chi^2_{(253)} = 2129.6$ ,  $p < 0.01$ ) were acceptable and significant indicating sufficient fit. Internal reliability analysis was done with Cronbach's alpha ( $\alpha$ ). All factors had alphas over or little bit below recommended 0.7 level suggesting good internal reliability for the factors [28].

The first factor exhibits heavy loadings for seven variables pertaining to the consumer perception of customer service and account for 23.4 percent of the variability of the items. Highest loadings for this factor were caused by statements *quick response on customer feedback* and *familiar brands on website*. Factor one can be called "a high standard of service". Factor two accounts for 14.9 percent of variance and is defined by items referring to social interaction. This factor can therefore be labeled as "social interaction". Factor three exhibits heavy loadings on four variables concerning speed and convenience. Thus, this factor can be labeled as "convenience". Factor three accounts for 8.1 percent of the variance.

Factor four appears to be a mix of variables exhibiting loadings for four variables referring to negative aspects and prejudices consumers had about electronic grocery shopping. This factor accounting 7.7 percent of the variance can be called as "negative prejudices of service". Factor five accounts 4.7 percent of the variability and is defined by two variables referring to physical barriers affecting the adoption. This factor can be called the "physical barriers". Factor six exhibits heavy loadings for two variables concerning name of the shop. This factor accounts 4.6 percent of the variability and can be called the "brand".

On the basis of this factor analysis, we go on suggesting that six factors have an influence on the adoption of electronic grocery shopping in Finland. The factors can be called high standard of service, social interaction, convenience, negative prejudices of service, physical barriers, and brand name.

In the final part of the data analysis we looked at the relationship between the six factors and electronic grocery shopping usage. A Pearson correlation analysis was conducted. Only one significant correlation was found between the factors and usage: between factor three "convenience and usage" ( $r = 0.180^{**}$ ,  $p < 0.01$ ). It is clear that users appreciate above all convenience referring to time saving and avoidance of travelling. This is similar to those findings we reviewed in the literature section of this study where convenience was found to be one of the key drivers of this service. When further examining the relationship between convenience and gender, a positive correlation was found ( $r = 0.270^{**}$ ,  $p < 0.01$ ), i.e. women value convenience of electronic grocery shopping more than men do.

Consumers who are highly familiar in the usage of the Internet for means other than shopping (such as for banking, communication, education, or entertainment) are more likely to adopt the Internet for shopping. For example, from the electronic grocery shoppers 83.2 percent had used Internet for banking, 61.7 percent had used Internet for information search, and 55.9 percent had used Internet for communications prior to becoming electronic grocery shoppers. This research finding is in line with previous research findings of Hirschman (1980a) and Citrin, Sprott, Silverman and Stern (2000) where it was found that the comprehension of the new product as a concept will generally precede its actual adoption [29][30].

## VI. POSSIBLE ADOPTION ACCELERATORS

When mapping is there any possibilities to speed up the adoption process by offering added-value offers to consumers, we posed a question about which factors the current Non-users would appreciate and value as part of the electronic grocery shopping. The most valued factors were "free from time and place" (26.7 % of the respondents) and "large product selection" (27.1 % of the respondents). Since electronic grocery shopping already is free from time and place, we assume that the respondents referred to the delivery service in a sense that delivery part of electronic grocery shopping is available only during regular working hours.

The Non-users wished also for more diversity in product lines were especially wished for bread and grain products (24.8 % of the respondents), meat products (20.0 % of the respondents), vegetables (13.2 % of the respondents), and dairy products including eggs (12.6 % of the respondents). However, one must address this research finding with caution, because they are also the very product groups (fish, meat, fruits, vegetables, frozen food, and bread) that the Non-users inform they are least likely to buy via the Internet.

We further went on suggesting the Non-users possible additional services they could use via the electronic grocery shopping websites. The only additional service offers that raised any interest among the consumers were information related in one's hobbies and collecting recipes. Every fifth (20.3%) of the Non-users informed, that he would use electronic grocery shopping websites often or always for searching for hobby-related information. Almost half (45.5) of the Non-users informed, that they would use electronic grocery shopping websites for studying food-making recipes. The other additional service offers didn't fancy the respondents at all. For example, over half (57.1%) of the Non-users informed they would never use electronic grocery shopping websites for chatting with other people, and obtaining nursery or childcare services got even less support as 66.1 percent of the respondents said they would never use such a service while shopping online for groceries. Housekeeping (41.4% would never use) nor laundry services (35.4% would never use) were neither popular among the Non-users.

## VII. DISCUSSION

### A. Relative Advantage

The electronic grocery shopping was overwhelmingly judged in relation to physical stores. None of the respondents saw it as an alternative to a physical store shopping experience but informed that they will always be products they go shopping to a physical store for. The major advantage that electronic grocery shopping has over the traditional retail distribution channels is that it saves time and effort for consumers as someone else is picking the groceries and delivering them home to a consumer.

"I still prefer going to a store. There I see everything for myself, I get to walk around the aisles and many times I remember something there that I had forgotten from my shopping list at home. And then there are all those free samples I just adore. I simply have to have a bite from every food sample there is available." Female, 30-35 years of age, metropolitan area, non-user.

On the other hand, some consumers did not feel confident in trusting other people to choose the perishable products on their behalf. They were also expecting longer opening hours for the delivery service. However, one might ask how relevant this issue really is in a country in which no store is every open after 9 p.m.

### B. Compatibility

We found at least two types compatibility concerning electronic grocery shopping: functional compatibility meaning the ease-of-use or difficulties related in electronic grocery shopping and emotional compatibility meaning using electronic grocery shopping feels to the consumers. One would expect electronic grocery shopping to have a built-in level of compatibility in areas such as accessing Internet and websites as most of the consumers are already used in communicating and searching for information via the Internet. They may however, find it less compatible to choose groceries via the Internet than in a physical store where touching and smelling are involved in the purchasing decision.

"I always run into the difficulty of seeing and finding specific product information when I shop online for groceries. In a store it's easy to read the labels, but on the Internet it's difficult to make any sense of them." Male, 61 years of age, metropolitan area, non-user.

Especially mature customers showed strong emotional links with the physical store shopping but also the women in their 30s seemed to fancy the feeling of shopping and giving in the impulse purchases.

### C. Communicability

In innovation theory it is thought that the more highly visible a product, the more easily it is likely to be diffused. Electronic grocery shoppers are able to observe the positive effects of the service at the time most convenient for them. For example, consumers may order for products whenever they have time and ask for the products to be delivered in the locked reception box on their yard or at their workplace.

"I think that control is essential what comes to grocery shopping. I want to check for myself that the tomatoes are

fine and that the milk is not outdated.” Female, 30-35 years of age, metropolitan area, non-user.

The communicability can be assessed at least in two ways: how consumers are using innovation when it offers a cost advantage and how often the consumers are using innovation. It is more difficult to assess electronic grocery shopping in terms of discounts, because there are hardly ever any present in the Finnish electronic grocery shopping. But what comes to observing the loyalty program benefits in electronic grocery shopping, it can be concluded that it's more difficult for a consumer than in a physical store, in which you actually handle the cashier your loyalty card.

Electronic grocery shopping should be pretty easily accessed in Finland if we keep in mind that over 70 percent of the respondents informed they have Internet connection in use. There is also a strong ongoing promotion of electronic grocery shopping present: 54.5 percent of the respondents informed they had started using electronic grocery shopping due to an advertisement.

#### D. Complexity

The physical store shopping may be cumbersome, but for many consumers it represents simplicity that electronic grocery shopping as yet has not been able to replicate. From the point of ordering through delivery to final use, consumers reported a range of difficulties. The key problem areas seemed to be verifying the quality of ordered products, being able to check product specific information, and not knowing how much the delivery charge is. Not knowing how to use computers seems to also create a type of complexity in the adoption of electronic grocery shopping.

“I'd prefer to have a separate delivery charge instead of the ones that are included in the product prices. In that way I'd be at least aware of the true cost of home delivery.” Male, 39 years of age, metropolitan area, expert user.

Electronic grocery shoppers perceive ready-made shopping lists to lessen the complexity of shopping and decision-making. After all, some items seem to appear on the shopping list over and over again every week and having the last week's list saved ready for the upcoming week makes shopping faster and more carefree.

#### E. Triability

The electronic grocery shopping websites can be tried out beforehand in the sense that a consumer is able to navigate through them, see the product sizes and selection, and so on. But triability in the sense of using electronic grocery shopping just to try it out to see how it works, is non-existent in the case of electronic grocery shopping. Whatever you order, will be charged, will be delivered, and can't be returned unless there is some flaw in the service.

#### F. Risk

The risk in electronic grocery shopping is most of all risk in terms of losing money. In Finland consumers traditionally perceive hardly any risk in using Internet [10].

“I guess it's more likely that I'd get robbed on my way to the supermarket than while shopping via the Internet. No, it doesn't worry me at all. Life in general is unsecured, but I'm not scared at all to use my credit card number on the Internet.” Male, 39 years of age, metropolitan area, expert e-grocery shopper.

We believe this enormous feeling of trust to be related in the fact that no single online fraud has been reported to take place in Finland. Also Finnish people in general perceive the national level of security very high. There are also a wide variety of different kinds of payment methods available from secure credit card payments to online debit payments, which will be charged directly from one's bank account.

### VIII. CONCLUSION

This study focused on consumer perceptions of electronic grocery shopping in Finland by surveying a sample of 1210 respondents. From a pragmatic standpoint, this study contributed to the existing literature in a number of ways. We showed that a typical electronic grocery shopping appears to be women, middle-aged, married, has a high level of income and a good job, and first and foremost, adds much weight on convenience factor in electronic grocery shopping. From a theoretical viewpoint, six factors affecting the adoption of electronic grocery shopping were examined. This study also showed that consumers valued several factors in electronic grocery shopping such as wide range of and familiar products and brands, freedom from time and place, time saving, and as stated, convenience.

The main limitation of this study comes from its local nature. The sample was collected purely in the Capital Region of Finland, which had an effect on our results. Almost all respondents were familiar with computers and the Internet, and can be considered innovators/early adopters of new technologies. However, electronic grocery shopping had not a steady position in their shopping.

Future studies need to be conducted in order to leverage the findings of this study. To better understand the relationship between convenience factor and different demographic variables and sociological information about consumers, a study focusing on these relations is recommended. By doing so we might shed more light on the factors that underlie convenience in electronic grocery shopping.

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# Event Management - A New Challenge for the Region of Korça

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**Abstract—** increasing competition between regions, cities and countries, has led to the search for new ways and opportunities to expand their knowledge from the audience and target market. These territories compete to attract investments, resources, new jobs, attracting visitors etc... One of the new ways to see these places to catch as more likely than those mentioned above, events management and development of their industry, as well as their use as an effective tool in increasing the knowledge of the destinations. Events tourism is one of the fastest growing sectors of the tourism industry. The growing interest in events "special" can bring profitable activities in the community. Industry events, including festivals, meetings, conferences, fairs, sports, and many other types of events, is developing rapidly and provides a significant contribution to economic development and tourist destinations. Programming events tourist destinations presupposes two objectives: to increase the number of visitors during their development and increase recognition of the destination through publicity and media coverage. Events tourism can contribute positively to a locality but may not automatically bring local economic development

**Keywords-** tourism of events, destination image, the impacts of events, Korca city holidays.

## I. INTRODUCTION

The term event refers to everything that happens, especially important, any observable event or emergency, a type of organization, a ceremony (e.g. a wedding), a competition or race (race sport), a convention or meeting, an event or show considered art, a festival (a musical event), a media event (an event that attracts media coverage), an evening or ball, a sports event (championship) etc.. As one of the first pioneers of literature events, Goldblatt [7], emphasized the human aspect of events, special events defined as a unique moment in time celebrated with ceremony and ritual to satisfy specific needs. Another author, Getz [4], suggests that special events are better defined by their content. Thus it provides two definitions, one of the event organizer's perspective and the other from the perspective of the customer or guest (guest):

1. A special event is an event that happens only once or rarely, outside of normal programs and activities of the organizer or sponsor.

2. For customer or guest, a special event is an opportunity to experience social, cultural or recreational activities outside of everyday experience.

Among the characteristics that create a sense of specifically (special), festive spirit, quality, originality, tradition, hospitality, theme and symbolism.

## II. EVENT TYPES

There are many different ways to categorize or events grouped

By size, shape and content.

### A. By Size

- a-Main events (Major events)
- b-Major Events (Mega events)
- c-Events badge (Hallmark events)
- d-Local events or community.

### B. In form and substance

- a-Events (events) cultural
- High-profile artistic celebrations.
- Festivals associated with local celebrations
- Events related to a special art show

Celebrations in the form of job fairs by a special group of the community. Events calendar  
Amateur arts festivals  
Commercial music festivals:

- b-Sports Events
- c-Business Events

## III. METODOLOGY

This study is based on a research on the development of events and impacts that give the place where events take place as well as in the host community in this country. Case study is

the city of Korca and the community of this city. The study focuses on primary and secondary data collection.

### Method of data collection

#### A. Collection of secondary data include:

- A detailed literature search for events, their management, the impacts that they provide in the country where the population of this country, how can control these impacts, relatively new industry events, its components and increase its fast. For this purpose, in this part of the paper have been used a number of works by different authors.
- A review of Korca Municipality tourism strategy, in relation to the organization and development of events.
- A look at the conception of Events Calendar published by the Municipality of Korca, to see how the events are distributed throughout the year and how they are intertwined events of tradition with new events in the city.
- A review of previous studies of different authors about providing opportunities for further development events destination. (Study "Visitor Economy", part of the "STEP", implemented by SNV in collaboration with the World Tourism Organization and the Municipality of Korca).
- A search on the website of the Municipality of Korca and website Beer Festival.

In the rest of the paper, the work is based on empirical research to present the current situation in Korça events Units management and the work done by the local authorities in this regard.

#### B. Collection of primary data include:

The study used primary data in the form of a questionnaire developed by the community in order to obtain their opinion on the development of events in Korca and their impact on the community. Previously conducted interviews and observations with Korça municipal leaders and tourism specialists, in order to extract the terms of questionnaires that can better define the profile of participants in community events in Korça, their behavior and attitude towards the development of events, interests and their opinions about management and organization events in Korca. For this purpose, selected a sample of 100 citizens, participants in the "Beer Festival 2011".

## IV. DEVELOPMENT OF EVENTS IN KORCA

### A. History of the development of events in Korca

Korca is the largest city of South East Albania, founded in XV century. The city has been an important trade and craft center. Caravans linking him to Turkey, Greece and Russia. In the second half of the nineteenth-century city turns into the biggest economic center, commercial and cultural center of the country. Culture, tradition and landscape that provides the city, have been and are its uniqueness.

Korca is often referred to the vibrancy and festive atmosphere that grants its citizens and visitors of the case or not. It is not a random phenomenon. If we look at the history of

this city, enthusiasm and his willingness to celebrate encounter at every step. Korca Carnival, celebrated for the first time in 1940, famous Korça serenade which have left their mark on the cobbled streets attest to the festive spirit that has accompanied this city in years. Cinema and theater have always been the center of cultural life of the city. Outstanding generations of artists, singers, instrumentalists, one of the best players in the country, point to the tradition of fans of this city.

Although the post-liberation period was accompanied by a change of the type of holiday that celebrated the people of Korca again followed its tradition in the way of celebrating these new holidays.

Along with the change of the system, the city began to return old celebrations. Religious holidays, ricelebration Carnival of Korca, brought to town many other visitors. According to data obtained from a study conducted by the City of Korça in 2009, based on statistics provided by the World Tourism Organization, it is seen that the number of tourists has increased by 10% as a result of the organization of events. It is this fact, that has become more aware of local government, having as one of its main objectives, creating a festive image to Korca. Binding the name of the city with some of the main festivities taking place in Korça: "Korca Carnival", "Holiday Beer - Just in Korca", etc., aimed at returning these holiday celebrations symbol of the city. This would lead to a greater likelihood that potential visitors to plan a festive weekend in the city.

#### B. Analysis of the questionnaires during Beer Festival organized by the community.

The organization of this questionnaire is intended to get the opinion of the host community for the organization of events; he expects their impacts, as well as to the acceptance or rejection of the community for the development of events.

The survey was conducted during the biggest event that already looks back on an event symbol of the city of Korca, "Beer Festival". In the questionnaire was attended by 100 randomly selected citizens.

The first part of the questionnaire was constructed with questions relating to the characteristics of the respondents.

Part two continues with questions that seek the opinion of the respondents mostly for event management.

The third part has to do mainly with the opinion of the community on the impact of community events.

Mainly closed-ended questions, but there are questions that require a brief expression of opinion of the respondents to better their opinion. It should be noted that of the 100 respondents, about 86 of them are open-ended questions answered.

### I. Did you attend events that take place in your town?

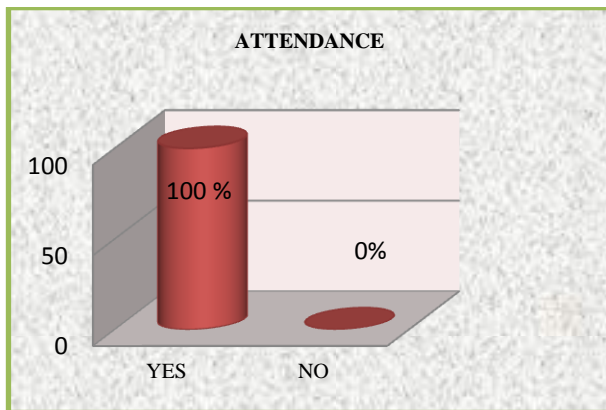


Figure 1. The attend of events that take place in Korça town?

We see from the graph, all respondents responded positively to this question

As regard to the opinion about the quality of management (fig 2) in Korça events the chart shows, the majority of respondents believe that management of events in Korça is good (34%) and moderate (48%). A small number of respondents believe that management events in Korça is very good (14%), and the smallest percentage of 4% is the share of respondents who think that we have a bad management. So, in the eyes of the community, events management in Korça gets an average rating with positive direction. **Regarding to the opinion of expertise in organizing events as well as what needs to be done in this regard (fig 3)** the respondents opinion is divided almost equally among given alternatives. But anyway, it is clearly understood that the community requires more professionalism in the organization of events.

## II. Your opinion about the quality of management in Korça events is?

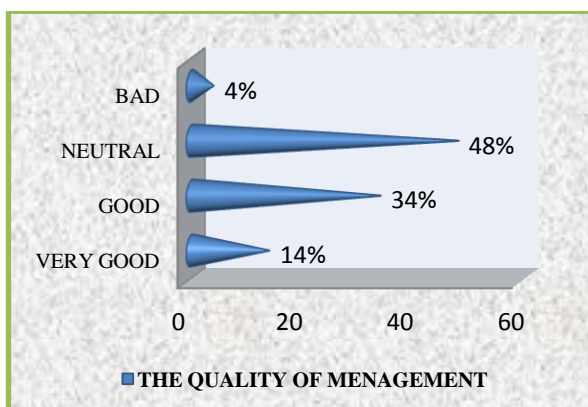


Figure 2. The opinion about the quality of management in Korça events

Respondents, through their opinions, require more expertise in crowd management, maintaining order in waste management, to solve the problem of parking, traffic management, etc

## III. In your opinion has expertise in organizing events? What needs to be done in this regard?

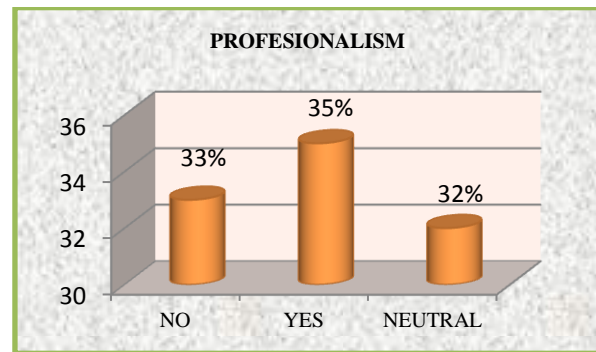


Figure 3. The expertise in organizing events.

As belongs to the events attended more (fig 4) responses to this question show a greater interest to cultural events, 58% of respondents attending more of these events. However, the sample in this case is selected during the development of a cultural event and the fact that the female gender is 62% of it, justifies cultural events superiority to those particular sports. This is the fact because, if we refer to the general climate sports city, which fills the stadium further and further, we suppose that there should be a balance between the pursuit of cultural and sporting events.

As we note in the chart (fig 5), it appears that almost all respondents believe that the development of events brings an increase in the number of tourists. Only a very small number of respondents, 6% of them think that the development of events has no impact on the increasing number of tourists. Respondents have argued their response to the fact that they have seen huge influx of visitors to the city during major events (Beer Festival, Carnival of Korça), but also because they think that such holidays create many opportunities good entertainment.

## IV. What events attend more?

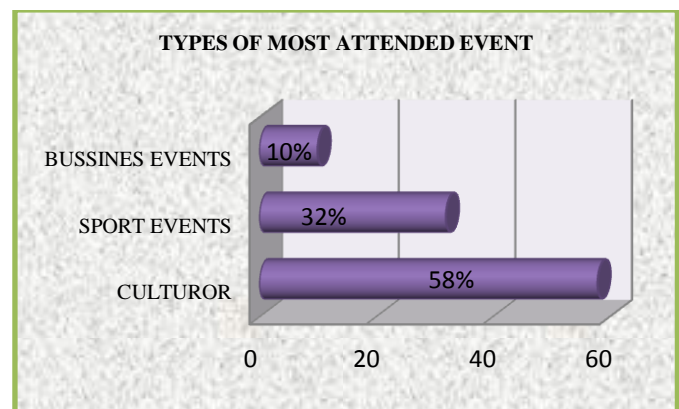


Figure 4. The types of events that are attend more

Do you think that the development of events has led to an increase in the number of tourists? Why?

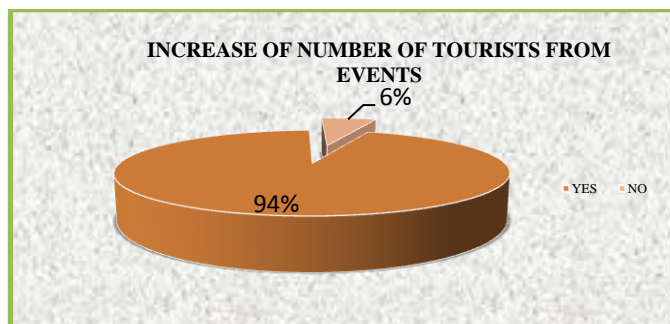


Figure 5. The increase in the number of tourists by events.

The opinions expressed by respondents to the question if they think that events tourism development will bring economic benefits to the country (fig 6) (although not all of the arguments of their choice), show a general belief in the positive impact that the development of events brings to the country where the economy and argue that the fact that visitors who come to the city spend there, giving different business income of the city such as: hotels, restaurants, bars, businesses participating in the event, etc..

A minority of respondents believe that the development of events not only bring economic benefit to the place where they take place, but bring negative impact to the community and may also lead to losses for businesses that expect to increase sales and for this purpose, starting from the different expectations increase their investments. In response to the question of impacts on employment as a result of events (fig 7), respondents seem suspicious in terms of development impact job growth events. Thus 67% of them believe that the development of events has no impact on the opening of new employment opportunities and only 33% think that there is a positive impact in this regard.

**Do you think that events tourism development will bring economic benefits to the country? Can you argue your answer?**

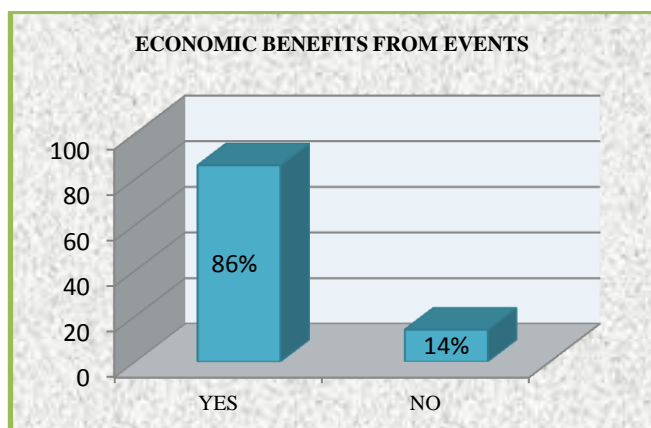


Figure 6. Economic benefits to the country by events in tourism.

**Do you think that the development of events can bring positive impacts on employment? Why?**

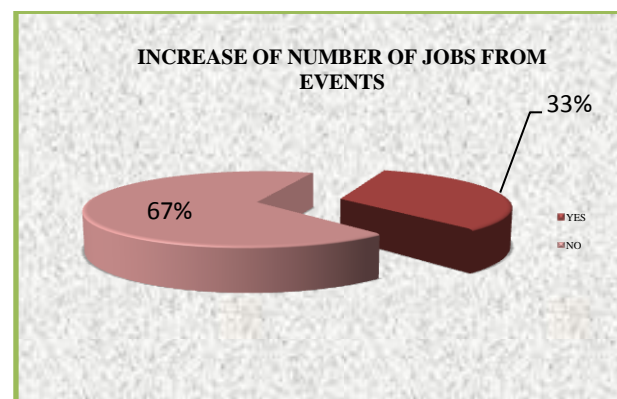


Figure 7. Positive impacts on employment as a result of events.

Respondents think that the jobs created by short-term events are often covered by the employees of the institutions that hold them. Half of respondents expressed optimism for the creation of new jobs corresponds mainly students and new age, who look at the organization of short-term employment opportunities events but which also gives them experience and knowledge opportunities that can 'was used in the future.

## CONCLUSIONS AND RECOMMENDATIONS

In recent decades, events have taken a great importance and have contributed to the development and renewal of a destination. In the field of events management, the overall goal is to provide competitive events, efficient and effective or otherwise expressed able to achieve quality events. Events must be an element of strategic planning and management to contribute to increasing the benefits of destination.

Some of the conclusions that can be taken into account are:

Events industry is seen as a creative image, creative profile destinations, they are positioned in the market, and approaching competitive marketing advantage. Events create one more opportunity to increase the number of tourists to a destination given that their development creates additional attractions for the destination. Regarding Korca own slogan: "Korca - City Holidays - is an attempt to make a differentiation in the market town. Also calendar of events is again an attempt to Korca positioned in this market.

Events have a direct impact on social and cultural development to its participants and their host community in Korçë. This impact may be simply to gain a new experience created by the development of the event. Other impacts include increased pride that results after the events in the city known as the "Beer Festival", Korca Carnival Festival, pie, etc.. Cultural events can broaden people's cultural horizons and expose them to new people and customs of their ideas. Given that Korca is a border town, during the major events in the city come many visitors from neighboring countries, especially Greece and Macedonia, creating the possibility of exchanges and recognition of new crops for the community and visitors.

Events are a very good way to make known the unique characteristics of host environments. Thus, during the Feast of the pie through traditional cooking and hospitality

characteristic expression of the community, as well as during the fair to pottery, another expression of the tradition, the city creates an opportunity to make its own unique values to visitors by making them to come specifically for these holidays in the city.

some of the recommendations can be given, starting from this study are as follows:

it has already been confirmed the involvement of governments in the organization and financing of events. during this study, it became clear that korca municipality has a maximum involvement in the organization and development of events in korçë. calendar of events, published by this municipality, the slogan: "korca - city holidays", the main sponsor role in almost all events held in the city, as well as local economic development strategy korce, indicate that there is a real commitment in this direction. certainly governments with taxpayer funds investments in events, want to know what you will get from these investments and how they compare with other opportunities for investment. not every idea is suitable for communities or places where applicable. for this reason it is necessary to make detailed studies and apply sophisticated techniques of analysis and economic evaluations.

in order to avoid or minimize negative impacts from events and maximize positive impacts, should be given special attention in the planning stage of the event. this implies a pursuit of professionalism in every step of planning the event:

1. Creating the concept of the event - to be compatible with the characteristics of the city, can be seen as an additional element for its tourist attraction, to be in compliance with the requirements of the community. statistics obtained at city hall clearly indicate what are the events followed.

2. Choosing the appropriate time - when the event will take place outdoors, she planned period of the less likely that this precipitation. at the same time, there should be taken into account before deciding on the period during which the event, should be considered in planning for similar events surrounding destinations, in order to avoid losing visitors.

3. Choosing a suitable location - the results of the questionnaire in this study showed a generally chosen country approval for the development of the event under study, but again there were some observations that should be taken into consideration in other plans. while the return of the city in festive city, requires the creation of a suitable infrastructure for organizing these celebrations. thus, we can think about the creation of a special center, a covered stadium or something similar, with a large capacity, which will be used for the development of various events and that will protect the city from its environmental damage .

4. A good cooperation with law enforcement to enhance the safety of participants.

5. A careful management of crowd behavior

6. A good planning for waste management.

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# SECTION 3.

*Economy and Business Economics*

# The Experience of Labour Market Forecasting in Latvia and Abroad

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**Abstract**—Labour market research is closely linked to the employment rate, which in turn affects the well-being of the population and the country's economic development. An important aspect of labour market forecasting is the horizon of the forecast prognosis - the medium and long-term forecasting results outline the potential of economic development, but the short-term forecast, the so-called "barometer", reflects the current employment situation. The aim is to carry out a feasibility study on the topic "Labour market forecasting" to gather information about what work has been done in labour market research and what forecasting instruments are used in Latvia and foreign countries. The study is based on literature on well executed practice in labour market forecasting, legal regulations and the European Social Fund sponsored research. The study compares the experience of various countries in the planning of employment. Analysis of different trends and a comparison with the current experience on labour market forecasting in Latvia is also done. Particular attention is paid to the foreign experience and developments in the European Union. **Conclusions:** The majority of the public agencies choose the opportunities offered by short-term forecasts. There is interdisciplinary interoperability - the subject of research in economic studies is the employer-employee, but education and further education institutions and policy makers prefer both types of labor market forecasting. For sustainability of the research results the appropriate model will be recommended to adapt for different Latvian employment agency activities

**Keywords-** labour market forecasting, employment

## I. INTRODUCTION

The economic development in Latvia affects every citizen, as it provides families with a stable income, and contributes to the growth of business in the country. The economic development takes care of the labour force quality and affordability. If the state provides labour market regulation, access to a job and also trained workforce with the necessary skills and knowledge for the current state of economy, then the public authorities that deal with the problems of employment do not need to take any urgent action to reduce unemployment. The steady development strategy is based on prevention, which allows monitoring of labour market trends and to plan activities for both short-term and long-term measures. An instrument such as labor market forecasting is necessary for this process. It provides support for education policy-makers and the social sphere authorities. The Ministry of Economy and the Ministry of Welfare are responsible for labor market forecasting in Latvia. Employment measures for the unemployed and education is taken care of by the State Employment Agency.

Medium-term and long-term forecasts have a strategic nature. They can be used for economic development strategy as well as a basis for political decision-making, which are fully reflected in the medium or long-term economic development. These political decisions have a potential impact on the economic development in the country. Short-term forecasts, including operational forecasts are focused on describing the current and foreseen economic trends not only qualitatively but also quantitatively. The aim of short-term forecasts is to point out the changes in the economic development cycle in the right time, as these changes may lead to different political decisions and a review of medium-term and long-term forecasts. In order to successfully invest financial resources in the individual work career development of the unemployed and job-seekers' by offering training or work experience, it is necessary to evaluate the short-term forecasts of labour market indicators.

## II. AIM OF THE STUDY, RESEARCH MATERIALS AND METHODS

The aim of the study is to prepare for gathering the materials derived from the main research and practical experience. Based on the feasibility study it is planned to further develop the topic "State Employment Agency Training Event Conformity to the Labour Market Needs." This includes such activities as previous research on the labour market summary, models of labour market forecasting selected by foreign employment, the investment of different research institutions on the evaluation of these models. The research method selected for this study is literature review and analysis of different data sources.

### A. Short-term labour market forecasting

The objective of short-term forecasts is to point out change in the economic development cycle as soon as possible, which may lead to changes in political decisions along with medium-term and long-term forecasts in order to be able to quickly respond to any negative or positive changes in the economic development. Looking into these negative or positive changes in the right time is the key to creating more effective policies which can aid the volatility of the economic development and may adversely affect the economic growth potential, as well as ensuring its sustainable development. Short-term forecasting econometric models are based on quantitative research methods so they provide users with much less subjective prognosis than long-term forecasts. To a greater extent it relates to operational forecasts, which may be entirely based on econometric

relations, and thus provide information that is not influenced by subjective judgment of any experts.

Given that the most important goal of econometric models used in short-term forecasting is to determine as accurately as possible the object's development tendencies, not to analyze these tendencies in detail, these models can be much less complicated than systems of simultaneous equations. This is another positive aspect, given that short-term labour market forecasting, including operational forecasting is a repetitive process, which must be as simple as possible.

#### B. State institutions in Latvia research on labour market

The Ministry of Welfare is the lead institution dealing with labour market research in Latvia. A crucial effect to the further development of research on the subject was given once joining the European Union, above all mentioning the many funds and programs of the European Union. In general three large-scale labour market research units of Latvian Ministry of Welfare can be highlighted: (1) Project "Research of the Ministry of Welfare" [8]; (2) Various labour market research on the labour situation of state and region magnitude along with research on certain social groups in the labour market; (3) the European Commissions EQUAL Initiative studies carried out within the context of the labour market.

In the context of methodology the study of "Detailed Study of the Labour Force and the Labour Market in Sectors of National Economy" [18] is of particular significance. During the study, using the econometric methods on labour market forecasting, the labor supply and demand potential inconsistencies were calculated for over 120 occupations and 37 aggregated occupational groups in the period of year 2007 to 2030. A labour demand forecasting methodology was developed for the forecasting process. It was based on exploiting new production function (see Figure 1.).

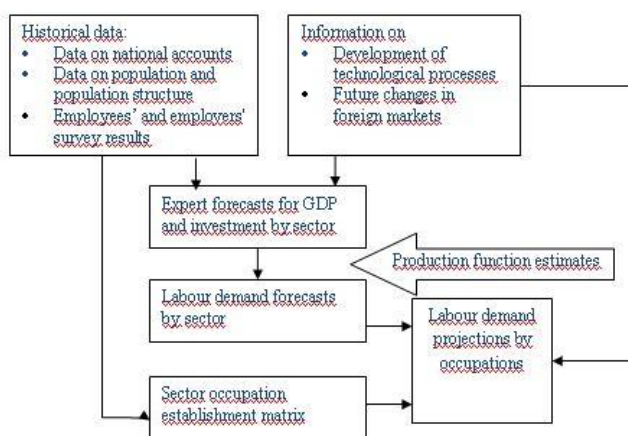


Figure 1. Labour demand forecasting methodology framework. Source: "Detailed Study of the Labour Force and the Labour Market in Sectors of National Economy" [18]

During the study medium-term and long-term forecasting models of labour supply and demand were developed (dynamic optimization (DOM) model and MS Excel model). Forecasts of labour force demand and supply were prepared on sections of economic sectors and occupational groups for the time period

until year 2020 for the MS Excel model and year 2030 for the DOM model.

The Ministry of Economy evaluated the research results and concluded that to continue the use of this labour market forecasting instrument a significant improvement in performance is necessary. Since 2008, the Ministry of Economy annually updates the medium-term labour market forecasts and gradually continue to update the forecasting instruments developed during the above mentioned study of the Ministry of Welfare, thus eliminating the weaknesses identified. The medium-term labour market forecasting model of the Ministry of Economics is based on DOM logical structure, which consists of three basic modules: society module, the economic development module and the labour market module (See Figure 2.).

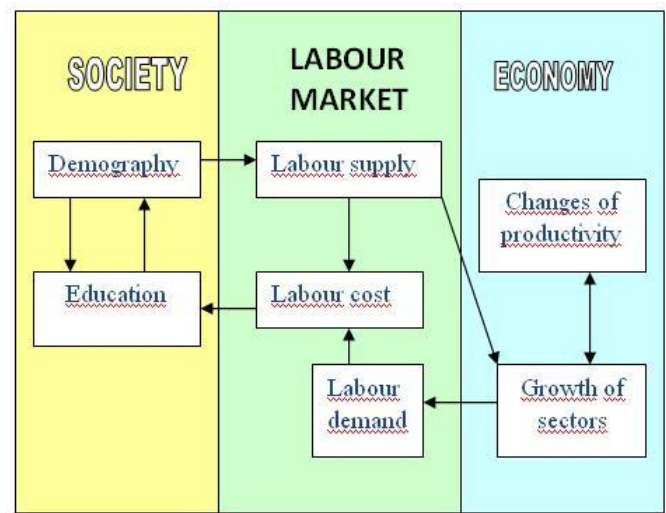


Figure 2. DOM model and modular structure interaction. Source: Ministry of Economy informative report on forecasts of labour supply and demand medium-term compliance [18]

Discussing the methods used in Latvian labour market forecasting along with the modeling methodology and theoretical framework, it is worth noting a few critical points. MS Excel environment is not suitable for the development and evaluation of complex econometric models [5]. There is specialized software that is widely recognized and praised by the benefits on developing econometric models and assessments, such as Eviews, Stata, RATS, MATLAB, PCgets, PcGive and many others. It is clear that MS Excel is not related to specific software-related skills, and significantly simplifies the use of the process, so it is only acceptable as an operating environment for the labour market forecasting model users, but not as a development tool by which the forecasting model is created [1], [2], [3], [

The suggestion to make the forecasting and modeling processes transparent – describe the econometric models used for forecasting, the evaluation results and the econometric tests characterizing these results in a detailed manner and make the description available to public. At the moment, the absence of such information denies any chance of an interested specialist to assess whether the models and results based on the research are reliable and correct. As such, it is written that the statistical

modeling is based on regression analysis - linear, logarithmic, exponential, grades, hyperbolic, parabolic. However, it is unclear whether all of the above mentioned techniques is used or is it just one of them. If so, what were the criteria used to select the specific method.

During the development and strengthening of various research processes carried out by the Bank of Latvia [22], this institution turned its attention to labour market research. In 2005 the first study on the Latvian labour market was published - "Assesment of Labour Market Elasticity in Latvia" The study analyzes the Latvian labour market flexibility by looking at the labour market dynamics and assessing the institutional environment. In their paper, the author identifies four key labor market flexibility factors that may also be indicators of labour market flexibility: (1) institutional environment, (2) wage flexibility, (3) labour mobility, (4) functional flexibility.

Based on the error correction model, the authors concluded that in Latvia there is a shock-absorbing mechanism which affects wages. In long-term one of the main real wage level determinants is labour productivity. In short-term, real wages depend on the proportion of jobseekers - if the Latvian economy will be affected by a negative shock, the unemployment rate will slow down the wage growth, which will strengthen competitiveness and enhance the return to the original economic balance. The model results show that in one quarter of the year the real wage dynamics neutralizes approximately 36.7% of the deviation from the long-term trend of the previous period. The authors' main conclusion is that the Latvian labour market flexibility level provides efficient adaptation to economic shocks, ie, the effective convergence to reach a steady state. While analyzing the available abroad studies of Latvian labour market, it can be concluded that the majority of studies found that Latvian labour market mechanisms are in place to ensure its flexibility. In 2001 while conducting research on the labour market in the Baltic States and Bulgaria, International Monetary Fund noted that the wage decline is a potential alternative to the decline in employment, suggesting labour market flexibility [32].

### III. ANALYSIS OF FOREIGN EXPERIENCE

In order to assess and compare the forecasting of labour market abroad, a labour market forecasting analysis is carried out. The analysis is focused on abroad countries and based on matching criteria is: (1) Forecasting experience; (2) Degree of centralization; (3) The breadth of data sources; (4) The level of detail in forecasting; (5) Complexity of the forecasting model; (6) Forecasting orientation (demand / supply); (7) Degree of potential usage of the study results.

During the analysis of foreign experience, labour market research and forecasting experience was examined as a whole, as well as the forecast methods used, including short-term labour market forecasting.

**Australia:** In Australia the institution dealing with employment forecasting is the Centre of Policy Studies, Monash University. The centres forecasts are based on (1) a wide economic system, which includes a macro model to predict aggregate employment, (2) dynamic general

equilibrium model MONASH to predict employment by sector, (3) the extension of the labor market to predict employment by occupation [27], [28].

**Austria:** Austria has a rich experience in the labour market activity forecasting. The forecasting was more focused on the economy and its labour demand [6], [19], [20], [21], [35].

**Canada:** In Canada labour market forecasting is dealt by the institution Human Resources Development Canada, formerly known as the Employment and Immigration Canada. This is done by using the Canadian Occupational Projection System. Canadian occupational forecasting model is based on demand-driven methodology, focusing on expected changes in demand for labour. Forecasting is based on a fixed ratio method, which is used in complex econometric methods [4].

**Cyprus:** The employment forecasting has a short history in Cyprus. The first time was just a few years ago. The organization, which is responsible for this operation is the Human Resource Development Authority. Forecasting methodology that was developed and is being used in Cyprus, is based on the approaches and methods that have been developed and used in European countries and the United States. In Cyprus employment forecasts are done for 27 sectors of economic activity and 36 occupational groups. Data source is the national census (held every five years and covers all sectors except agriculture and fisheries), as well as labour force surveys [9].

**Czech Republic, Poland, Slovenia:** Czech Republic uses an occupational forecasting model, which is based on the model developed and used by the Netherlands. The occupational forecasting model used in Poland is similar to the model used in the U.S. and Australia. Forecasting horizons of one year, 5 years and 10 years. Estimates are both at the national as well as regional level. Slovenia's occupational demand and supply forecasting is done mainly by the Employment Service of Slovenia. Once a year (at the end) it launches a study "Employment Forecast" [31].

**France:** In France, employment forecasting has a long history – it has been performed since the 1950 and 1960s. Nowadays, the employment forecast in France is done by the Ministry of Employment and Solidarity Statistical and Economic Research Department. Despite the fact that in France there is a view that education can not be planned on the basis of such models, it is believed that it is necessary to monitor the skills and knowledge needed by the labour market Monitoring is essential to ensure the people involved in the labour market have acces to any possible information needed, thus contributing to a rational choice of occupation between those involved in the current state of labour market [37].

**Germany:** There are ancient employment forecasting traditions in Germany. Unlike France, the forecast results can not be used to provide information to those who are going to decide on a career choice, but it is only used for policy analysis. Despite the fact that in Germany there is a sharp debate about the usefulness of this prediction, the government continues to support these activities [25].

**Ireland:** Irish occupational forecasting model is developed by the Economic and Social Research Institute in collaboration

with the Training and Employment Agency (Foras Aiseanna Saothar). Employment Forecasting in Ireland was launched in 1989, once the Labour Ministry asked the Training and Employment Agency information on which it plans the future of vocational education and training programs [33], [34].

**Japan:** In Japan labour market forecasting is performed by a number of organizations involved. Most representative and authoritative estimates are done by the Ministry of Labour, which since 2001 has been integrated with the Ministry of Health and Welfare in the form of Health, Labour and Welfare Ministry. The labour forecasting is used to develop the Basic Employment Measures Plan, which is updated every five years since 1967 [29], [36], [38].

**Netherlands:** The government of the Netherlands is legally responsible for an adequate education for the entire labour market. It also requires the government to foresee changes in interest occupations. In the middle of the 1980s, the Research Centre for Education and the Labour Market in Maastricht University was authorized to develop a framework for labour market forecasting, which would primarily be oriented to help manage career choice. The developed forecast model is used to determine updated prognosis every two years [7].

**Spain:** In Spain there is a large number of agents which are involved in forecasting different training. These agents work at national, regional and local levels. At national level, there are currently two main institutions: the National's Institute of Occupational Employment Observatory and the National Institute of Qualifications Observatory [10], [12], [13], [26].

**Sweden:** In Sweden there are several institutions involved in the labour market forecasting process. The main ones are the Statistics Sweden and the National Labour Market Administration. Statistics Sweden has developed skills supply and demand forecasts since the 1960s. The forecasts are done by the type of education, which are used for two different models of the task: (1) trend and forecast model, (2) education and labour demand model [23], [24].

**United Kingdom:** The Department for Education and Skills is a UK government body in charge of the labour market and related issues. It deals with the data collection and analysis on the labour market. The data is compiled from a variety of sources: the unemployment statistics, assessment of vacancies, salaries, etc [39], [40], [41].

**U.S.A.:** The organization which is responsible for the labour market forecasting in the United States is the Bureau of Labour Statistic. It also deals with labour supply forecasting (Fullerton, 2003). It focuses on the aggregated labour market participation rates, such as sex, age and ethnic groups. Overall, it is estimated for 136 different groups [15], [16], [17].

**Estonia:** The Estonian Ministry of Economics and Communication prepares annual forecasts on the labour market, which is used as a key tool to predict the labour market at national level.

**Denmark:** The National Labour Market Board and the Regional Labour Market Councils carry out quantitative estimates of the imbalances in the future Danish labour market. Twice a year the National Labour Market Board and Regional

Labour Market Councils provide detailed estimates of labour demand by sector and occupation and also assess the supply and demand mismatch in the Danish labour market [11].

**Finland:** In Finland it is a barometer of professions that are based solely on the results of the expert panel. Consequently, the published short-term labour market forecasts are of high quality. Short-term forecasts are published for 200 occupations, which are divided into 3 groups: the deficit, balance or in surplus. Finland econometric modeling is used only for labour market forecasting in the medium and long-term [14].

#### IV. RESULTS AND CONCLUSIONS

Higher levels of labour market forecasting are in the U.S., Canada, Australia, Japan, Great Britain. Medium-level forecasting can be assessed in Austria, Ireland, the Netherlands, Sweden, the Czech Republic. A fairly low level of labour market forecast is in Cyprus, Germany, Poland, France, Latvia, Spain. In the countries studied the labour market forecasting is mainly based on the econometric approach, is econometric model or set of models that use the Cobb-Douglas production function. Frequently used is the Cobb-Douglas production function with constant return to scale, in some cases, if more research resources and statistical data is available, the Cobb-Douglas production function with variable return to scale is used.

Labour market forecasting result is in assessable in groups of professions or aggregated professions. Different countries use different professions aggregation, according to economic characteristics and the available statistical data and. The approach to labour market forecasting and the complexity of the forecasting model used depends on the country's economy and labour market size. In short-term forecasting of the labour market a combination of an econometric model and surveys of current employers is used. In some countries, short-term forecasting is performed only by using an employers' survey with a large sample of respondents.

There is no foreign labour market study and short-term forecasting model, which could be directly adapted to the specific needs of Latvia and the SEA. Theoretical insights, different approaches and individual elements may be useful. The next stage of the research is planned to merge with the labour market forecasting methodologies and development of an ICT tool during a project of State Employment Agency project (scheduled for completion in 2014). For the collection of data and information the „State Employment Agency labour market forecasting and monitoring systems development", "Labour market research methodology development and improvement for the preparation of the study, SEA 2011/5\_ESF" material was used.

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# The precedential-sensitivity analysis

## Influence by external faktor to changes of precedence – analysis of the number of entrepreneurs in the Moravian-Silesia region

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**Abstract**—The classical methods of analysis do not allow to analyze simply flow and state values with identical instruments. At the same time it is very difficult to analyze and compare incommensurable values. The case analysis compares changes in the values of the variables with the changes in the surroundings. Increase or decrease of values of selected variables is determined by this comparison. The whole process of analysis is based on the definition of the elements for which we monitor changes of attributes values. The values of these attributes define the state of the element. Subsequently, links are found and defined between these elements. Characteristics of these links are defined by comparison of values of individual attributes of adjacent elements. Due to the simple system definition, precedence analysis is suitable for regional analysis, where system boundaries and structural division of region are determined. The paper analyzes the quantities of business entities “natural person” in the municipalities with extended powers (MEP) in the Moravian-Silesian region (MSR). The factors influencing the system are searched, when a change in the number of entrepreneurs in the surrounding (Poland, Slovakia, Olomouc, Zlín Region) occurs, and the sensitivity of the system to these changes is examined.

**Keywords**- precedence, incidence, system, element of the system, link, sensitivity, entrepreneur, municipality with extended powers, Moravian-Silesian region

### I. INTRODUCTION

At the Silesian University in Opava, School of Business Administration in Karvina there are a number of project that explore the relationship between economic values.<sup>1</sup> One of the researches is to investigate the influence of the quality of transport infrastructure in the region. It was necessary to find apparatus and method which were easy to use and which would be analyzed in the same way variables that are otherwise incomparable. The analysis is in progress in the surroundings of infrastructure, unemployment, ecology, education, crime, etc. Analyses are performed in the intervals (change over the time) and the structure (changes in space). We are currently performing research in the surrounding of business entities. Recently published sensitivity model<sup>2</sup> captures changes in

precedence in MSR, which occurred when changing the selected variables outside the region. The analysis was conducted by business entities. There were observed number of entrepreneurs, individuals, legal entity and foreigners. The next there were analyzed number of business licenses, the number of concessions bound trade, craft trades and free trades. There sensitivity of the system to changes in the surrounding was investigated, when changes in the values of 1% of the interval (min, max) were gradually examined for individual variables, where min and max are the extremes values of selected variables in all MEP. The system did not distinguish the type of surroundings. Therefore, the system was extended by 4 types of surroundings, Poland (PL), Slovakia (SK), Zlín Region (ZR) and Olomouc Region (OR), in which the value of the original surroundings were flipped. Due to the large number of analyzes (in thousands), in this paper is demonstrated the sensitivity of quantity “natural entities”. It indicates 23 testing; they were values of the variable in the relevant surroundings gradually set at maximum respectively low values of all MEP, respectively they are changed by one percent difference (max - min), with an increase from minimum to maximum. The “x” in the Tab. 1 means that the value has gradually changed.

TABLE I. MODEL VARIANTS

variant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PL,SK, OR, ZR	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max
	x	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min	min	min
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	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	min
	x	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max	max

### II. PRINCIPLE OF THE METHOD

#### A. Precedence

The precedence analysis consists of comparison of the differences in the values of the given variable that have occurred over time, or comparison of differences in values of the variables that occur when surrounding changes (e.g. between MEP). For each of the defined elements of the system have been established links between elements and links to the surroundings. Based on the links, system is described using the incidence matrix. The links between elements are defined by the matrix flowingly: if the element described in row is linked with the element described in column then the relevant element of the matrix has the value “1” in that row and column.. This

<sup>1</sup> SGS 5/2013 - Precedence Analysis of Selected Parameters  
 Influencing Interaction Between Traffic Infrastructure and Regional  
 Expansion. Grant System, Silesian University in Opava, School of Business  
 Administration in Karvina.

<sup>2</sup> Posted in [3],[6],

matrix is symmetric and allows easy control of recording system. Based on changes in values of the relevant variables are defined orientation links between the elements of the element with the lower value the element with the greater value. These links are written to the incidence matrix. In this matrix the value "1" is given for the element of the matrix, where the row element precedes column element. Precedence matrix can record precedence type "element - element", "element - binding", "bond - bond" or "bond - element". For the incidence matrix is defined operation binary multiplication and composition with selective vector. On the basis of binary multiplication can be calculated squared of incidence matrix. These matrices then set multiple-precedence. In practice, multiple precedence sets path length between two objects, which is the value of the monitored variables constantly increasing (decreasing). Using the precedence we can determine the number of elements related to the analyzed elements that have smaller values of the relevant variable. This way, we set the "power" of the impact of changes on the surrounding. Then using the powers of precedence matrix we can set longer routes with a permanent increase (decrease) the value of the variable and then set a "reach" of the changes. Using binary multiplication we discover the existence of multiple-precedence. Using classical precedents matrix multiplication we obtain frequency of occurrences. The principles of precedence analysis are based on systems theory. The basics are described sufficiently in [1], [2], [12] and [13]. Basics of the method for the analysis of economic systems are said for example in [3], [4], [5], [7] and [9].

#### B. Model

The model for this analysis is designed as a two-level. The first level allows the definition and capture of the elements of the system, the definition of the surrounding, the definition distinguishing level and the definition of links. This level is composed of a square incidence matrix whose rows and columns are formed by elements of the system. The number of elements is given distinguishing level. In this case, the distinguishing level is set to MEP. The elements are then formed by MEP. The links between elements can be at this level defined differently. In this analysis, the link is determined by the existence of a physical boundary between the two MEP. Surrounding of the system is determined by the boundary of MSR. For the purposed of this analysis, the surrounding is subsequently segmented into internal surrounding (MEP) and external surrounding (PL a SK). System elements and their markings are shown in Tab. 2. Links with the surrounding are defined by the existence of the border the relevant surrounding and MEP.

TABLE II. MEAS

Bilovec	Bohumín	Bruntál	Český Těšín	Frenštát pod Radhoštěm	Frydek-Místek	Frydlant nad Ostraví	Havířov	Hlučín	Jablunkov	Karviná	Kopřivnice	Kravaře	Krnov	Nový Jičín	Odry	Opava	Orlová	Ostrava	Rýmařov	Třinec	Vitkov	surrounding PL	surrounding SK	surrounding OR	surrounding ZR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

The second level of the model is formed by concrete values analyzed variables, as shown in Tab. 3. Based on the selected

rules values of variables are comparisons between all the elements. By elements with link is captured orientation. Orientation is written using precedence matrix. Subsequently, binary and classic square matrices are calculated thus there were discovered the frequency and multitudinousness precedence different lengths (this type of model is used in [5] and [6]).

TABLE III. SUMA OF PRECEDENCE BY DEFAULT

municipality with extended competence	Sum individual entrepreneurs
Bilovec	4232
Bohumín	4690
Bruntál	6201
Český Těšín	3725
Frenštát pod Radhoštěm	3355
Frydek-Místek	18159
Frydlant nad Ostraví	4429
Havířov - město	12349
Hlučín	6685
Jablunkov	2971
Karviná	7616
Kopřivnice	6405
Kravaře	3590
Krnov	6378
Nový Jičín	7964
Odry	2577
Opava	17693
Orlová	4627
Ostrava	54872
Rýmařov	2672
Třinec	7534
Vitkov	2036

### III. ANALYS RESULTS

During the analysis were gradually changed the value of the surrounding. There were counted precedence in length 10. Precedence numbers and frequency were recorded. On the basis of the interval, which was calculated as the difference between the minimum and maximum number of entrepreneurs of the "natural entity" in the MEP there was monitored, how the system reacts to changes in the values surrounding. The chart shows the number and frequency of occurrences of precedence so that the base graph is formed matrix, rows and columns are formed by indexes MEP Fig. 2, column in the corresponding element of the matrix indicate number of precedence. These charts are denoted "Amount of Precedence" and "Frequency of Precedence". Furthermore there is on the charts "Total number of Precedence" captured the total number of precedence for each element. The number of the precedence lengths in the system is in the chart "Length of Precedence". The charts of matrices are only illustrative due to the extension of the article and matrices sizes.

#### A. The initial status of the model

The initial status of the model has been defined so that the values in all four surroundings were set to the minimum value of the values in the MEP (shown in Fig. 1 and Fig. 3 identified as (min, min, min, min)). Acyclic system has been reached by further reduction of the default value by 0.01 for ZR, by 0.001 for OR, by 0.0001 for SK and by 0.00001 for PL. Simultaneously, it has caused that all the precedence lead from the surrounding into the system at the first phase and weight of each surrounding according to their importance was determined. From the charts it is evident that Ostrava and Frydek Místek is the dominant in the number of precedence in this stadium. The most common precedents are elements 23 to 26, which corresponds to the initial parameter settings. Quite interesting is the frequent predecessors of Český Těšín and Orlová. On the graph of the total number of precedence is obvious relatively high number of precedence in MEP Opava.

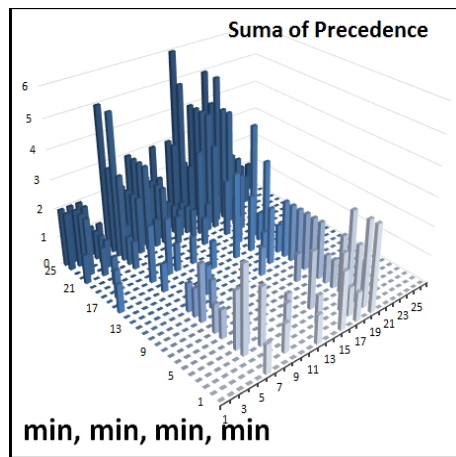


Figure 1. Suma of precedence by default

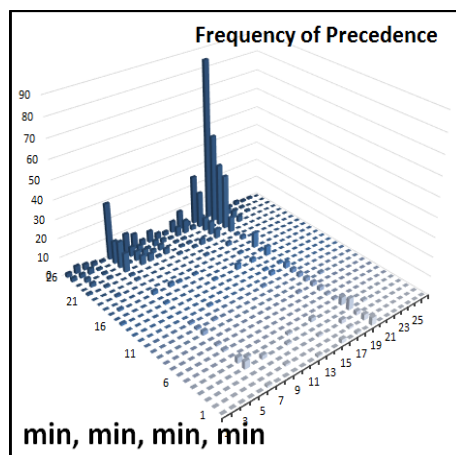


Figure 2. Frequency of precedence by default

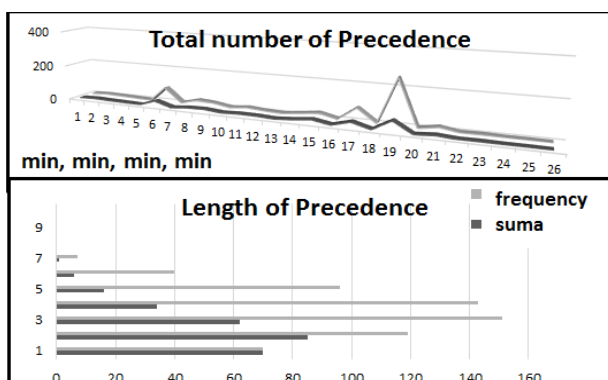


Figure 3. Total number and length of precedence by default

In the system dominate precedence of two lengths, by the precedence with frequencies then precedence length 3. The longest precedence in the system has a length 7. The largest number of precedence is between PL and Nový Jičín, by the precedence with frequencies between PL and Ostrava. As the Ostrava has a direct link to PL, it is obvious that there is a high frequency of longer precedence, which are between Ostrava and PL and pass through another MEP.

## B. Model x, max/min, max/min, max/min

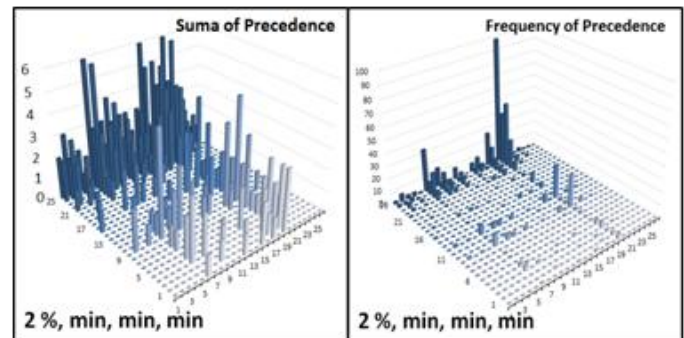


Figure 4. Precedences x,min, min, min - 2. %

In this case, the initial value of SK, OR and ZR were set up to the minimum (maximum), value PL changed from min to max with step 1 %. When setting x, min, min, min, began to be sensitive to changes in the system already in an increase of 2% (Fig. 4) from which it is apparent sensitivity of this surrounding. With this change there was to decrease the number of precedence and frequency of precedence of 47, respectively 159, as shown in Fig. 30. Sensitivity continued at intervals of 2% to 5%, when there was a loss of precedence especially in MEP 6 and 19. Next step changes occurred with an increase of 9%, which corresponds to surrounding 6791. Surroundings reached higher values than the values of MEP 3, 9, 12 and 14 (Bruntál, Hlučín, Kopřivnice and Krnov). The total length of precedence reached the value 9. These changes are evident on Fig. 5 - Fig. 10.

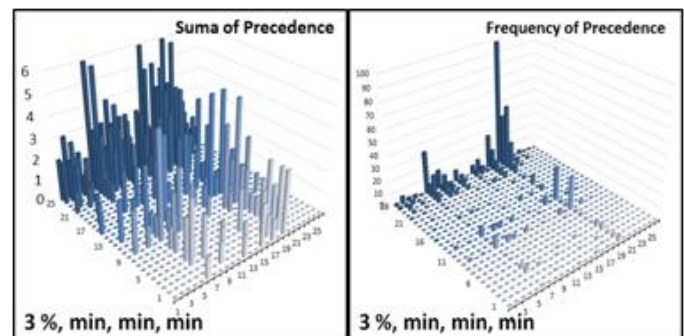


Figure 5. Precedences x,min, min, min - 3. %.

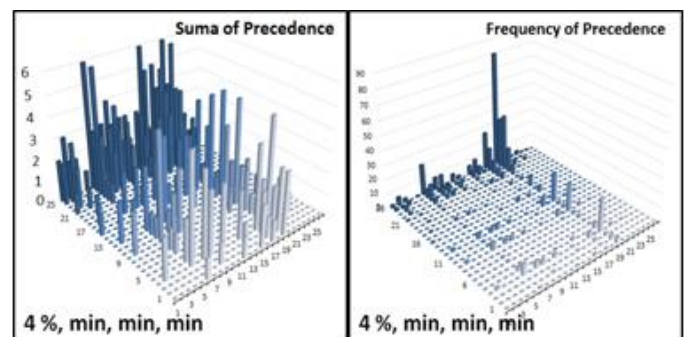


Figure 6. Precedences x,min, min, min - 4. %.

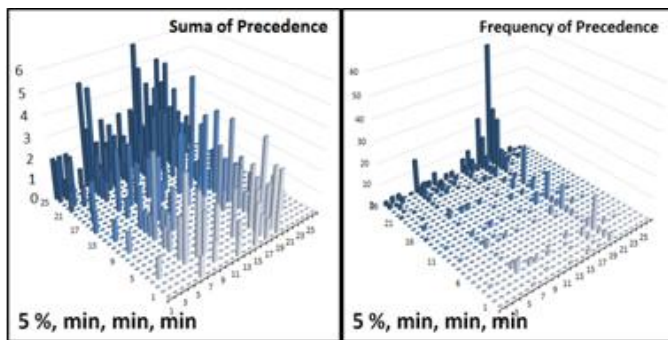


Figure 7. Precedences x,min, min, min - 5. %.

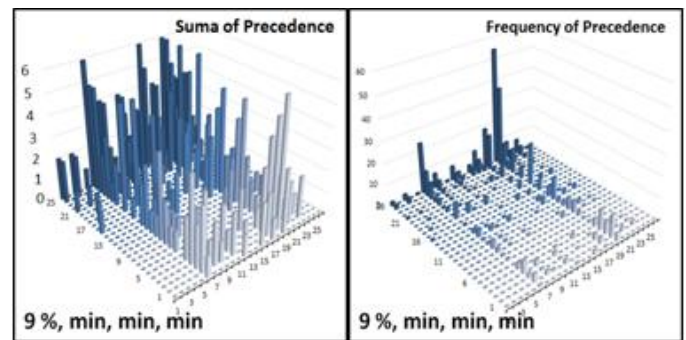


Figure 11. Precedences x,min, min, min - 9. %.

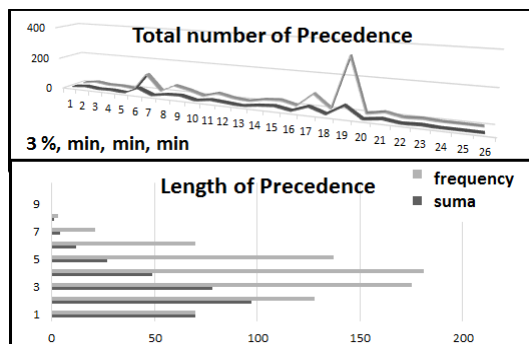


Figure 8. Total and Length Precedences x,min, min, min - 3. %.

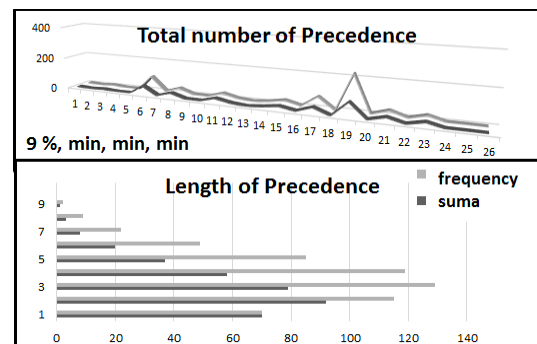


Figure 12. Total and Length Precedences x,min, min, min - 9. %.

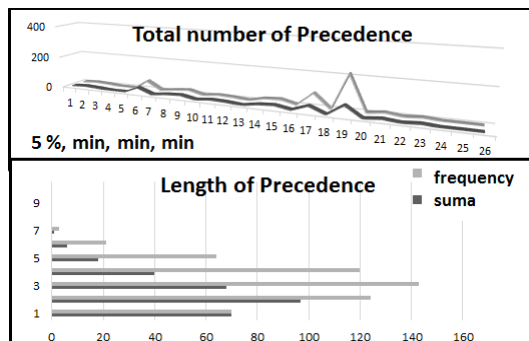


Figure 9. Total and Length Precedences x,min, min, min - 5. %.

With the change in the value of surrounding of about 9% precedence of MEP 8, 11, 15, 17 (Havířov, Karviná, Nový Jičín, Opava) was changed.

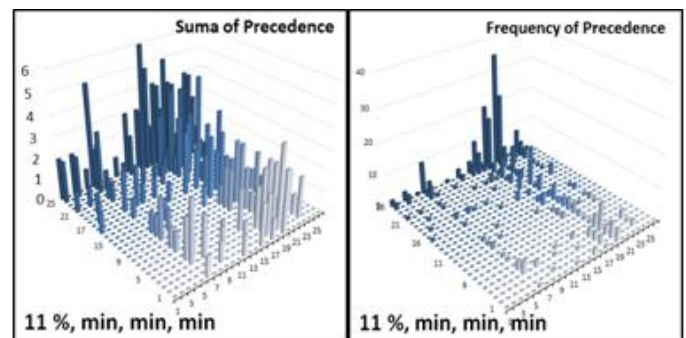


Figure 13. Precedences x,min, min, min - 11. %.

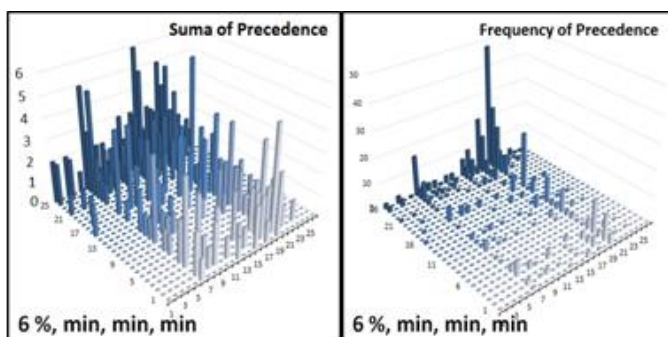


Figure 10. Precedences x,min, min, min - 6. %.

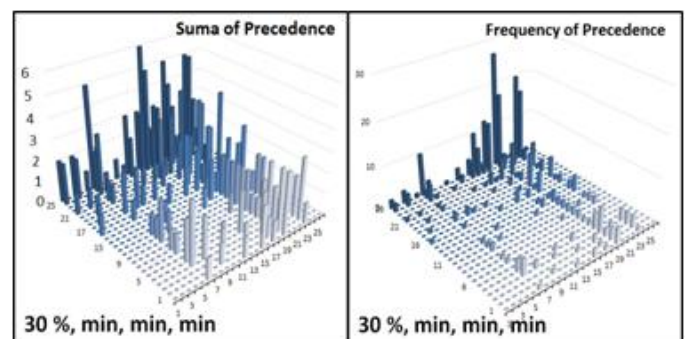


Figure 14. Precedences x,min, min, min - 30. %.

Next step changes occur at 11% where the value of PL surrounding reaches 7848. This will invert precedence in the MEP 11 and 21 (Karviná, Třinec), then the value of 30%, which corresponds to a value PL surrounding 17888 when there is a reversal of precedence for MEP 17 (Opava), as shown in Fig. 13 - Fig. 15.

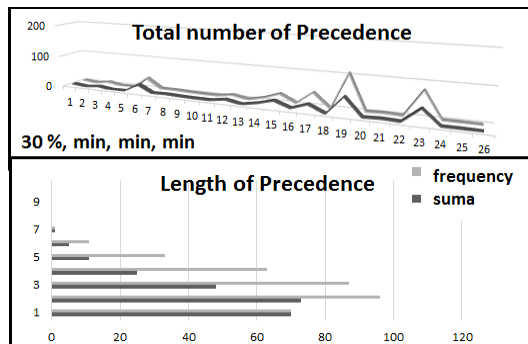


Figure 15. Total and Length Precedences x,min, min, min - 30. %.

### C. Comparison of the model x, max/min, max/min, max/min

In this section, we will show changes in sensitivity and the number of precedence at different values of the remaining surrounding (SK, AB, ZR). Fig. 16-18 shows the changes in the decomposition of precedence in the gradual increase in values in the surrounding of the minima at the maximum.

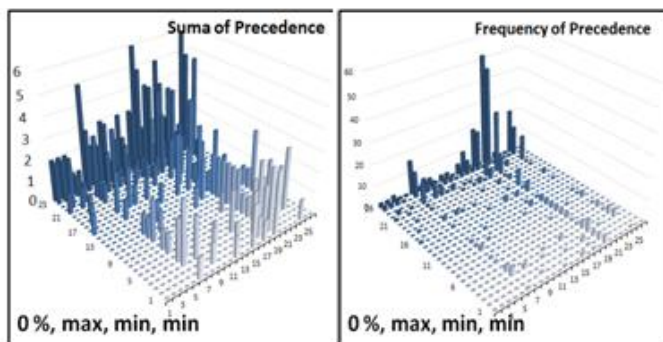


Figure 16. Precedences x,max, min, min - 0. %.

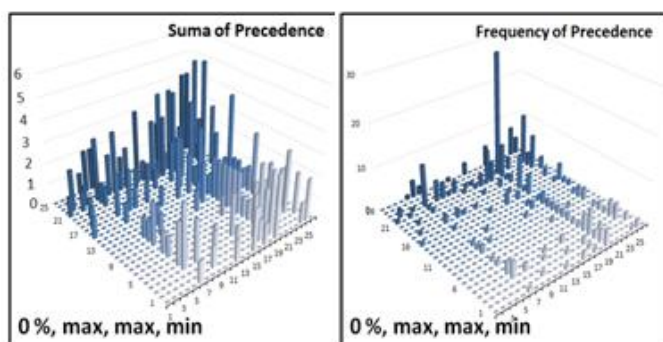


Figure 17. Precedences x,max, max, min - 0. %.

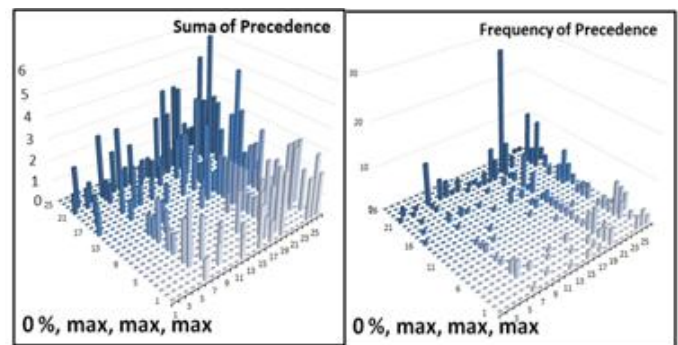


Figure 18. Precedences x,max, max, max - 0. %.

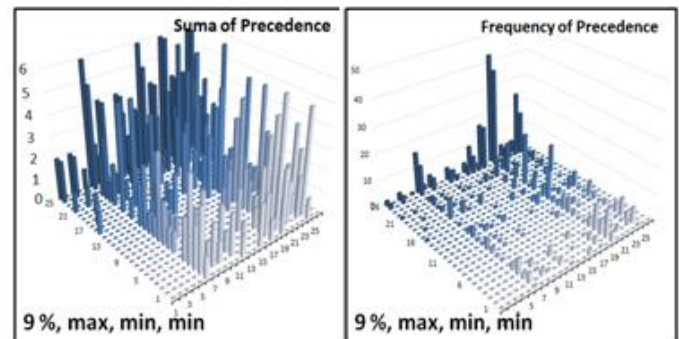


Figure 19. Precedences x,max, min, min - 9. %.

The charts show a decrease in the number and frequency of precedence, which are created by SK, OR and ZR. Different behavior is visible in Fig. 19 and 20 for the value of PL 9% when the number of frequencies of precedence grow the faster the more types of the surrounding reach the maximum value.

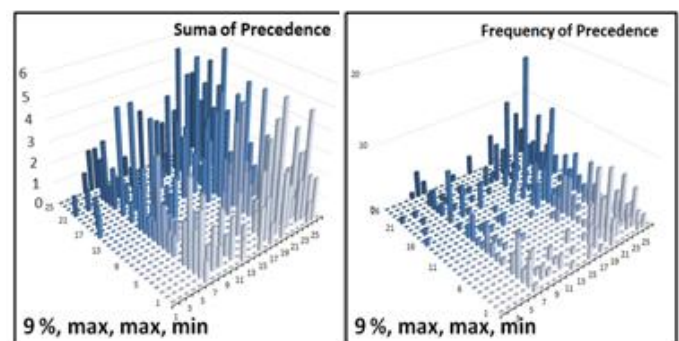


Figure 20. Precedences x,max, max, min - 9. %.

The charts in Fig. 21-23 illustrate the growth of precedence of the surrounding when the value of this surrounding to the maximum. Increasing the number of precedence surrounding is at the expense of the loss of precedence especially in the MEP 19. It is interesting to reduce the largest of precedence from 7 to 5 by the model (x, max, max, and min). This decrease is probably due to the longer routing precedence over the OR.

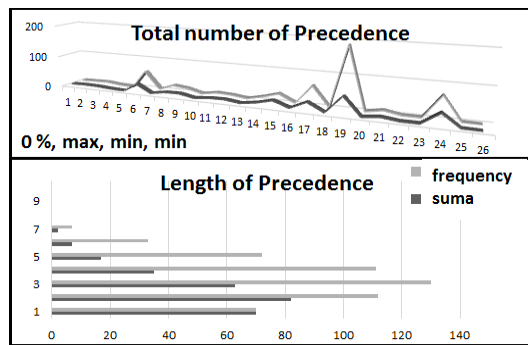


Figure 21. Total and Length Precedences x,min, min, min - 5. %.

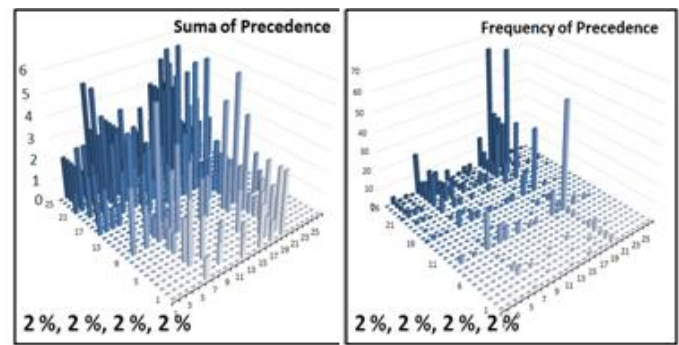


Figure 25. Precedences x, x, x, x - 2. %.

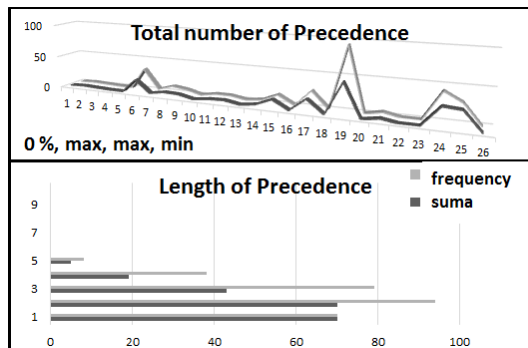


Figure 22. Total and Length Precedences x,max, max, min - 0. %.

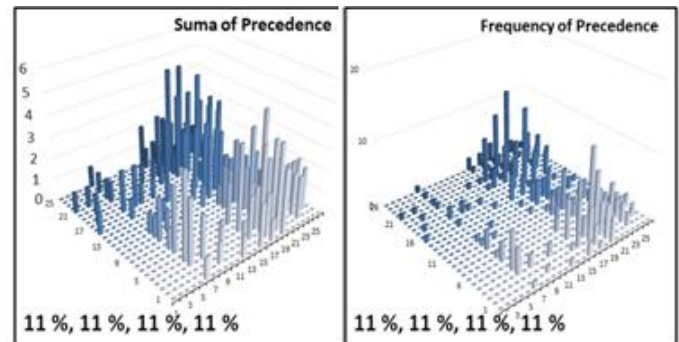


Figure 26. Precedences x, x, x, x - 11. %.

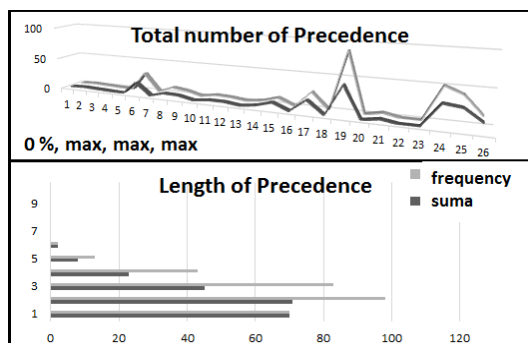


Figure 23. Total and Length Precedences x,max, max, max - 0. %.

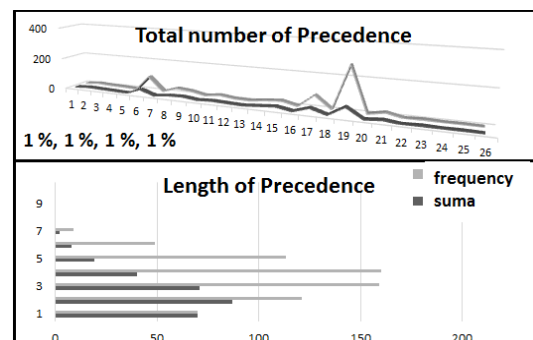


Figure 27. Total and Length Precedences x, x, x, x - 1. %.

#### D. Comparison of the model x, x, x, x

The next category of charts shows the changes which are generated along with value of all surroundings increase. Again it is the greatest sensitivity to changes in the amount of 2 % and 11 %.

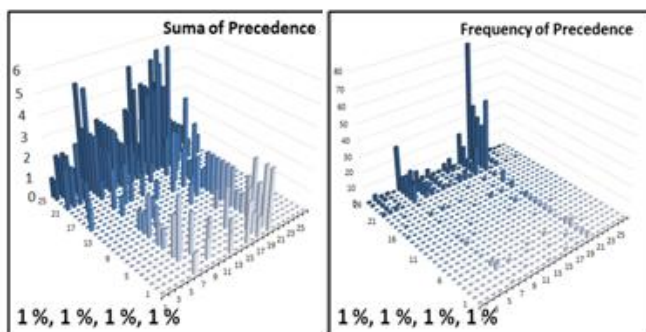


Figure 24. Precedences x, x, x, x - 1. %.

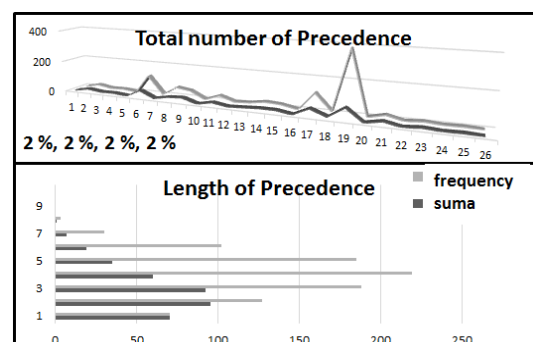


Figure 28. Total and Length Precedences x, x, x, x - 2. %.

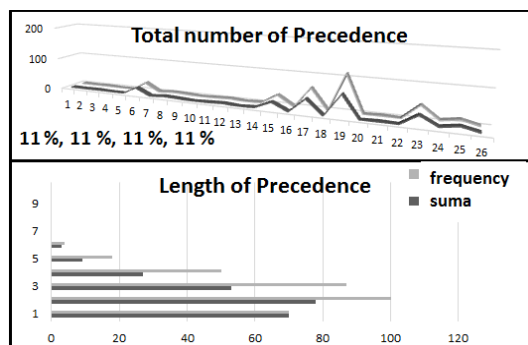


Figure 29. Total and Length Precedences x, x, x, x - 11. %.

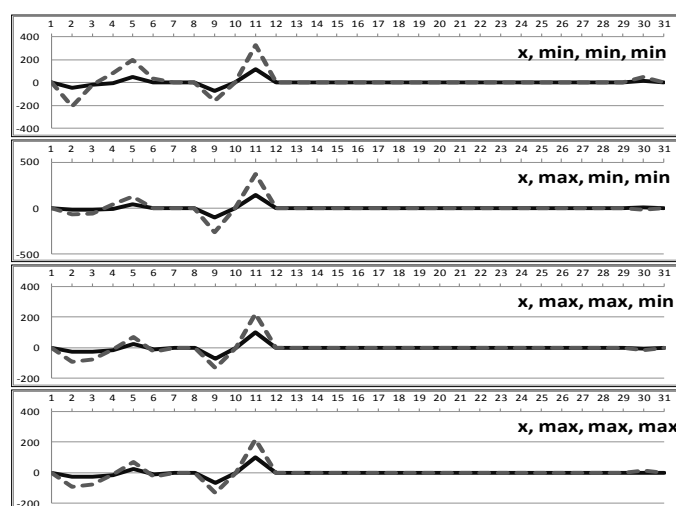
#### IV. CONCLUSION

During the analysis the sensitivity to changes in the system surrounding was determined. The values of the surrounding were changed in the first phase separately for each surrounding. Due to a considerable number of combinations, in practice value of the surrounding was changed continuously in the interval 1% - 100%, the remaining area was changed in steps between min and max values. In the second phase changes were monitored in pairs. Values of external surrounding were fluently changed (PL, SK) and values of internal surrounding (OR, ZR) were changed in steps. In the third phase values of internal surrounding were changed and values of external surrounding in steps. At the end all values surrounding were continuously changed so that they have the same value in every step. The table Fig. 30 and the charts Fig. 31 show that the changes in precedence aren't continuously in the whole interval 1% - 100% but jump at certain values. These values are set the values of the analyzed variables in certain elements of the system. From the analysis we can deduce the finding that the dominant elements in the system are those which have the values given value similar to the value as value of variable of changing element at the time of fluctuation of number of precedence. The present model has 12 basic break event point, not all of them are active in each measurement. The table Fig. 30 shows that due to the changes in the surrounding PL occurs in intervals of 2% - 5% to a sharp decrease of precedence and subsequent growth. Other fluctuations occur in 9%, 11% and 30%, when there is occurred decrease, increase and stabilize precedence. If we observe the changes in the surrounding of SK, we find that the fluctuations are less and not so considerable. The fluctuations happen only by the change 2%, 5% and 31%. The changes aren't so extensive (mostly in tens of changes), they have simultaneously opposite tendency; first numbers of precedence are rising and then falling. Similar results are achieved also for changes in the surrounding ZR, where they occur for 3% and 5%, however consolidation is done for 12% already. Generally, consolidation can be noticed when 12% is achieved regarding internal surrounding and 30% is achieved regarding external surrounding. The system is the most sensitive for simultaneous changes in all the types of surroundings. The purpose of this paper was to introduce professional public with the concrete research performed by the research team of School of Business Administration in Karvina and, at the same time, to demonstrate non-standard analysis methods and their practical

use. Further methods are demonstrated for example in [1], [2] and [12].

value in surroundings		2564	3093	3621	4149	4678	5206	6263	6791	7848	8376	17887	18415
x (%)		1	2	3	4	5	6	8	9	11	12	30	31
x, min, min, min	Sum		-47	-17	-7	54	5		-73	118		17	
	Frq		-159	0	94	146	30		-85	208		31	
x, max, min, min	Sum		-24	-24	-13	35			-108	141		3	
	Frq		-45	-37	49	87			-161	226		-24	
x, max, max, min	Sum		-29	-28	-19	21	-12		-72	99		-5	
	Frq		-65	-53	9	47	-16		-64	120		-15	
x, max, max, max	Sum		-29	-28	-19	21	-12		-70	98		-4	
	Frq		-65	-53	9	47	-16		-64	120		15	
min, x, min, min	Sum		1			5							-20
	Frq		6			15							-32
max, x, min, min	Sum		5			-5							-35
	Frq		9			-7							-42
max, x, max, min	Sum		6			-5							-21
	Frq		9			-7							-34
max, x, max, max	Sum		-5			2							-70
	Frq		-5			-2							-92
min, min, x, min	Sum	18	45					14	4		1		
	Frq	83	93					39	22		4		
max, min, x, min	Sum	-2	13					13	14		-18		
	Frq	15	27					30	33		-17		
max, max, x, min	Sum	1	20					11	14		-11		
	Frq	17	33					30	33		-17		
max, max, x, max	Sum	-9	10					-2			-12		
	Frq	-20	5					3			-12		
min, min, min, x	Sum			10		2					-11		
	Frq			31		6					12		
max, min, min, x	Sum			12		3					-11		
	Frq			31		6					-12		
max, max, min, x	Sum			5		12					-33		
	Frq			29		13					-52		
max, max, max, x	Sum			5		2					-22		
	Frq			9		-2					-48		
x, x, x, x	Sum	-23	-82	-48	1	36	23	-18	-15	160	-80	60	12
	Frq	-55	-243	-101	169	67	96	-15	85	294	-160	143	0
x, x, min, min	Sum		-35	-18	-8	-12	12		-58	141		19	-35
	Frq		-90	-7	79	30	48		-64	238		33	-42
x, x, max, max	Sum		-43	-22	-14	-9	2		-38	105		11	-60
	Frq		-122	-30	32	24	14		-8	128		12	-92
min, min, x, x	Sum	14	38	-4		-18		27	19		-8		
	Frq	83	93	8		30		63	36		-8		
max, max, x, x	Sum	1	20	-10		-13		23	30	-31			
	Frq	17	3	-8		-28		57	48	-64			

Figure 30. changes in precedence and values



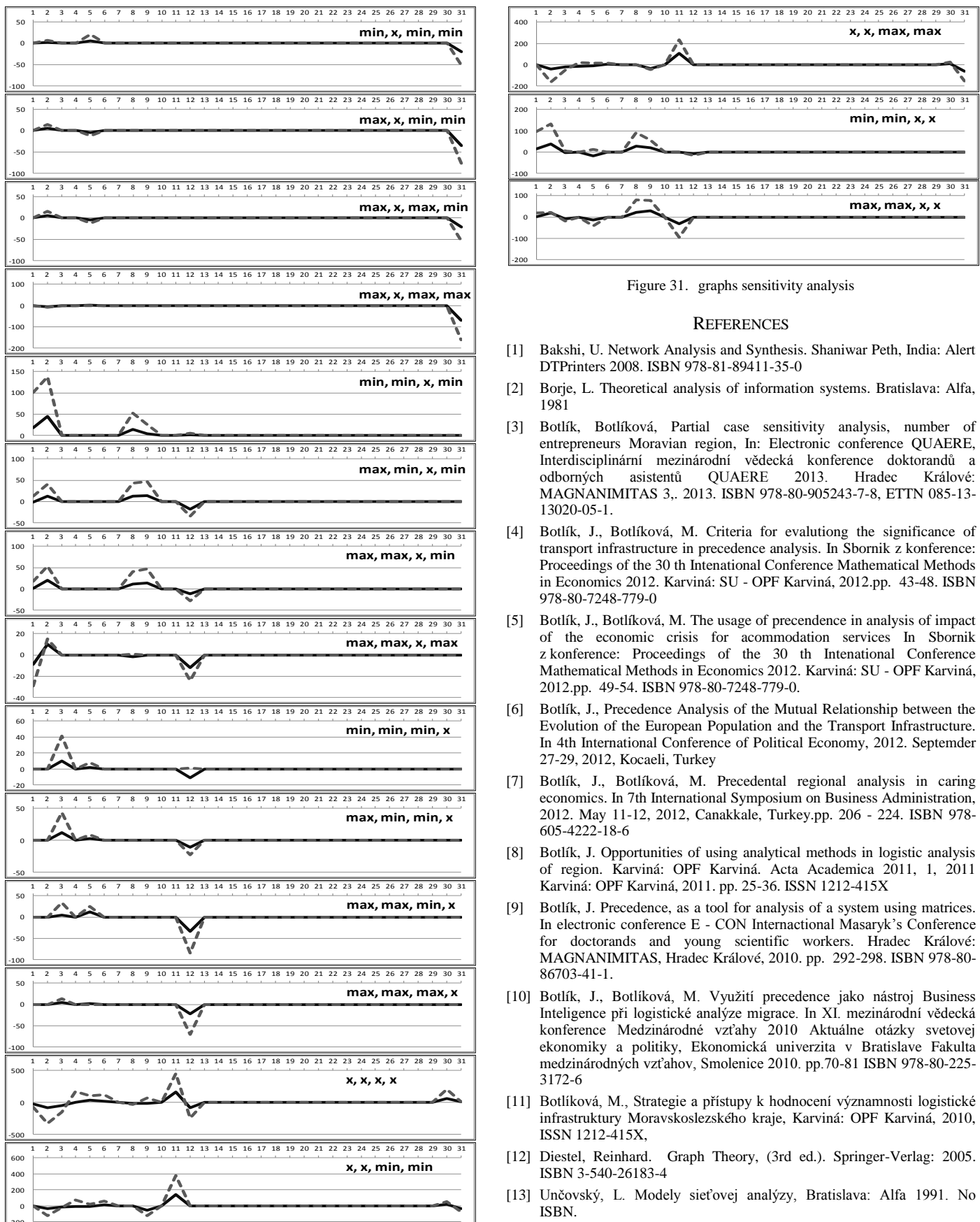


Figure 31. graphs sensitivity analysis

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# A Thermodynamic Framework for Economic Production

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**Abstract**—Economic theories lack rigorous validation found in other areas of science, making them vulnerable to endless, inconclusive debate. Using an approach termed by the authors as “domain concept transference”, certain universal and undisputed concepts found in thermodynamics can lend its precepts as a guiding structure for understanding key elements in economic production behaviors, due to the commonality of a key parameter—energy—that both areas have in common. The thermodynamic principle of minimum energy can be used to predict that the production quality of a business will decrease if changes in pay or required employee effort occur in a closed system without an external source of energy.

**Keywords**- *Economic Equilibrium; Quality Auditing; Domain Concept Transference; Adjunct teacher pay and time study; 2<sup>nd</sup> Law of Thermodynamics; Principle of Minimum Energy*

## I. INTRODUCTION

The concept of energy use and its optimization, as well as the seemingly distinctive issue of production as it relates to economic efficiency have been discussed independently *ad nauseam* by numerous scientists and economists in their respective fields.

While the idea of energy and the laws of thermodynamics which govern it are laid out as universal and unchanging to our reality—as a series of expectations on nature to be observed without exception—the purported edicts of economics are treated far differently.

The absence of an “uber-theory” in economics allows the Keynesian enthusiasts to hold adamantly to the economic theory of active government intervention in the marketplace (and monetary policy as the best method of ensuring economic growth and stability); while at the same time leaving disciples of Adam Smith without seeming conflict as they hold firmly to the idea of monetarism and in the belief that the best path ahead lies with the unfettered free market.

Many social behaviors can easily be linked to a thermodynamic framework; a simple example might be as follows:

Imagine a person has to carry a load and can choose from 2 paths to get from A --> B; path 1 requires a 1 mile walk down a gently sloping road, while path 2 involves walking up a steep hill. *Ceteris paribus*, the vast majority (if not everyone) will choose the first path. This is not surprising since path 2

requires less energy yet accomplishes the same objective. In other words, it can be said that people generally chose behaviors that align with certain thermodynamic principles.

A management strategy that expects people to deliberately choose path 2 with no added incentive is neither thermodynamically favored nor predictably viable. Subsequently, one should expect unintended consequences as the system seeks to regain an equilibrium in context of the additional energy required.

Should management attempt to increase the required energy expenditure of its employees without any incentives and in the absence of a meaningful audit measure, it is foreseeable that a shift in behavior(s) away from those that deliver the expected quality will occur. This “respect for equilibrium” is also seen in a range of other systems, for example those whose behaviors are predicted by Le Chatelier's principle.

This paper attempts to answer a simple question: How do the fundamental laws of thermodynamics—the building blocks of all observable natural phenomena—translate to the fundamental tenants of economics?

While it remains beyond the scope of this paper to do a full and comprehensive vetting of the congruency of these two fields, a more limited juxtaposition of the two areas will be completed. Further, it is stipulated that not only will clear and rational similarities be identified, but also that the principles belying the second law of thermodynamics—the principle of minimum energy—can be used to dependably predict outcomes in the area of economic production.

## II. BACKGROUND

### A. *The Thermodynamic Principle of Minimum Energy in Economic Theory*

The principle of minimum energy is essentially a restatement of the second law of thermodynamics. It states that for a closed system with constant external parameters and entropy the internal energy will decrease and approach a minimum value at equilibrium [1]. For example, a marble rolling back and forth in a bowl will always come to rest at the lowest point of the bowl.

In the area of economics, a corollary of the fundamental principles of this sociological science include that [2]:

- i. People respond to incentives and
- ii. Rational minded people think at-the-margin.

The first and second points are linked. The first (something immediately confirmed by experience) serves as a compliment to the second which says that most rational decision makers would proceed with an action if the marginal benefit exceeds the marginal cost (for example, a farmer should produce another bushel of corn only if the benefit (price received) exceeds the cost of producing it)[3]. While somewhat self-evident, these points support the underlying thermodynamic viewpoint that effort (or energy) is minimized and never expended without an aim at net benefit. If one considers that the physical and mental resources of workers to represent true energy input into a system of economic production, then it becomes a basis for modeling the relationship that could exist among the core variables of that production.

This paper proposes that increasing workers' effort expenditure while keeping pay stagnant would be considered an unstable system. If, in the absence of technological innovation it is suggested that such a system was in fact stable, the authors would speculate with predictable thermodynamic certainty that 1) either the quality of the production is being compromised or 2) increased operational risk is being tolerated.

Events have been occurring on the international stage with increasing frequency that espouse this idea. In recent years there have been numerous cases observed where a severe drop in production quality occurred in tandem with the pursuit of obtaining the same level of output with less and less cost. Examples abound, with many involving imports from China including [4]:

- Dried apples preserved with a cancer-causing chemical
- Frozen catfish laden with banned antibiotics
- Scallops and sardines coated with putrefying bacteria
- Mushrooms laced with illegal pesticides

Even more recently, there has been the case of the mass deaths of workers in Bangladesh, resulting from the collapse of a building in which they worked; it is documented that before the collapse workers pointed out their concern with the infrastructure. The decision by management to maximize the return on assets (in this case, fixed assets) without any additional inputs resulted in a wide scale loss of life and mass injuries [5].

### *B. Implications of using Thermodynamic Principles as a Framework for Economic Production*

This paper lays out the following premise:

Businesses which are closed systems and use intensive human capital are a function of the following variables:

- i. **Quality** of the product or service (system output) that allows it to be acceptable in the marketplace over the long-term (Q)
- ii. **Pay** given to the workers (system input) to produce the product/service (P)

- iii. **Effort** required of workers (system input) in the course of production (E)
- iv. Technology/procedure based **Innovation** (I) in the workplace that reduces human effort (E) and maintains or increases quality (Q).

This paper defines a "closed system" in the context of business as one where no new substantial costs are added or removed, and is best imagined as a snap shot of business operations on a stable day to day basis.

This paper stipulates that economic production systems trend toward a thermodynamically favored equilibrium:

- a) This equilibrium is a balance point among the variables Q, P, E, and I which are guided by the principle of minimum energy
- b) If true, then Quality will always decline (over time) when the Pay or Effort of workers is attempted to be minimized or maximized respectively, without any true innovation

Subsequently, the following would also be true in cases where real innovation is absent:

$$Q = f(P, E)$$

and,

-If  $P \downarrow$  and  $E_{\text{constant}}$  then eventually  $Q \downarrow$

-If  $E \uparrow$  and  $P_{\text{constant}}$  then  $Q \downarrow$

-Also, If  $P \downarrow$  and  $E \uparrow$  then  $Q \downarrow$

Other combinations are possible (e.g.  $P \uparrow$  and  $E \downarrow$ ) but not likely to occur in the majority of for-profit capitalist businesses.

### III. ETHNOGRAPHY

#### Adjunct teaching in For-Profit Colleges

The job sector of adjunct teaching in the college industry offers a good opportunity to examine the principles laid out in this paper. For over 5 years, qualitative data have been collected from various adjunct roles at for-profit colleges across various subject areas. During this time, there has been a significant increase in the shift toward use of adjunct teaching positions instead of permanent, full time employees. Adjuncts are typically paid contract positions with no benefits or reliable income [6]. Further, there has also been a gradual substantial increase in the administrative responsibilities given to adjuncts with no increase in pay.

The nature of the job is more clearly defined by the following requirements:

1. Pay for teaching a course is constant, whether the class has 15 students or 30 students

2. Pay is typically stated as an amount per hour of *teaching*; time and effort spent on any other work tasks are not factored in
3. There is no difference in pay if an adjunct is required to just teach a course versus building a course: selecting and putting together all the subject material even though it requires significantly more work is not recognized or rewarded financially
4. There is no monetary bonus or reward for meeting any of the performance metrics laid out by the college

The authors conducted a thorough, detailed journaling and measurement of time spent on all adjunct duties, including those not involving direct face-to-face teaching time. The database applications Microsoft Access and Excel were used to record tally and analyze the quantities of time spent on various tasks. Non-teaching duties included:

Preparation of class materials, marking student work, following up with student concerns, issuing make-up work for absentees, giving extra credit for students on a special case basis, student counseling, attending department meetings etc.

It was found that an adjunct position offering a pay range of “\$30-\$35 per hour to teach” was really paying an effective rate of \$11-\$13 per hour to realistically fulfill all the duties required of the position.

By conducting confidential qualitative interviews with adjunct teachers in various subject areas, it was confirmed that the main factors measured by colleges for “quality assurance” of education include: class passing rate, overall grades, student complaints and attendance.

***There was little or no auditing of actual classwork or verification of student knowledge via standardized exams.*** Consequently adjuncts are motivated to liberally “bend” the scope and quantity of the material covered, in addition to offering repeated “make-up work” opportunities to ensure the metrics being captured by college administrators are being satisfied.

The authors believe that if in fact more accurate quality measurements were used that assessed the actual product of education (i.e. standardized tests as opposed to financially driven metrics) that:

-Since Q (quality) is then held constant by auditing the actual product (student learning)

-then either P (pay) would increase to match the required E (effort)

OR

- adjuncts would quit the field and again a higher P (pay) would be needed to attract enough professionals to fill the positions.

At least directional support is seen for issues discussed here in the recent indictment of the entire for-profit school industry by a U.S. Senate Committee on Health, Education, Labor and Pensions Report about the underperformance in delivering on

its promise of a high quality education despite high profitability [7].

## DISCUSSION

This paper makes the assertion that in economic production systems that depend on the use of intensive human capital, the principle of minimum energy can be used as a guide to forecast behavior that will result from the changes of certain economic parameters.

Effort expended by workers represent energy input into a closed business system; they continually seek to attain yield optimization with regard to expended energy, following the principle of minimum energy.

### A. Shifts from Equilibrium

If a production system as alluded to above is at equilibrium (no new employees, no new costs, quality is constant), and a shift occurs to the inputs in the form of less pay or more worker effort required (or both) then the system will tend toward a new equilibrium which will *guarantee* a reduction in quality, unless there is an outside energy source or technological innovation is introduced

Where these production systems experience such changes and *yet appear to be stable*, it is highly likely that:

- Systems that claim to not have this problem are almost certain to have very poor, non-existent or liberally interpreted audit systems, or metrics that incorrectly measure true quality.
- Equivalently, there may also be a decrease in the quality of the production process as risk is increased via shortcuts taken by workers or management.

Alternatively, “stability” may be accomplished by “opening up” the closed system: i.e. by allowing the introduction of an “outside” force, namely: providing other forms of benefits or facilitating a high turnover rate among employees.

It seems advisable that in the absence of innovative technology, businesses which record a rising workload per pay unit over consecutive periods, be:

- a) Tasked with laying out the rationale as to why this approach would be expected to result in sustained quality beyond the short-term
- b) Have the audit systems checked to see exactly what parameters are being measured, particularly in claims of unwavering quality

Keeping only to those thermodynamic relationships that will offer insight, it is known that for a closed thermodynamic system at equilibrium:

$$dS \propto dU$$

where  $dS$  represents a change in entropy (or disorder) and  $dU$  a change in the internal energy of the system[8]. It is recognized that if the internal energy of the system is changed then there must be a corresponding change in its entropy, and vice versa.

In production it is known that any measure of quality (Q) must include the notion of consistency—i.e. there must be a certain reliability of uniformity in whatever is being produced.

For comparative purposes we see that in an economic production system:

- Entropy is a measure of the degree of order which is also a measure of Quality (i.e. lower entropy means more order, which translates into a better measure of quality output)

And further,

- Internal energy can be seen as comparable to the operating profit margins in a business (reasonable since profits, like energy, represent the ability to do “business work”) then:

$$dQ \propto dP \quad \text{and} \quad dQ \propto 1/dE$$

It is well known business dogma that two factors which can rapidly increase business profits are 1) paying employees less and/or 2) getting employees to work more without a change in pay. Profits being considered as the internal energy of a business, is directly proportional to the measure of quality output (level of disorder).

In other words, although net operating profits can be increased by decreasing worker pay [P] (for the same effort) or increasing worker effort [E] (at constant pay), there is little basis for assuming that in the absence of a new innovation, quality can be held constant (that is, unless the quality measurement process itself is flawed).

#### CONCLUSION

Many social behaviors can easily be linked to a thermodynamic framework; it can be said that people generally chose behaviors that align with certain thermodynamic principles. The literature runs deep in both fundamental thermodynamic principles and the classical concepts (and dichotomies) proposed by major economic philosophies. However, the absence of the availability of “petri dish” scientific studies in the field of economics often permits endless and ultimately inconclusive debate. Using principles from the wider area of thermodynamics that are *conclusive*—and past debate—as a basis to provide structure and a platform for rational discussion and scenario analysis, gives a starting point for tying in areas of economics that are by nature open-ended due to its sociological nature.

A management strategy that expects employees to deliberately exert more energy without added incentive is neither thermodynamically favored nor predictably viable. Subsequently, one should expect unintended consequences as

the system seeks to regain an equilibrium in context of the additional energy required.

Should management attempt to increase the required energy expenditure of its employees without any incentives *and* in the absence of a meaningful audit measure, it is foreseeable that a shift in behavior(s) away from those that deliver the expected quality will occur.

Using this paper as a foundation, perhaps future deliberations of economic models could include a focus beyond circumstantial validation of Keynesian economics or the free market approach. Additionally, future studies might benefit by attempting to show how an advocated economic system actually demonstrates corroboration with governing thermodynamic principles such as those discussed in this paper.

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# The analysis of Keynesian theory

## (methods, backgrounds, main positions, consequences and model)

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**Abstract** – This paper focuses on the analysis of Keynesian theory on the basis of the systems approach. The classifications of methods, backgrounds, main positions and consequences of the Keynesian theory are given. Also the Keynesian model of the national economy is shown as a cybernetic model\*.

**Keywords** – *Keynesian theory, systems approach, methods, backgrounds, consequences, model.*

### I. INTRODUCTION

In this paper, the theory of John Maynard Keynes is considered on the basis of the systems approach, in particular Synergetics and Cybernetics, General System Theory and Theory of Homeostasis.

In Synergetics the general patterns of the self-organization, development of the system are considered [1; 2; 3; 4]. Cybernetics considers the mechanisms of the system functioning and adaptation [5]. Also the General System Theory [6] and the Theory of Homeostasis [7; 8] are used in this paper in addition to the Cybernetics and Synergetics.

This study is an attempt to classify the methods of Keynes, to distinguish backgrounds, main positions and consequences of Keynes's theory, as well as analysis of the model of the national economy from the position of the systems approach.

### II. METHODS

First of all, let's turn to the system of methods of John M. Keynes, as it's a basis of the theory.

We can distinguish the following methods used by Keynes: logical method; macroeconomic approach; method of causal analysis; method of marginal analysis; method of psychological analysis.

All the above mentioned methods are used by Keynes in a complex. Let's consider them in more detail.

#### A. The logical method

The logical method is the basis of Keynesian methodology. Even the concept of probability is considered by Keynes as a logical relation.

The logical method is connected with Keynesian macroeconomic approach; it's used to identify the dependencies between macroeconomic indicators.

Keynes uses the logical method to prove the need of government intervention in the economy as well as for a critical analysis of the classical theory.

For example, according to Keynes, the classical theory not merely neglects the influence of changes in the level of income, but involves formal error [9, p.179].

#### B. Macroeconomic approach

Keynes analyzes the relationships between macroeconomic indicators (such as national income, aggregate demand, aggregate supply, employment, savings, investments, etc.) to describe the functioning of the national economy.

The General Theory of Employment, Interest and Money of Keynes is constructed as a logical analysis of the relationships between macroeconomic indicators.

Keynes points out that our present object is to discover what determines at any time the national income of a given economic system and (what is almost the same thing) the amount of its employment [9, p.247].

#### C. Method of causal analysis

Keynesian method of causal analysis is a return to the methods of the classical theory, when dependent and independent economic categories are determined. In contrast to the causal analysis the functional method, which has spread during the "marginal revolution", represents all elements of the economic system as equal and interdependent. The functional analysis assumes the rejection of the search of the fundamental factors that are the causes of economic processes.

For the analysis of macroeconomic indicators Keynes uses causal analysis, which corresponds to the theory of cybernetics. In the cybernetic model the regulatory body (the government) determines, which commands should be given at the input of the "black box" (the national economy) to get the ideal, planned output results and to ensure the sustainability of the system.

Our final task might be to select those variables which can be deliberately controlled or managed by central authority in the kind of system in which we actually live [9, p.247].

According to this approach the national economy is considered as a "black box". Attention is paid to its input and

<sup>1</sup> \* Supported by the Erasmus Mundus Action 2 Programme of the European Union.

output parameters, the determination of cause-effect relationships between the input and output parameters.

To begin with, it may be useful to make clear which elements in the economic system we usually take as given, which are the independent variables of our system and which are the dependent variables [9, p.245].

Our independent variables are, in the first instance, the propensity to consume, the schedule of the marginal efficiency of capital and the rate of the interest. Our dependent variables are the volume of employment and the national income (or national dividend), measured in wage-units [9, p.245].

Keynesian construction of cause-effect relationships between macroeconomic indicators is based mostly on a logical approach than on the analysis of the real statistical data.

Keynes writes about his method the following: It should not be difficult to compile a chart of the marginal propensity to consume at each stage of a trade cycle from the statistics (if they were available) of aggregate income and aggregate investment at successive dates. At presents, however, our statistics are not accurate enough (or complied sufficiently with this specific object in view) to allow us to infer more than highly approximate estimates [9, p.127].

Although Keynes uses some statistical data, mainly S. Kuznets and Clark, for example, to check the Multiplier, but basically he uses a logical approach to determine the macroeconomic dependencies.

#### *D. Method of marginal analysis*

Keynes uses a method of marginal analysis of macroeconomic indicators. Keynes uses the theory of Marginalism together with the logical method and macroeconomic approach. For example, Keynes explores such macroeconomic indicators as the marginal propensity to consume, the marginal efficiency of capital.

#### *E. Method of psychological analysis*

Keynes also uses the method of psychological analysis.

Keynes's theory is based on the mass psychology, not on the individual psychology. The mass psychology may have priority for several reasons. First, the methodological individualism is denied in the theory of Keynes, and secondly, the psychological analysis is mainly used for the analysis of macroeconomic variables.

Keynes considers such macroeconomic indicators as saving, consumption, the rate of interest on the basis of the psychological approach.

The method of psychological analysis is implemented in "psychological law" of Keynes: The outline of our theory can be expressed as follows. When employment increases, aggregate real income is increased. The psychology of the community is such that when aggregate real income is increased aggregate consumption is increased, but not so much as income [9, p.27].

Keynes distinguishes the three fundamental psychological factors, namely, the psychological propensity to consume, the

psychological attitude to liquidity and the psychological expectation of future yield from capital-assets [9, p.247].

So we have considered the system of methods of Keynes, which is based on the logical method. Keynes's methodology is the complex of methods, which do not contradict, but complement each other.

### III. BACKGROUNDS, MAIN POSITIONS AND CONSEQUENCES

Below is presented the analysis of Keynesian theory as a set of backgrounds, main positions and consequences.

#### *Backgrounds:*

The denial of methodological individualism and the assertion of holism.

#### *Main positions:*

- 1) The denial of the self-organization of national economy.
- 2) The denial of possibility to achieve the optimum by the national economy through the actions of individuals.

#### *Consequences:*

- 1) The need of government intervention in the national economy.
- 2) The expansion of the national economy should be a function of the State that is realized through the maintenance of quasi-boom.
- 3) The mechanism of the adaptation and expansion of the national economy is realized through the multiplier and accelerator stimulated by the State (Keynesian theory and Neo-Keynesian theory).

#### *A. The backgrounds*

*The denial of methodological individualism and the assertion of holism.*

The holism has priority over the methodological individualism concerning the national economy in Keynesian theory.

According to the methodological individualism, the individual is the foundation and the driving force of economic processes. Keynes argues that the actions of individuals in their interests do not always match, and sometimes contrary to the interests of society.

According to the principle of holism, the whole object is more important than its parts, and the interests of society are over the interests of individuals.

Thus, Keynes stands for "purified" (controlled by the State) individualism, that is, the holism. In other words, it is the methodological individualism for the elite (mainly for those who are in the regulatory body, in the government) and holism for all others.

But, above all, individualism, if it can be purged of its defects and its abuses, is the best safeguard of personal liberty in the sense that, compared with any other system, it greatly widens the field for the exercise of personal choice [9, p.380].

Whilst, therefore, the enlargement of the functions of government, involved in the task of adjusting to one another the propensity to consume and the inducement to invest, would seem to a nineteenth-century publicist or to a contemporary American financier to be a terrific encroachment on individualism, I defend it, on the contrary, both as the only practicable means of avoiding the destruction of existing economic forms in their entirety and as the condition of the successful functioning of individual initiative [9, p.380].

The authoritarian state systems of today seem to solve the problem of unemployment at the expense of efficiency and of the freedom. It is certain that the world will not much longer tolerate the unemployment which, apart from brief intervals of excitement, is associated – and, in my opinion, inevitably associated – with present-day capitalistic individualism. But it may be possible by a right analysis of the problem to cure the disease whilst preserving efficiency and freedom [9, p.381].

According to the systems approach, the principle of holism represents the block of direct links of the system (the impact of the regulatory body, rules, and institutions on individuals and economic agents). The principle of holism is the condition of the system existence. The principle of methodological individualism represents the block of feedbacks (relations of individuals and economic agents for the formation and changing of rules, institutions). The principle of methodological individualism is the condition of the adaptation and self-organization of the system.

Denial of the methodological individualism corresponds to the cybernetic concept of the national economy, in which the elements of a cybernetic system (individuals, economic agents) are only executive mechanisms subordinated to the regulatory body (to the State).

The principle of holism corresponds also to the cybernetic hierarchical model of corporation. This model became common in the late 19<sup>th</sup> and first half of 20<sup>th</sup> centuries.

#### *B. Main positions (theorems)*

##### *The denial of the self-organization of national economy.*

Denial of the self-organization of the national economy follows from denial of the methodological individualism.

But the elements of a self-organizing system and the individuals in a society provide a process of self-organization and self-regulation. The denial of the methodological individualism means that individuals don't have the opportunity to take part actively in creation and changing of the rules, institutions of the national economy. This leads to the denial of the self-organization and self-regulation of the national economy.

The assertion of holism means that the regulatory body (the State, but not individuals) becomes the main structural element for the stable functioning of the economy.

Keynes criticizes the classical theory in his logical description of saving, investment and the rate of interest as follows: and, further, that this is a self-regulatory process of adjustment which takes place without the necessity for any special intervention or grandmotherly care on the part of the

monetary authority... This account of the matter must be erroneous [9, p.177].

For the Classical Theory has been accustomed to rest the supposedly self-adjusting character of the economic system on an assumed fluidity of money-wages; and, when there is rigidity, to lay on this rigidity the blame of maladjustment [9, p.257].

There is, therefore, no ground for the belief that a flexible wage policy is capable of maintaining a state of continuous full employment; - any more than for the belief than an open-market monetary policy is capable, unaided, of achieving this result. The economic system cannot be made self-adjusting along these lines [9, p.267].

Thus, Keynes denies the self-organization of the national economy and argues that the national economy should be the same vertical (cybernetic) control system, as corporations, where the elements obey the commands of the regulatory body.

*The denial of possibility to achieve the optimum by the national economy through the actions of individuals.*

The denial of methodological individualism and the assertion of holism means not only that the purpose of the whole system (the national economy) may be different from the private purposes of the system elements (individuals, firms), but also the fact that the purposes of the system as a whole are more important than private purposes of its elements.

Therefore, Keynes denies the possibility to achieve the optimum by the national economy only through the actions of individuals, firms (elements of the system) without the intervention of the State (regulatory body). This proves also the need of government intervention.

For example, Keynes notes the negative impact of the stock exchange speculation on the optimization processes in the real economy.

Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done. The measure of success attained by Wall Street, regarded as an institution of which the proper social purpose is to direct new investment into the most profitable channels in terms of future yield, cannot be claimed as one of the outstanding triumphs of laissez-faire capitalism [9, p.159].

Keynes considers the crises, unemployment, and inequitable distribution of income as evidence that the actions of individuals do not lead the economy to the optimum.

The outstanding faults of the economic society in which we live are its failure to provide for full employment and its arbitrary and inequitable distribution of wealth and incomes [9, p.372].

The denial of the optimum of the national economy as a result of the actions of its elements (individuals and firms) is implemented in the psychological law of Keynes.

When employment increases, D1 (expected to spend on consumption) will increase, but not by so much as D (effective demand); since when our income increases our consumption increases also, but not so much. The key to our practical problem is to be found in this psychological law [9, p.29].

### C. Consequences

*First consequence* from 1<sup>st</sup> and 2<sup>nd</sup> theorems (the denial of the self-organization of national economy and the denial of possibility to achieve the optimum by the national economy through the actions of individuals) *is the need of the government intervention in the national economy.*

Since in Keynesian theory the national economy isn't a self-organizing system and it can't achieve the optimum by itself, therefore, the economic system can't cope with the crises and unemployment. Therefore, the central regulatory body of the national economy is needed, i.e. the government.

The central controls necessary to ensure full employment will, of course, involve a large extension of the traditional functions of government [9, p.379].

From the point of view of the systems approach to the theory of Keynes, the function of the State as the regulatory body consists, first of all, in establishing and changing the rules of the economic life, and not in the ownership of the means of production.

But beyond this no obvious case is made out for a system of State Socialism which would embrace most the economic life of the community. It is not the ownership of the instruments of production which it is important for the State to assume [9, p.378].

For whilst it indicates the vital importance of establishing certain central controls in matters which are now left in the main to individual initiative [9, p.378].

*Second consequence* from 1<sup>st</sup> and 2<sup>nd</sup> theorems (the denial of the self-organization of national economy and the denial of possibility to achieve the optimum by the national economy through the actions of individuals): *the expansion of the national economy should be a function of the State that is realized through the maintenance of quasi-boom.*

Keynes considers the equilibrium and the economic cycles but only in the short term.

But in the long run is there not some simpler relationship? This is a question for historical generalization rather than for the pure theory [9, p.306].

Keynes argues that the national economy tends to equilibrium. Principle of equilibrium is accepted by Keynes from the classical theory.

According to Keynes, the equilibrium can be established under the conditions of full employment and underemployment, in contrast to the classical theory.

Keynes doesn't deny the cyclicity of the national economy.

By a *cyclical* movement we mean that as the system progresses in, e.g., the upward direction, the forces propelling it upwards at first gather force and have a cumulative effect on

one another but gradually lose their strength until at a certain point they tend to be replaced by forces operating in the opposite direction [9, p.313-314].

We do not, however, merely mean by a *cyclical* movement that upward and downward tendencies, once started, do not persist for ever in the same direction but are ultimately reversed. We mean also that there is some recognizable degree of regularity in the time-sequence and duration of the upward and downward movements [9, p.314].

According to the systems approach, the oscillatory processes (including cyclic processes) are more unwanted for a cybernetic system than for self-organizing system, because the cybernetic system has fewer capabilities to adaptation than the self-organizing system.

Keynes offers the cybernetic vertical model of the national economy, controlled by the regulatory body, the State. According to the systems approach, a cybernetic system strives to achieve a sustainable equilibrium, to minimize internal and external vibrations. That corresponds mostly to the zero economic growth, to the stage of depression. According to Schumpeter, it is acceptable if the economy has reached a sufficiently high level [10].

But Keynes was strongly against the depression and crisis, because his theory was aimed against the Great Depression.

Keynes denies the self-organization of the national economy and the possibility to achieve the optimum by the national economy independently. Thus, Keynes offers to give a function of adaptation of the national economy to the regulatory body, the State.

Keynes offers to solve the problem of economic cyclicity, namely to direct the efforts of the State on maintaining a quasi-boom and to prevent a crisis and depression. The quasi-boom, in fact, means a permanent progress of the national economy, an increase of the national income and employment through the investment growth.

Thus the remedy for the boom is not a higher rate of interest but a lower rate of interest! For that may enable the so-called boom to last. The right remedy for the trade cycle is not to be found in abolishing booms and thus keeping us permanently in a semi-slump; but in abolishing slumps and thus keeping us permanently in a quasi-boom [9, p.322].

But according to the systems approach, the functioning of a complex system requires a cyclical movement. So, if we maintain the quasi-boom we can only delay the recession.

The price of a quasi-boom is a need to stimulate the consumption and investment by the State, a formation of mass consumption society, a state budget deficit and an increase of the national debt, an increase of the dependence of the developing countries, a growing influence of the financial markets on the real goods markets, a formation of the bubble economy, growing prices for resources, and also a sharp and long crisis at the time when the State can't support a quasi-boom.

*Third consequence* from 1<sup>st</sup> and 2<sup>nd</sup> theorems (the denial of the self-organization of national economy and the denial of

possibility to achieve the optimum by the national economy through the actions of individuals): *the mechanism of the adaptation and expansion of the national economy is realized through the multiplier and accelerator stimulated by the State (Keynesian theory and Neo-Keynesian theory).*

One of the mechanisms for the maintenance of a quasi-boom is a multiplier of J. M. Keynes.

The Multiplier can be established between income and investment and, subject to certain simplification, between the total employment and the employment directly employed on investment [9, p.113].

According to Keynes, the Multiplier is activated by the new investments, which lead to the growth of the national income.

Also the growth of consumption stimulates the growth of national income. The growth of government consumption expenditures and gross investment is the Keynesian way to stimulate the growth of national income.

Keynes' followers consider an accelerator as a mechanism of expansion in addition to the multiplier. A. Hansen calls the system of interaction of multiplier and accelerator "the system of super multiplier" [11].

Thus, the multiplier and accelerator are the external mechanisms of adaptation of the national economy, and they lead to a cyclicity of its functioning. The use of the mechanism of super multiplier requires systematic state intervention in the economy (to start the mechanism, to smooth its operation, to launch a new wave, etc.).

Keynes and his followers offer to create a system of the national economy, which is close to the cybernetic model. They suggest a special kind of control action on the system of the national economy through the multiplier and accelerator.

The mechanism of the super multiplier is an external source of adaptation of the system of the national economy.

So the State should stimulate and regulate the mechanism of the super multiplier.

So, we have considered the backgrounds, the main positions and consequences of the Keynesian theory. Let's move on to the analysis of the Keynesian model of the national economy on the basis of the systems approach.

#### IV. THE KEYNESIAN MODEL

The model of national economy, proposed by Keynes, is a cybernetic model of management (Figure 1).

According to Keynes, the government is a regulatory body of the national economy. The government sets the system goals or standards in the Keynesian model. The ideal economic parameters are determined on the basis of the goals of the system.

The objectives of the national economy in Keynes's theory are the following: the functioning of the national economy without crises and the maintenance of a quasi-boom; effective demand; national income which provides full employment; the optimal distribution of wealth and income, etc.

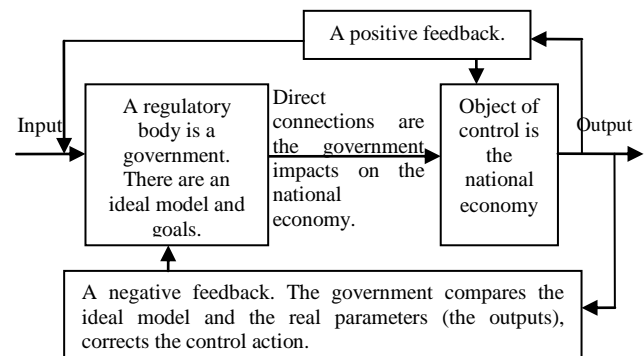


Figure 1. The Keynesian cybernetic model of the national economy on the basis of the systems approach

*Object of control* is the national economy. Essentially, Keynes considers the national economy as a black box, that is, he does not consider the internal structure and functions of its elements. In this case, the main issue for the regulatory body (the government) is following: what control action should be done to provide the ideal output parameters of the national economy.

*Direct connections* are the direct control actions of the regulatory body (the State) on the control object (the national economy) in order to get the ideal output (macroeconomic indicators). In the Keynesian model a direct impact of the State on the national economy is achieved by changing the following macroeconomic parameters:

- Investment parameters (related to the investment demand) including the government investment in the national economy, the amount of money in circulation, the interest rate, the inflation.
- Consumer parameters (related to the consumer demand) including the level of the distribution of the national income, the amount of government consumption expenditures.

*The output parameters* are the real parameters of the national economy, which may deviate from the ideal parameters. The output parameters, which are considered by Keynes, include the national income, employment, unemployment rate, investment, saving and consumption, etc.

The input parameters of the national economy can be simultaneously viewed as the output parameters of the previous period.

*The functions of the negative feedback* in the cybernetic model are performed by the State. The government compares the current output parameters of the national economy with the ideal parameters. The government corrects the control action to bring the output parameters to the ideal value. The State changes the interest rate, the money supply, the volume of government investment, the level of taxation, grants and subsidies in order to achieve the ideal outputs.

The State performs the functions of the current negative feedback, providing the current functioning of the system, and the functions of the strategic negative feedback to adapt the system of the national economy.

*Positive feedback* is not considered in the theory of Keynes. This is the flow of previously uncorrected external and internal deviations that lead to the destruction of the system. These deviations include the growth of the public debt, budget deficits, inflation, etc. Only in the self-organizing system the positive feedback can lead to the development of the system.

## V. CONCLUSIONS

In this paper we have considered the theory of John Maynard Keynes, including methods, backgrounds, main positions, consequences, and model on the basis of the systems approach. We have identified the main and secondary assertions of the theory of Keynes.

Thus, from the position of the systems approach Keynes considers only the mechanisms of the functioning and adaptation of the national economy. Keynesian theory doesn't include the mechanisms of development. An ideal cybernetic system can't develop, it can only adapt.

But according to the systems theory, only the self-organizing system of the national economy can include the mechanism of self-development. The condition of the self-organization of the whole system (national economy) is the self-organization of its elements (economic agents). But Keynesian theory denies the self-organization of the national economy and economic agents.

However classical economics, Schumpeter's theory of economic development, evolutionary institutionalism consider the mechanisms of development (of self-organization) of the

national economy, but they do not pay enough attention to the mechanisms of functioning and adaptation.

Therefore, the future research direction may consist in the formation of the economic theory of self-organization on the basis of the systems approach, including both the mechanisms of development and mechanisms of functioning and adaptation of the national economy.

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# The Analysis of Development of Insurance Contract Premiums of General Liability Insurance in the Business Insurance Risk

in the Frame of the Czech Insurance Market in 1998–2011

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**Abstract—** This paper deals with the time series analysis and their development prediction of insurance contract premium of general liability insurance in the business insurance risk in the frame of the Czech insurance market for years 2012 and 2013. The time series are defined as a sequence of data points, measured typically at successive times, spaced at time intervals. Data in this modeling are gross premium written of liability insurance of employers for work injuries and occupational diseases of members of CAP (Czech Insurance Association) in years 1998 to 2011. This analysis does not include economic factors (for example: inflation, economic progress, economic recession, economic shocks).

**Keywords-** time series analysis; prediction; contract premium; general liability insurance, business insurance risk.

## I. INTRODUCTION

When characterizing the Czech insurance market, several basic economic indicators will appear. For example, gross premium written of insurance contract premium of general liability insurance in the business insurance risk. In this paper, gross premium written insurance contract premium of general liability insurance in the business insurance risk within years 1998 to 2011 will be analyzed and their development prediction for years 2012 and 2013 will be given. The data for this analysis are used from the Czech Insurance Association (CAP). The analysis is developed for the Student Project Grant Competition 2013; grant No. 38010. Time series analysis is discussed in many textbooks, see Hamilton (1994) [1]; Hindls, Hronová and Novák (2000) [2]; Chatfield (2003) [3] and Tsay (2005) [4].

In the first part of this paper, basic characteristic development of time series will be analyzed. The second part will be focused on identification of the trend by means of hypotheses tests, than an acceptable model with prediction for years 2012 and 2013 will be chosen. The estimate of trend function values will be analyzed by using the statistic program Statgraphic Centurion XVI. In the final tables R.M.S.E. (root mean square error),  $I_{adjusted}^2$  (adjusted index of determination), t-tests (tests criterion), P-values (critical significance limits) and total F-test will be calculated.

## II. TIME SERIES ANALYSIS

For calculation of basic characteristic development of time series it is necessary analyze data about development of gross premium written of insurance contract premium of general liability insurance in the business insurance risk in years 1998 to 2011 (see in Tab. I).

TABLE I. DEVELOPMENT OF GROSS PREMIUM WRITTEN OF BUSINESS INSURANCE RISK

Year ( $t$ )	Gross premium written of business insurance risk (in thousands CZK) ( $y_t$ )
1998	1 724 346
1999	1 858 111
2000	1 900 203
2001	2 073 818
2002	2 301 347
2003	2 503 152
2004	2 911 805
2005	3 470 271
2006	3 337 113
2007	3 329 308
2008	3 606 335
2009	3 762 793
2010	3 895 223
2011	4 021 801

Source: CAP (1999–2011) [5]

Using the visual analysis of the graphic record during the time series can recognize as a long-term trend during the series. You can also monitor some periodic developmental changes. The following Fig. 1 shows the progress of business insurance premiums in the years 1998 to 2011.

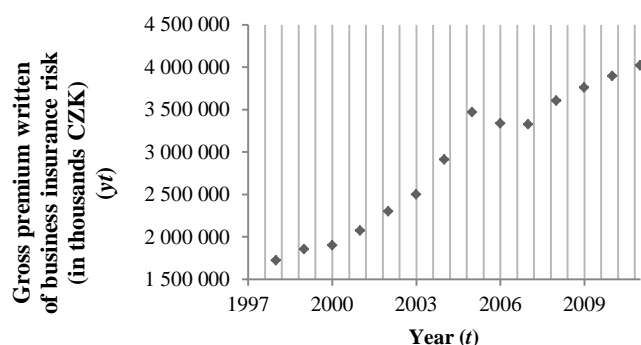


Figure 1. Development of Gross Premium Written of Business Insurance Risk

However, it must be said that this visualization is never enough to know the deeper connections and mechanisms of the process.

The elemental characteristics include:

- difference of first and second order,
- the rate of growth / decline,
- pace of gain / loss and average,
- average rate of growth / decline,
- average absolute increase / decrease.

In the text below, these characteristics described in more detail in Table 2 are already calculated specific values.

The first difference (1) characterizes the increment value of the indicator time series for a certain period with the period immediately preceding. In other words, it tells us how units of measure decreased or increased value.

$$\Delta_t^1 = y_t - y_{t-1}, \quad t = 2, 3, \dots, n. \quad (1)$$

If the series shows a certain developmental tendencies, we can derive from first differences the second or third difference. Acceleration is determined by comparing the absolute increments, as the second (absolute) differences. The second difference (2) states the number of units decreased or increased value of the first difference.

$$\Delta_t^2 = \Delta_t^1 - \Delta_{t-1}^1 = (y_{t+2} - y_{t+1}) - (y_{t+1} - y_t), \quad t = 3, 4, \dots, n. \quad (2)$$

Growth coefficient expressed in percentage is called the coefficient of growth (3). Indicates the percentage increased value of the time series at time  $t$  from the previous period.

$$k_t = \frac{y_t}{y_{t-1}}, \quad t = 2, 3, \dots, n. \quad (3)$$

Other characteristics are described relative additions to the delight of growth ( $T_{yt}$ ) determining a ratio between that and the previous member of the series. These are percentages coefficient growth. If the growth rate multiplied by 100, indicates the percentage of the value at time  $t - 1$ , increased value at time  $t$ . Growth rate (4) indicates the percentage increased or decreased value of the indicator.

$$\delta_{yt} = T_{yt} - 100 \quad (4)$$

As the aggregate characteristic of relative changes for the entire time series of reports the average growth index (5), which is the geometric average of the individual coefficients of growth.

$$\bar{k} = \sqrt[n]{k_1 \cdot k_2 \cdot \dots \cdot k_{n-1}} = \sqrt[n]{\frac{y_n}{y_1}} \quad (5)$$

The mean absolute increase (6) is the average annual increase or decrease in value for the period studied. All defined basic characteristics are given in Tab. II.

$$\bar{d}_i = \frac{1}{n-1} \sum_{i=2}^n d_i = \frac{y_n - y_{n-1}}{n-1} \quad (6)$$

TABLE II. DEVELOPMENT OF ELEMENTAL CHARACTERISTICS OF THE GROSS PREMIUM WRITTEN OF BUSINESS INSURANCE RISK

Year (t)	(y <sub>t</sub> )	$\Delta_t^1$	$\Delta_t^2$	$k_t$	$T_{yt}$	$\delta_{yt}$
1998	1 724 346	×	×	×	×	×
1999	1 858 111	133 765	×	×	×	7,75743
2000	1 900 203	42 092	-91 673	1,02265	102,26531	2,26531
2001	2 073 818	173 615	131 523	1,09136	109,13666	9,13665
2002	2 301 347	227 529	53 914	1,10971	110,97150	10,97150
2003	2 503 152	201 805	-25 724	1,08769	108,76899	8,76899
2004	2 911 805	<b>408 653</b>	206 848	1,16325	116,32554	16,32554
2005	3 470 271	<b>558 466</b>	149 813	1,19179	119,17937	19,17937
2006	3 337 113	-133 158	-691 624	0,96162	96,162893	-3,83711
2007	3 329 308	-7 805	125 353	0,99766	99,766115	-0,23388
2008	3 606 335	277 027	284 832	1,08320	108,32086	8,32085
2009	3 762 793	156 458	-120 569	1,04338	104,33842	4,33842
2010	3 895 223	132 430	-24 028	1,03519	103,51946	3,51946
2011	4 021 801	126 578	-5 852	1,03249	103,24957	3,24957

From the above Tab. II can be seen the largest increase surveyed values for the period 1998 to 2011 in 2004 and 2005 (compared to the previous period, the biggest increase being in 2005, an increase of more than 0.5 billion CZK). The second largest growth market in insurance business insurance was observed during the reporting period (in terms of premiums) in 2004. Growth rate shows the percentage increased or decreased the value of the investigated indicators. As already mentioned, the highest increase in gross written premiums for general liability insurance (business insurance) for the reporting period was recorded in 2005, the growth rate values examined indicators (previous year) amounted to more than 19 %. The rapid decline recorded insurance market insurance business during the reporting period in 2006, when the rate of decrease values researched indicators (previous year) amounted to 3.83 %.

The average growth rate, which characterizes the average growth of the parameter, is 1.06731. The mean absolute increase for the period 1998–2011 is examined after rounding 176 727.3 thousand CZK.

### III. MODELING THE TREND OF THE TIME SERIES

The trend identification was analyzed by the program Statgraphics Centurion. The results of tests of individual trend functions parameters can be find in Tab. III.

TABLE III. LINEAR, QUADRATIC AND EXPONENTIAL TREND

Trend	Linear trend	Quadratic trend	Exponential trend
<b>Trend function</b>	$T_t = a + bt$	$T_t = a + bt + ct^2$	$T_t = e^{(a+bt)}$
<b>Forecast</b>	$1\ 456\ 840\ 000 + 193\ 332\ 000t$	$1\ 315\ 280\ 000 + 246\ 418\ 000t - 3\ 539\ 010t^2$	$e^{(21,2211 + 0,070457t)}$
<b>R.M.S.E.</b>	171 919 000	170 081 000	237 493 000
<b>R<sup>2</sup> modif.(%)</b>	95,6623	95,7546	94,109
<b>H<sub>0</sub></b>	$a = 0$	$a = 0$	$a = 0$
<b>H<sub>1</sub></b>	$a \neq 0$	$a \neq 0$	$a \neq 0$
<b>a</b>	1 456 840 000	1 315 280 000	21,2211
<b>T-test</b>	-16,8345	8,29981	510,985
<b>P-value</b>	0,0000 < 0,05	0,000005 < 0,05	0,0000 < 0,05
<b>Test conclusion</b>	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .
<b>H<sub>0</sub></b>	$b = 0$	$b = 0$	$b = 0$
<b>H<sub>1</sub></b>	$b \neq 0$	$b \neq 0$	$b \neq 0$
<b>b</b>	193 332 000	246 418 000	0,070457
<b>T-test</b>	16,9617	5,06997	14,4456
<b>P-value</b>	0,0000 < 0,05	0,000361 < 0,05	0,0000 < 0,05
<b>Test conclusion</b>	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .
<b>H<sub>0</sub></b>	$c = 0$	$c = 0$	$c = 0$
<b>H<sub>1</sub></b>	$c \neq 0$	$c \neq 0$	$c \neq 0$
<b>T-test</b>		-1,12285	
<b>P-value</b>		0,285411 > 0,05	
<b>Test conclusion</b>		Disapprove H <sub>1</sub> , prove H <sub>0</sub> .	

From the above Tab. III shows that the value of *R.M.S.E.* (7), the root mean square error (Root Mean Squared Error) is lowest for quadratic trend. Value *R.M.S.E.* is calculated according to the formula:

$$R.M.S.E. = \sqrt{\frac{\sum_{t=1}^n (y_t - T_t)^2}{n}} \quad (7)$$

To test a suitable model was also used for determination index (8). The higher the index value determination closer to the number one (or 100 %), the better the model captures the trend of the time series and vice versa.

$$R^2 = \frac{\sum_{i=1}^n (\hat{y}_i - \bar{y})^2}{\sum_{i=1}^n (y_i - \bar{y})^2} \quad (8)$$

Lack of determination coefficient (8) is that it depends on the number of model parameters (trend function). This deficiency removes the modified index determination (9) in the form:

$$R_{mod.}^2 = 1 - (1 - R^2) \frac{n-1}{n-p} \quad (9)$$

Determination index is found in the range: <0, 1>. The strongest dependence follow a linear model (*R<sup>2</sup>* modified value is highest). In Tab. IV we are testing the hypotheses *H<sub>0</sub>* and *H<sub>1</sub>*. We are using F-test to find the suitability of the model linear, quadratic or exponential.

TABLE IV. TESTING A SUITABLE MODEL

H <sub>0</sub>	The linear trend is not acceptable model.	The quadratic trend is not acceptable model.	The exponential trend is not acceptable model.
<b>H<sub>1</sub></b>	Non H <sub>0</sub>	Non H <sub>0</sub>	Non H <sub>0</sub>
<b>F-test</b>	287,70	147,61	208,67
<b>P-value</b>	0,0000 < 0,05	0,0000 < 0,05	0,0000 < 0,05
<b>Test conclusion</b>	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .	Disapprove H <sub>0</sub> , prove H <sub>1</sub> .

According F-test, the null hypothesis is rejected. It is necessary to proceed in selecting an appropriate model. Another option is an automatic model selection in the program Statgraphics. According to the method for selecting criteria such as Akaike information criterion (Akaike, 1974) [6] is based on a linear model does not stick.

Akaike information criterion provides information about the relative appropriateness of the statistical model, in other words, represents the relative rate of loss of information in describing reality using the model. The general formula for calculating the Akaike information criterion (10):

$$A.I.C. = 2k - 2\ln(L) \quad (10)$$

where *k* is the number of parameters of the statistical model, and *L* is the maximum value of the likelihood function for the estimated model.

Akaike information criterion tells us that the compared statistical models seems to be the best, but says nothing about how and whether a particular model corresponds to the observed data. In other words, if all the compared models describe the real data poorly, the value of the Akaike information criterion by us of this fact does not warning would only be able to decide which of these "bad" models corresponding to the data set relative best.

The following Tab. V it can be consulted point and interval forecast for 2012 and 2013 and the lower and upper confidence limit of 95 %.

The Tab. VI shows point and interval forecast for 2012 and 2013 and the lower and upper confidence limit of 99 %.

TABLE V. LINEAR TREND WITH FORECASTS FOR 2012 AND 2013

Year (t)	Forecast (CZK)	Low limit, 95 % (CZK)	Upper limit, 95 % (CZK)
2012	4 356 820 000	3 926 680 000	4 786 970 000
2013	4 550 160 000	4 108 690 000	4 991 620 000

TABLE VI. LINEAR TREND WITH FORECASTS FOR 2012 AND 2013

Year (t)	Forecast (CZK)	Low limit, 99 % (CZK)	Upper limit, 99 % (CZK)
2012	4 356 820 000	3 753 790 000	4 959 860 000
2013	4 550 160 000	3 931 250 000	5 169 060 000

The following Fig. 2 shows the linear trend with two-year forecasts with 95 % confidence.

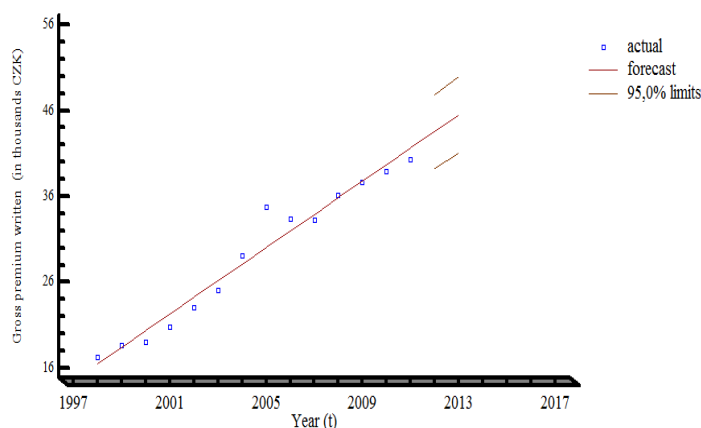


Figure 2. Linear Trend with Two-year Forecasts

The criteria that take into account data (unlike *A.I.C.*) are: *M.S.E.* (mean squared error), *M.A.E.* (mean absolute error), *M.A.P.E.* (mean absolute percentage error). For automatic model selection in the program Statgraphics we have chosen the *M.S.E.* criterion. The average squared error (*M.S.E.*) of the estimate is one of the ways to quantify the difference between the values resulting by estimating a true value of that estimate. *M.S.E.* evaluates the diameter squared errors.

The lowest value *M.S.E.* according to the calculations in Tab. III is based on quadratic trend. The following Tab. VII it is shown predictions for 2012 and 2013, just as the quadratic model.

TABLE VII. QUADRATIC TREND WITH FORECASTS FOR 2012 AND 2013 WITH 95 % CONFIDENCE

Year (t)	Forecast (CZK)	Low limit, 95% (CZK)	Upper limit, 95 % (CZK)
2012	4 215 260 000	3 703 610 000	4 726 920 000
2013	4 351 970 000	3 764 120 000	4 939 820 000

The above values derived from the analyzed trends (linear and quadratic) is inclined to the linear trend, mainly because of the null hypothesis prove the quadratic trend of the parameter *c* (the value of *P*-value > 0.05, namely

0.285411). The above linear trend forecasting process even for the 99% confidence interval. Tab. VIII shows the forecast for 2012 and 2013.

TABLE VIII. QUADRATIC TREND WITH FORECASTS FOR 2012 AND 2013 WITH 99 % CONFIDENCE

Year (t)	Forecast (CZK)	Low limit, 99% (CZK)	Upper limit, 99 % (CZK)
2012	4 356 820 000	3 753 790 000	4 959 860 000
2013	4 550 160 000	3 931 250 000	5 169 060 000

The following Fig. 3 shows a linear trend with a two-year forecasts. For 2012, it is predicted gross insurance premiums investigated 4,3 billion CZK and 2013 CZK 4.5 billion, with a confidence interval of 99%. It would be very interesting to compare whether this prediction came true in 2012, but the data are not yet available.

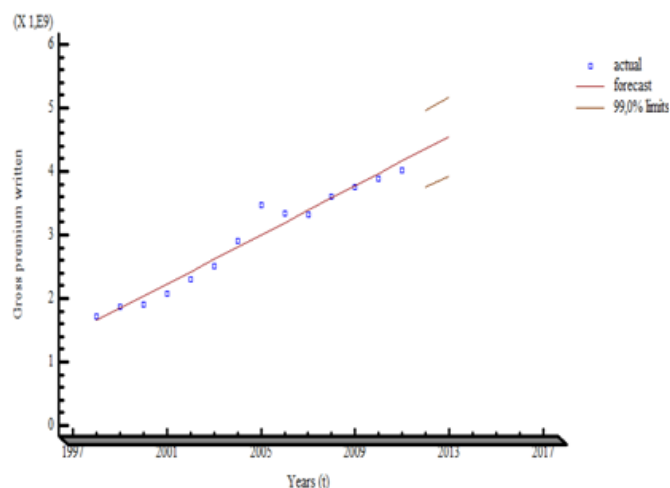


Figure 3. Linear Trend with Two-year Forecasts

#### IV. CONCLUSION

The main aim of this paper was to analyze the development of insurance contract premiums of general insurance liability, namely business insurance premiums, in the period from 1998–2011 with prediction of gross premiums written for the years 2012 and 2013.

In the first part of this paper have been identified the basic characteristics, namely the difference of the first and second order rate of growth / decline, the rate of increase / decrease, the average rate of growth / decline and average absolute increase / decrease. The largest absolute increases were recorded in 2004 and 2005 (compared to the previous year, the biggest gain in the year of 2005 by more than CZK 0.5 billion). The second largest growth market in insurance business insurance was observed in 2004. The highest growth was recorded in 2005 (growth rate amounted to more than 19 %). The rapid decline recorded insurance market insurance business in 2006 (the rate of decrease amounted to 3.83 %). Average growth rate (characterizes the average growth observed indicators for the period) is the period analyzed 1.06731. The mean

absolute increase for the period 1998–2011 is examined after rounding 176 727.3 thousand. CZK.

The second part of the article have been focused on modeling trend. Researched trend function has been chosen as the basic characteristics of the development of the examined values, as follows: linear trend, quadratic trend, exponential trend. Using Statgraphics Centurion XVI. were calculated required parameter values  $a$ ,  $b$  and  $c$ . Furthermore, the calculations  $R.M.S.E.$  values and a modified index determination. To select the appropriate model required for the analysis of time series, it was necessary to evaluate the amount of  $R.M.S.E.$ , respectively,  $M.S.E.$ , then the index of modified according to the results of determination and P-value for each parameter a rejection or acceptance of hypotheses. The lowest error was published on the quadratic trend function, while the modified determination index was highest in the linear model. The best model for the analysis time was chosen linear trend and the reasons that the P-value was published on quadratic trend testing parameter  $c$  is high (0.285411) and the null hypothesis ( $c = 0$ ) was therefore adopted.

According to the results point forecast for the selected linear model was a confidence interval of 99 % for 2012 predicted gross premiums written insurance business after rounding of CZK 4 356 820 000 in 2013 and the rounding of CZK 4 550 160 000. For comparison, if the predicted values correspond to reality, due to data unavailability, we'll

know until the end of 2013, which will be published in the Annual Report of the Czech Insurance Association.

The program Statgraphics Centurion XVI. was also used by the auto model selection criteria such as the selection method I chose the Akaike information criterion ( $A.I.C.$ ). According to the criteria  $A.I.C.$  published by automatic model selection as well as the best model linear model.

#### ACKNOWLEDGMENT

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# Current problems of entrepreneurship in the context of deepening economic crisis

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**Abstract-**Entrepreneurship is a result of the free economic initiative, which stimulates its existence and its particular manifestation in different forms. At the same time, it forms the basis for the sustainable development of an economy. It is through entrepreneurship that economic resources are organized and managed, innovations are purposefully sought and introduced, and favorable opportunities for business development, leading to economic growth and profitability are taken. One of the tools for coping with the deepening economic crisis in Bulgaria is the gradual overcoming of the problems, which the entrepreneurial development is facing. Studying, analyzing and assessing its state and development make it possible to identify its major problems and take measures for their solving.

**Keywords-** *entrepreneurship, state, development, analysis, study*

## I. INTRODUCTION

Since the onset of the global financial and economic crisis of 2008, the socio-economic development of Bulgaria has undergone a number of negative processes. According to the National Statistical Institute (NSI), income from operations of the nonfinancial sector in 2011 was 2.23% lower compared to 2008<sup>1</sup>, steady decrease in domestic and foreign investment and domestic consumption is also reported. The result is a highly deteriorated state and trends of the labor market - a loss of about half a million jobs, a sharp increase in unemployment, lower employment rate [15], deepening structural problems. In the context of the severe economic crisis in Bulgaria the opportunities and prospects of entrepreneurship development in the country are strongly deteriorated, including the ones at regional level. It is therefore important to identify the main problems facing the development of entrepreneurship in order to create conditions for overcoming them.

The aim of the study is to examine and identify the current problems of the state and the trends in the development of entrepreneurship in the Southwest planning region. In order to achieve these objectives, a survey was conducted in 358 companies from all municipalities in the Southwest region. In the course of data collection, representatives of their management (owners and co-owners, directors, managers) were interviewed. The share of enterprises which were included in the study in the different municipalities is in line with the proportion of the total number of registered enterprises in the same municipalities.

<sup>1</sup> Note: latest actual data is for 2011 r.

The survey was conducted between June and September 2012. The data collection method was a self-administered questionnaire (see the questionnaire in the appendix). The collected data was statistically processed by using SPSS for Windows. All figures were created using Microsoft EXCEL.

## II. THEORETICAL AND APPLIED ASPECTS OF ENTREPRENEURSHIP

In a market economy, entrepreneurship is essential for the economic development. It is one of the most characteristic features of the modern economy, and provides employment for hundreds of millions of people worldwide [10]. This phenomenon is the basis for development of the market economy, the main driving force of economic processes and one of the main factors for growth in the ever-increasing competition and globalization. According to K. Todorov, entrepreneurship is the engine of modern economic and social development and is the primary cause of a number of processes and events [13].

The entrepreneurial activity is defined as unification of the three production factors – land, labor, and capital [9]. Some authors define it as the most important component of the national production process, starting from innovations in the production of tangible goods and ending with the satisfaction of needs in the field of public services [11].

Entrepreneurship is a phenomenon typical for the market economy, the competitive environment and the opportunity for free, independent economic activity. The free market economy, as V. Stoyanov notes, is usually associated with free entrepreneurship [12]. The latter, and “the adequate free market economy”, according to the same author, are based on both the private and individualized property, and the freedom of making economic decisions, the freedom of choice [12]. Its characteristic features are freedom in the choice of kinds and methods of activities, and the independence of decision-making [4]. At the same time, K. Manolov argues that the natural environment of entrepreneurship is the free market economy and it starts with the economic initiative [8].

In contemporary scientific studies entrepreneurship is related to innovation and development [2] and more specifically – as an economic activity and initiatives of economic subjects, connected with innovation and directed towards achieving their goals by combining personal benefits with public interests [4]. Entrepreneurship can be defined as a purposeful creative activity based on economic activity, the

best organization and use of economic resources, the search for and the introduction of new ideas, exploration and exploitation of opportunities to answer the economic interests of businesses and generation of profit regardless of the risks. In today's economy, it acts as a catalyst for economic processes, critical precondition for economic growth and an important tool for increasing the number of jobs and thus to solving the social problem of unemployment [6].

The development of entrepreneurship is essential for the growth and competitiveness of the economy. It is regarded as its backbone, the main engine of development and a "key to the new economy." Entrepreneurship has limitless potential; it is a powerful factor for the opening of new businesses, transfer of new technology and introduction of scientific research, increase employment, regional development, and more. Therefore, the opinion of P. Drucker on key entrepreneurial tasks: first, to make the existing business effective, secondly, to find potential business, thirdly, to ensure the future of the business [3].

Creating or adopting and applying new ideas entrepreneurs are able to change the business, the attitudes of customers and transform the economy. Thus L. Thurow stated that they were "conductors of change in capitalism." [14]. At the microeconomic level, the entrepreneur is obviously an important figure in the foundation and development of firms. Although economic theory has little to say on the matter, intuition suggests that there is a close connection between the personal qualities of the entrepreneur and the economic success of the firm, as measured by its growth and profitability [1]. M. Gordon considers entrepreneurship as a collective of three factors - attitudes, actions and process [5]. Entrepreneurship as a process includes: a constant search for ideas everywhere, sifting the true opportunity among the thousands of ideas, building and strengthening the team, opening and managing the resources, whether or not belonging to the entrepreneur, the development of the strategy in such a way as to attract customers and to ensure stable sales and profits, development of a detailed business plan, assessment of risks, management of the enterprise [5].

The effective management of entrepreneurial activity is impossible without a strategic concept for the enterprise as whole, and for each of its functional units as well. Strategies are an expression of an active attitude towards entrepreneurship and help to expand its potential [7].

The elaboration of functional strategies (marketing, production, innovation, investment, etc.), which define guidelines for the various activities of the enterprise and the foundations on which specific action plans are developed, is essential for the development of entrepreneurship.

It is important to note that every enterprise operates in a competitive market environment. Therefore it is very important to carry out regular monitoring of the potential that the company has for performing its activities. Thus, opportunities for active, dynamic development and achieving goals in a changing external and internal environment are created.

### III. ANALYSIS OF STUDY RESULTS

The first part of the study aims to establish the actual state of the companies according to their legal form, sector of economic activity, size, etc. According to the legal form of registration, the structure of the surveyed enterprises is as follows: 74% of companies have been registered as a limited liability company – sole owner Ltd. (40%) and Ltd (34%), 13% of the surveyed companies were registered as sole proprietors, joint-stock companies - 11%, other types of enterprises according to their legal status (cooperatives, general partnerships, limited partnerships, etc.) – an insignificant share of no more than 1.5%. The data reveals that most of the surveyed companies (54%) were registered before 2004, 20% were registered from 2004 to 2007, 25% were registered between 2007 and 2011, and only 1% of them were registered in 2012. There is a sharp decrease in the number of newly registered enterprises in 2012, which is a reflection of the worsening economic crisis in the country. Most companies which were registered before 2004 operate in the sphere of production, and are medium and big enterprises. On the other hand, most enterprises which were registered after 2004 operate in the sphere of trade and services. (Fig. 1).

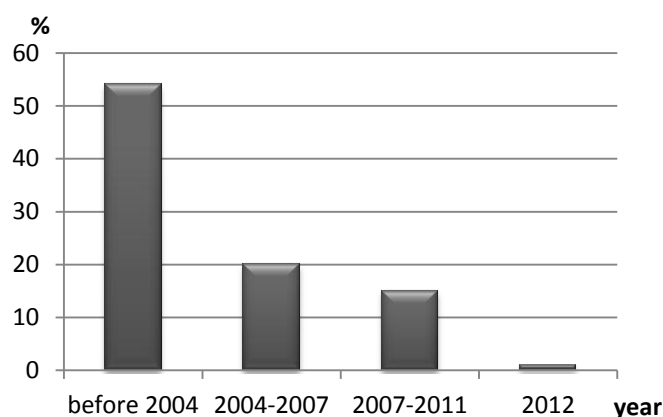


Figure 1. Dynamics in the number of registered enterprises

There is a negative process of a dramatical decrease in the number of newly registered enterprises in 2010 (1%), which reflects the deepening economic crisis. The prevalent part of enterprises registered before 2004 are foodservice industry, medium and large enterprises. The prevalent part of enterprises registered after 2004 are micro enterprises in the sphere of trade and services.

In terms of number of employees, micro and small enterprises (up to 50 persons) prevail - these form 69% of the companies surveyed, followed by medium-sized enterprises (number of employees ranging from 50 to 249 people) - 27% and large enterprises (with number of employees over 250 persons) - 4%.

According to their main economic activity the enterprises are distributed as follows: 44% in the production sphere (the major proportion in these is held by the clothing industry (16%), followed by the furniture industry (9%), construction

(8,1%) and the food industry (7%). The share of enterprises operating in a different sector of production is insignificant. 36 % of the surveyed enterprises operate in the sphere of trade and 33 % are in the service sector<sup>2</sup>. It was found out that 35 % have exported, and 26 % have imported. Both import and export activity was carried by 24% of the enterprises.

The share of enterprises with foreign investment is relatively low (9%), the main reason for this being the significant number of micro and small enterprises. Insignificant involvement of enterprises in various forms of cooperation, e.g. clusters, franchising and others, was recorded – only 4% reported such participation.

The second group of questions refers to the identification of the state and trends in the volume of activities in qualitative and quantitative expression.

15 % of enterprises show an increase in activity in quantitative terms. The companies whose production decreases in quantitative terms are 23%, while the ones whose volume of activity remains unchanged are 19%. At the same time it was found that the trends in the change in the volume of activity in qualitative terms are identical to those in quantitative terms. Further analysis of the influence of factors forming the value of the volume of activity has shown that this is due to the combined effects of three factors: nomenclature, assortment and commodity prices. Significant result of the data analysis is that there is a strong correlation between the change in the volume of activity and the size of the enterprises. Increase in the volume of production was observed in large enterprises. Production volume does not change primarily in medium-sized enterprises, and reduction was recorded in the micro and small enterprises. A big share of the businesses (92%) indicated that their use of production capacity is insufficient due to lack of demand for the goods and services they offer.

The third group of questions was designed to identify the competitive status of the enterprises. One of the most important indicators for the analysis and assessment of the market position of the companies is the size of their market share. 37% of surveyed enterprises assess their market share as small (less than 5%), 26% of them as medium (between 5% and 20%) and 11% think that their market share is large (over 20%). The share of enterprises which do not know their market share is significant – 26% (Fig. 2).

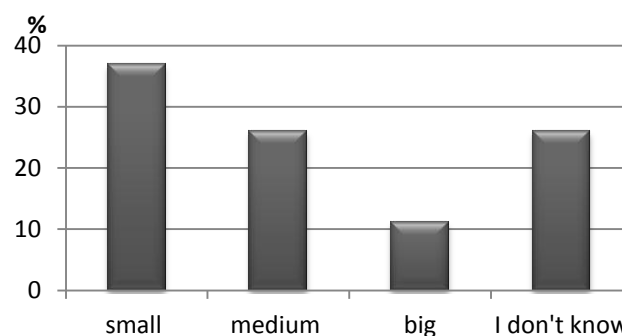


Figure 2. . Market shares of surveyed enterprises

At the same time, the analysis of the relationship between the size of the enterprises and their market share shows that 54% of micro-enterprises, 43% of small and 29% of medium-sized enterprises define their market share as small, 31% of small and 38% of medium-sized enterprises estimated their market share as medium.

The share of the enterprises which cannot assess their market share is strikingly big – nearly one quarter. This is due to the fact that almost half of the surveyed companies (48%) share the opinion that it is not necessary to carry out competitive analysis within their sphere of activity. The highest proportion of enterprises which do not conduct competitive analysis is held by the ones operating in the service sector (60%). It is worth mentioning that about 25% of the big enterprises state that it is not necessary to analyze their market competitors.

At the same time almost all (91%) of the surveyed companies say they research and have information on their main competitors in the market, which is at odds with the responses to the question of conducting competitive research and analysis. The highest proportion of companies knowing their competitors is registered among the ones in the field of trade, and the lowest - among those in the service sector. Among the respondents, the share of large enterprises compared to micro, small and medium) indicating that they know their competitors is the largest.

Answers to a question related to identifying the areas of competitive analysis within the industry (subsector, scope of work), which was limited only to companies that carry out such studies, show that they perform competitive analysis of sales management (38%), analysis to develop a strategic plan, (17%) and for the purpose of competing against major rivals (10%)<sup>3</sup>.

<sup>2</sup> Note: the sum total of the shares (in percent) of enterprises according to their main economic field of activity is higher than 100%, because some of them operate in more than one field.

<sup>3</sup> Note: The sum total is less than 100%, because the question was answered only by enterprises which perform competitive analysis

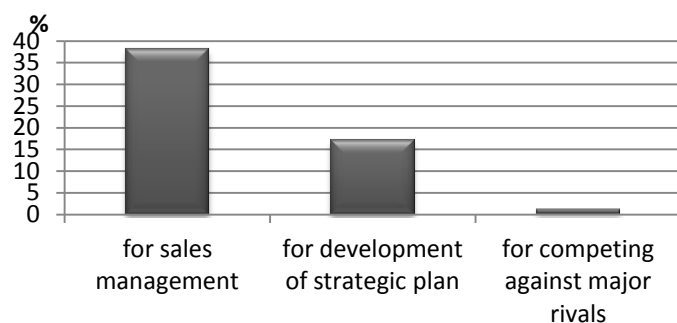


Figure 3. Areas of competitive analysis

The next set of questions is to examine the strategies and plans for the development of enterprises. Answers to the question on the existence of a strategy for development show that a higher proportion (56%) of companies surveyed indicate they have no such strategy. These are mainly companies in the field of trade and micro-enterprises.

The survey results suggest that the development strategies that enterprises apply are<sup>4</sup>:

- increase in the market share of the company (28%);
- product development (19%);
- entry into new markets (9%);
- differentiation (7%);
- maintaining the existing market share (12%);
- low prices (5%);
- specialization (2%);
- applying for loans for business development (1%);
- vertical integration (1%);
- N/A (2%).

At the same time, 32% of businesses are not planning for a future increase in their market share and/or entry into new markets, and 20% are not planning to extend the nomenclature of goods and services they offer. Companies who say they intend to take action towards entering new markets are focusing on domestic markets (16%), in the Southwest region (11%) and the EU (8%).

Further analysis of the relationship between the strategy applied on the one hand and the size of companies and their objects on the other hand, shows that the strategy of increasing market share is applied primarily by large enterprises and enterprises whose main activity is the manufacture. The highest proportion of medium-sized companies relies on a strategy for product development. Primarily large enterprises apply a strategy for entering new markets.

<sup>4</sup> Note: The sum total is less than 100%, because the question was answered only by enterprises which perform competitive analysis

It was found out that 60% of enterprises do not develop and implement development plans, the predominant part of them operating in the sphere of trade and micro-enterprises.

The main tools that firms implement in their development plans are<sup>5</sup>:

- Improvement of the quality of products / services (14%);
- investment in new equipment / technology (8%);
- cooperation with foreign business partners (8%);
- increase in labor productivity (5%);
- opening of new offices / branches (7%);
- training of staff (4%);
- improvement of working conditions (3%);
- repair of existing facilities (2%);
- reduce costs (2%);
- keeping the total number of jobs in the company (3%);
- transition to mass production (1%);
- N/A (1%).

It was found out that increasing the quality of products and services is a key tool in the development plans of the enterprises in the services sector. It is mainly large companies who rely on investment in new technology and cooperation with foreign partners.

The results from the study reveal that the main objectives which the enterprises set in their development plans are:

- creation of new products and services (60%);
- renewal of their assortment (67 %);
- increase in activity effectiveness (87 %);
- increase in revenues and profitability (83 %);
- increase in the volume of sales (80 %);
- increase of investments (75 %);
- increase of productivity (77 %).

Interest shall constitute the fact that mainly medium-sized businesses and enterprises specializing in the manufacture direct their efforts to product innovations.

It is noteworthy that mostly medium and large enterprises aim to improve the financial and economic parameters of its activities in the future pursue.

Specific action to increase labor productivity, which businesses plan are mainly related to investments in new equipment and technology, optimization of business processes and training of staff.

<sup>5</sup> Note: The sum total is less than 100%, because the question was answered only by enterprises which have development plans

It is important to note that in the context of the objectives for product innovation and increased productivity only 3% of companies (mainly large companies) allocate funds for research and development (R & D) in the period 2009 – 2012, which does not create objective conditions for practical realization of these goals.

#### IV.CONCLUSION

The presented results were obtained in the process of a study, which has some limitations in terms of time and place of conduction, as well as the employed methodology. Considering these limitations we can still outline some major problems connected with the state and perspectives for development of the South-west planning region.

1. The deepening of the economic crisis in Bulgaria leads to a serious deterioration of the economic conjuncture. This decreases the interest towards entrepreneurship development. The latter is clearly exemplified by the sharp decrease of the number of newly registered enterprises in 2012.
2. The main part of manufacturing enterprises operates in the field of the light industry, which has low added value. The presence of forms of integration and cooperation between enterprises is very low. This does not allow for exploiting the opportunities that such forms provide for acceleration of the development and acquisition of competitive advantages. The low share of enterprises with foreign investment is an indication that the region is not sufficiently attractive to foreign investors.
3. The vast majority of businesses are not using the available production capacity and there is no increase in the volume of activity in quantitative and qualitative terms. This has a negative impact on production, innovation, investment, financial, marketing and human resources of enterprises and limits the prospects for their future development.
4. The majority of enterprises do not conduct market and competitive environment research. This does not provide a sufficient volume of representative and reliable information on the status and prospects of the industry, market and the specific firm. This prevents the development and implementation of successful marketing strategies as a prerequisite for achieving sustainable competitive advantage.
5. The research that companies conduct does not cover the full monitoring of all aspects of competitiveness. Thus information resources and opportunities for optimal management of business competitiveness are severely restricted.
6. Substantial part of the businesses do not develop and implement strategies and action plans, which reflects the lack of strategic vision and specific management interventions to achieve the objectives of the business in the short, medium and long term. This makes the management of the enterprise and its individual functional areas ineffective.

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## APPENDIX

### Questionnaire

#### 1. What is the name of your company?

--

#### 2. what is the form under which your company was registered?

Sole proprietor
LLC
Ltd
Joint-stock company
Sole joint-stock company
Limited partnership
KGaA
General partnership
Production cooperative
Other (please state) .....

#### 3. Your company is based in the municipality of:

--

#### 4. What is your position in the company?

Owner of the company
Co-owner of the company
Owner and manager (executive director etc.) of the company
Co-owner and manager (executive director etc.) of the company
Manager (executive director etc.) of the company
Medium-level manager (, marketing director, finance director, trade director, chief accountant etc.)

#### 5. What has been the main field of economic activity of your company since its registration?

<b>Production</b>
<b>Trade</b>
<b>Services</b>

#### 6. Which sector does your company operate in?

<b>Mining industry (mines, quarries, logging)</b>
<b>Heavy industry (metallurgy, machine construction)</b>
<b>Light industry (furniture, clothing etc.)</b>
<b>Food service industry</b>
<b>Trade</b>
<b>Services</b>
<b>Tourism</b>
<b>Education</b>
<b>Health care</b>
<b>Transport</b>
<b>Building construction</b>
<b>Science, culture, art, media</b>

Computer and information systems
----------------------------------

Agriculture
-------------

Other (please state).....
---------------------------

**7. Is there foreign investment in your company?**

No
----

Yes, under 50%
----------------

Yes, 50% to 50%
-----------------

Yes, over 50%
---------------

**8. Does your company participate in clusters?**

YES ⇒ GO TO QUESTION 9
------------------------

NO ⇒ GO TO QUESTION 12
------------------------

**9. What kind of cluster does your company participate in:**

*(More than one answer is possible)*

Regional cluster
------------------

National cluster
------------------

Cross-border cluster
----------------------

Other (please state) .....
----------------------------

**10. Please state the name of the cluster your company participates in:**

**11. How many other enterprises participate in this cluster?**

**12. How many people are employed in your company?**

1 - 9
-------

10 - 49
---------

50 - 249
----------

More than 250
---------------

**13. Has the production of your company increased or decreased in qualitative terms in the last year?**

Production has increased
--------------------------

Production has stayed unchanged
---------------------------------

Production has decreased
--------------------------

N/A (the company has no production activity)
--

**14. Has the production of your company increased or decreased in quantitative terms in the last year?**

Production has increased
--------------------------

Production has stayed unchanged
---------------------------------

Production has decreased
--------------------------

N/A (the company has no production activity)
--

**15. What expenses did your company make for research and development in the period of 2009-2011?**

*(please indicate approximate amount in leva)*

*The company has no expenses for research and development activity for this period*

**16. In the period of 2009 – 2011 , did your company:**

*(Please circle the correct answer)*

	Yes	No
export		
import		

**17. Does your company have:**

**17.1. Strategy for development**

1. YES (Please indicate the strategies that you apply) 2. NO 3. I don't know	
--	--

**17.2. Plan for development**

YES (please briefly describe the main point in your development plan) NO I don't know	
---	--

**18. Do you know your main competitors?**

Yes
I don't know them
Our company has no competitors

**19. Do you analyze the competitors in your sector?**

*(More than one answer is possible)*

Yes, for the purposes the strategic plan
Yes, in order to manage sales
Yes, we create a reactive profile of the more important competitors
No, this is not necessary

**20. how do you assess the market share of your company in the district of Blagoevgrad?**

Big (more than 20%)
Medium (between 5 and 20%)
Small (less than 5%)
I don't know

**21. Is your company planning a renewal of the range of products you offer?**

Yes
-----

No

I don't know

**22. Is your company planning future creation of new products/services?**

Yes

No

I don't know

**23. Is your company planning future expansion of its markets?**

Yes (*please indicate*)

No

I don't know

**24. Is your company planning to increase its sales?**

Yes

No

I don't know

**25. Is your company planning to increase its profits?**

Yes

No

I don't know

**26. Is your company planning to increase its labor productivity?**

Yes

No

I don't know

**27. Is your company planning to increase its investments?**

Yes

No

I don't know

**28. Is your company planning to increase the profitability of its products/services?**

Yes

No

I don't know

**29. Is your company planning to increase the efficiency of its activity?**

Yes

No

I don't know

**THANK YOU FOR YOUR RESPOSIVENES AND THE TIME YOU TOOK!**

# The Financial Instability Hypothesis in Developing Countries: The Anatomy of Crisis

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**Abstract**—In this paper we shall sketch the anatomy of financial crisis in developing countries. In order to answer to the question of how and why crisis develops in developing countries we embrace the Financial Instability Hypothesis of the seminal post-keynesian economist Hyman Minsky. We will see that, in contrast to developed countries in which fragility develops endogenously, in the case of developing countries implementation of market-led macroeconomic policies create incentives which lead to the generation of the boom-bust cycle. According to Minsky, if the system is on the verge of crisis, the only possible way to avoid deep depression is to conduct government massive deficit spending and perform a lender-of last-resort function by the central bank. We also find that, in the long run, the best strategy to prevent or mitigate financial crisis is to develop strong economic fundamentals. At the same time, it is of crucial importance to control increase in external debt in the first place and in the second to minimize share of a short-term debt or floating-rate debt and debt denominated in hard currency in total debt as much as possible. Control of capital flows is a measure that could prove useful in constraining indebtedness and designing desirable capital structure.

**Keywords**—efficient markets; financial crises; Minsky; the financial instability hypothesis; developing countries; debt

## I. INTRODUCTION

It is a striking fact that in the last 30 years, crises have stricken predominantly emerging markets characterized by weak institutional environment and loosely regulated and non-transparent financial markets.<sup>1</sup> Consequences of crises in all impaired countries (except the Eastern European) were immense and severe.<sup>2</sup> As a consequence of rising uncertainty, fears, disbelief and investor's panic, intensive capital flight took place that resulted in a devastating vicious circle of debt-deflation episode: sharp exchange rate depreciations, substantial and sudden rise in nominal interest rates, further capital flight, sharp decrease in production, investments,

consumption, employment, inhabitant's standard of living and, often, a drastic rise in violence.

Interestingly enough, mainstream (orthodox) and heterodox analytical approaches to this phenomenon are irreconcilable. Consequently, diametrically different problem diagnosis results in different prevention measures and different emergency measures in the case of crisis eruption. Erroneous diagnosis implies the implementation of wrong remedy prescriptions, which doubtlessly result in the further worsening of the health condition of the crisis economy (example of the great Asian crisis in 1997 is representative one). Therefore, the aim of this paper is to identify a problem correctly, i.e. to answer to the question of how and why crisis develops in developing countries.

## II. THE MAINSTREAM ACCOUNT OF FINANCIAL CRISES

The theory of efficient markets [2, 3, 4] is based on the assumption that economic agents are perfectly rational, perfectly informed and capable of forming rational and on average true expectations. In this view, self-regulated financial markets led by Smith's "invisible hand" are an optimal mechanism for rational and productive allocation of scant resources to the most productive uses. Market-clearing equilibrium is an aggregate outcome of choices made by myriad rational decision makers. [5, 6]. On the other hand, in this view, financial crises emerge as a consequence of a sudden effect of some unanticipated exogenous shock. This is, in most cases, the interference of government in the free functioning of omniscient markets. In the open-economy model, financial crises can emerge due to a number of factors: inconsistency between the internal and external objectives of monetary authorities [7]; a lack of credibility of the central bank's and the government's commitment to fully defend the foreign exchange rate [8]; massive withdrawals from the host country due to irrational behavior on the part of lenders [9]; corruption and cronyism [10] etc. Should an unanticipated exogenous shock disrupt the normal functioning of markets, corrective forces that at least in the long run restore market clearing conditions, would be activated. In a word, the problem is not rooted in systematic flaws in the functioning of free markets, but in the lack of freedom for market forces. Thus, according to the neo-liberal view, the prescription for stable and rapid growth of the economy and living standards is a simple one: balanced fiscal policy, anti-inflationary monetary policy,

<sup>1</sup> The great debt crisis in 1982, Tequila crisis in Mexico in 1994, the great Asian crisis in 1997, Russia in 1998, Brazil in 1999, Ecuador in 1999, Turkey 2000, Argentina 2001-2002, Uruguay in 2002, East Europe in 2009.

<sup>2</sup> Debt-deflation in East Europe was avoided thanks to massive liquidity injections in the Euro Area conducted by the European Central Bank. This provided breathing room for the foreign exchange markets and the central banks. On top of that, upon concluding stand-by arrangements with the International Monetary Fund (IMF), the most affected countries replenished their reserves. Finally, several countries benefited strongly from the "Vienna Initiative" that helped to contain the largest portion of the foreign exchange reserves within their financial sectors. For more details see [1].

privatization of state owned enterprises, deregulation and liberalization of financial flows and world trade and stable foreign exchange rates. On the other hand, if these rules are not obeyed and consequently crisis erupts, the only way to regain the confidence of investors, domestic and foreign, is to implement measures of economic austerity.<sup>3</sup>

Consistently, according to the efficient markets model, once these market-led stabilization policies implemented by developing country deliver the first positive results, investor confidence grows, and capital inflow gains momentum [14]. Rational investors who seek new opportunities to earn profits, respond to improved economic prospects in countries, which were, up to that moment, excluded from major capital centers. In such a way, improved economic conditions precede investment inflows [15].

However, Pettis [15] holds that although appealing, real world experiences do not support the efficient market model. There are numerous examples of experimenting with desired economic reforms in Latin American countries, which were not followed by capital inflows. One would expect that capital inflows into developing countries are more random than actual experience shows, i.e. highly correlated with the timing of implementation of economic reforms. Still, as Pettis [15] stresses, there is little evidence that capital flows respond to desired policy decisions in developing countries. On the contrary, what can actually be seen is that the timing of capital inflows towards developing countries is virtually identical, although there is no reason to assume that different countries around the world simultaneously undergo preferable political and economic changes. Therefore, capital movements to poor countries are better explained by the "liquidity model", which emphasizes the source, and not the destination – the spark that initiates massive capital movements towards developing countries is Minskyan liquidity expansion in rich countries.

### III. MINSKYAN VIEW ON FINANCIAL CRISES IN DEVELOPING COUNTRIES

In total opposition to the mainstream model stands the Financial Instability Hypothesis (FIH), interpretation of Keynes' General Theory by the seminal post-keynesian economist Hyman Minsky [16]. In his Financial Instability Hypothesis, a work widely neglected by mainstream economists, Minsky argues that financial markets are the heart of modern capitalist economies, which are prone to fragility, thanks to the non-neutrality of money, division of ownership and management in big corporations and financial institutions, the ever-growing and massive debt financing of uncertain investment projects over the business cycle, continual financial innovation and fundamental uncertainty. In a word, ups and downs are natural product of unregulated free markets. Or, to put it more precisely, if let alone, endogenous market processes

<sup>3</sup> Uniformly recommended remedies against crisis that has already erupted are restrictive monetary and fiscal policy, enforcement of capital adequacy standards, immediate closure of insolvent banks and other financial institutions, non-financial structural changes, etc. For more details see [11, 12, 13].

generate financial and economic instability in an upward phase of business cycle [16, 17, 18].

As he sees it, during a prolonged period of prosperity, conditions emerge that cause system transition from an environment of stable towards an environment of unstable financial relations. The core thesis of the FIH is that stability is destabilizing because, in an environment of fundamental uncertainty, ignorant human beings have no other choice but to extrapolate stability into infinity. Naturally, with calendar flow of time, when agents extrapolate stability into infinity they become more confident and, as their aim is to pursue ever-higher profits, they become more and more willing to increase their liabilities relative to income. Furthermore, the rise in market optimism might not be gradual but rather the result of some outside shock powerful enough to cause displacement of the system and consequently dramatic change in profit horizons and the expectations of agents. Such a shock might be the beginning or end of a war, an abundant or insufficient harvest, some revolutionary far-reaching invention (railway, automobile, radio, film, computers), a political event [19] or, most frequently, expansion of liquidity in major financial centers. Expansion of liquidity might take the form of an increase in traditional measures of money or more complex changes in financial structure induced by a change in the regulatory framework or the profit-seeking activities of financial mediators (merchants of debt).<sup>4</sup>

Minsky's theory of speculative markets and financial instability, although primarily devised to study economic behavior of closed advanced capitalistic economy, is, by making several amendments, also applicable to the case of open emerging markets, in which a period of financial robustness and optimism lead to fragile finance and instability [11, 14, 15, 20]. In contrast to rich country case where factors that trigger boom develop endogenously, in the case of developing country, the very same marked-led macroeconomic policies recommended by the mainstream economics create incentives, which lead to the generation of the boom-bust cycle.

In developing country case, booming cycle starts with liquidity expansion in developed countries. As liquidity in rich countries rises, financial markets take off, the real interest rate drops and a growing number of assets become more money-like, which further reinforces liquidity expansion [15]. New liquid assets can now perform the function of collateral and a rise in the value of collateral justifies the increased value of loans demanded.<sup>5</sup> As the liquidity of financial markets and thus

<sup>4</sup> A change in the regulatory framework such as financial deregulation and liberalization stimulates the creation of new banks and deposits, thus expanding the monetary base and therefore money supply. On the other hand, the profit-seeking activities of financial institutions end in transformation of illiquid assets into liquid (for example, the massive securitization of real estate assets that occurred over the past twenty years) or in significant increases in the turnover of some liquid assets. Acceptance of some financial innovation by a broader financial community and a rise in its turnover or simply a rise in turnover of some already existing financial asset results in an increase in liquidity and an increase in the liquidity of financial markets has the same effect as an increase in the supply of money – decline in real interest rates and consequently a rise in asset prices [15, 18].

<sup>5</sup> For example, cheap money policy and massive securitization of house mortgages, students' loans, auto finance, credit card debt, etc., in the

turnover increase, the volatility of risky assets starts to decline which makes them a more attractive investment destination in comparison to traditional assets. In response to lower volatility, over-optimistic investors systematically underestimate risks or overestimate prospective earnings in nontraditional sectors. As, in time, investors start to exhaust local higher risk investment opportunities, some capital finds its way toward developing countries in order to “make on the carry”.<sup>6</sup> Still, an important precondition for capital inflows is macroeconomic and foreign exchange rate stabilization as well as financial liberalization and deregulation of the host country. Deregulation opens all doors to foreign wealth owners since it enables them to do business in different types of financial and real estate markets within country.

In their profit-seeking activity, foreign investors will buy domestic financial assets<sup>7</sup> and domestic corporations and financial intermediaries will, due to high local interest rates, refrain from raising debt domestically and, in order to maximally exploit arbitrage opportunities, borrow short-term funds in low interest major financial centers and lend locally these funds later at higher interest rates or finance buying of long-term securities, real estate and capital assets. The rise in price of local financial, real estate and capital assets has two important effects.<sup>8</sup> Firstly, it implies a rise in the demand price of capital assets in relation to the supply price of investment output<sup>9</sup> causing a rise in investment activity and consequently

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aftermath of dot-com crash in 2000, led to the liquidity expansion of the U.S. financial markets. Consequently, from 2002 to 2006, debt in the U.S. increased by more than 8 trillion US\$ whereas at the same time GDP increased by 2.8 trillion US\$ [1].

<sup>6</sup> In case of open economies, “making on the carry” means borrowing short-term funds in developed low-interest rates markets and their investment at higher interest rates in developing countries.

<sup>7</sup> Predominantly loans to domestic banks and firms and portfolio and real estate investments. As recent experience showed, the liquidity expansion of the U.S. financial markets in the post dot-com crash period, led in no time to liquidity expansion in other developed countries exposed to financial markets in the U.S., and further, due to the increased optimism and consequently profit appetite of Western investors, to massive capital flows towards investment outlets – developing countries. Resultantly, new private capital inflows to developing countries increased in 2007 by 269 billion US\$ and reached a record high of 1 trillion US\$, which was more than 7% of aggregate developing countries’ GDP. In the years that preceded the Eastern European financial crisis in 2009, this region was especially attractive destination for foreign capital. In the period between 2002 and 2007, countries of emerging Europe received more than 500 billion US\$, which was approximately close to one-third of all private flows to emerging markets. Only Asia received around 100 billion US\$ more during the same period [1].

<sup>8</sup> For example, the average share price level in 14 East European economies (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Turkey and Ukraine) increased around six-fold in the period between 2000Q<sub>1</sub> and 2008Q<sub>1</sub> [1].

<sup>9</sup> In Keynes’ dual price investment theory, supply price of investment output is determined by corporate managers and is equal to “...the present value of the series of annuities given by the returns expected from the capital-asset during its life...” [21, p. 177]. Demand price of capital is determined by the financial markets and is equal to the future cash flow expectations of the managers of big financial institutions. If the ratio between the market value of shares and the supply price of an investment good is below one, that is if the market is depressed and private investors are pessimistic (bears), the advantageous strategy for managers is to take over an existing company through mergers and acquisitions. Conversely, if the market gains momentum, (ratio of market value of shares and supply price of investment good is above

employment, consumption and output.<sup>10</sup> Exports also grow, since liquidity expansion in major financial centers entails higher consumption, and increased export demand usually leads to higher commodity prices.<sup>11</sup> However, since the other side of the massive capital inflow coin is a trade deficit, imports go up faster than exports.<sup>12</sup> Secondly, it increases turnover of local financial and real estate assets and therefore their liquidity. New liquid assets can now perform the function of collateral and a rise in the value of collateral justifies the increased value of loans demanded.<sup>13</sup> Growing capital inflows, as well as an ever-rising leverage ratio (debt to equity) are the order of the day, since, in a booming market, financial and real estate assets can always be sold at inflated prices.<sup>14</sup>

As liquidity rises, interest rates and interest spreads fall.<sup>15</sup> Large capital inflows in economies with a floating exchange rate regime and balanced current account cause their currencies to appreciate, whereas those that suffer persistently high current account deficits see, at least, stable nominal exchange rate levels. Also, no matter whether the economy implements a fixed or floating exchange rate regime, central banks usually sterilize capital inflows in excess relative to their current account deficits in order to avoid appreciation of the real foreign exchange rate,<sup>16</sup> aiming at preserving a competitive position in international markets. In that way, quasi-fiscal costs

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one), that is if agents are optimistic (bulls), it is advantageous for managers to order production of new capital goods [21].

<sup>10</sup> The average annual growth rate of GDP, final consumption and gross fixed capital formation in 14 emerging European countries in the period of 2001-2008 equaled 6%, 14% and 16% respectively. In the same period, unemployment rate decreased from 12.3% to 6.7% and industrial production increased around 65% [1].

<sup>11</sup> As a consequence of the post dot-com crash liquidity expansion of the U.S. financial markets and the following expansion of developed countries financial markets, developing countries’ exports accelerated more rapidly compared to the 1990s. This led to an increased share of exports in aggregate developing countries’ GDP from 29% in 2000 to 39% in 2007 [1].

<sup>12</sup> From 2000 to 2008, the export revenues of 14 Eastern European economies increased five-fold. Simultaneously, import costs increased more than five-fold. That is why throughout most of the 2000s, the regional current account deficits were, on average, very high by global standards [1].

<sup>13</sup> In the case of 14 emerging European economies, in a period of only 10 years (2000-2010), the ratio of domestic credit to private sector to GDP grew strongly from 20% to 70%, and came much closer to 140%, the level seen in the Euro Area. A rapid growth of mortgage lending to households, which fueled the real estate bubble in almost all emerging European countries was among several infamous drivers of the dynamic growth of domestic credit to private sector. The most notorious form of this mortgage lending, which turned out to be extremely risky and most prone to default, were floating rate loans linked to the Swiss franc [1].

<sup>14</sup> The consequence of soaring credit activity in 14 emerging European economies was that net foreign debt relative to GDP increased sharply between 2000 and 2008. This variable increased from about 5% of GDP in early 2000, to almost 40% at the beginning of 2009, reaching as high as 60% in the most indebted country in the region, Latvia [1].

<sup>15</sup> For example, the real lending interest rate differential, calculated as the difference between the average real lending interest rates on loans denominated in local currencies in 14 emerging European economies and the average real lending interest rates in the Euro Area, compressed considerably in the period between 2002Q<sub>3</sub> and 2007Q<sub>3</sub> from 4 percentage points to zero [1].

<sup>16</sup> The nominal exchange rate is the rate at which one can trade the currency of one country for the currency of another. The real exchange rate is the nominal exchange rate adjusted for relative prices among the countries under consideration.

simultaneously increase with the country's foreign exchange reserves.<sup>17</sup>

All in all, a growing economy and a stable or appreciating currency create the impression of improved economic conditions which further reinforces capital inflow and the optimism of market participants. [20]. Stimulated by economic growth and rising profits, local politicians and elites agitate and call for broadening of the scope and further deepening of internationally preferable economic reforms. This is done in the belief that it was the reforms that were attracting capital inflows and not vice versa - that in truth the increasing volume of capital inflows created new profit opportunities which stimulated local officials and big business to give up resisting economic changes.<sup>18</sup> On the other hand, international investors further increase their investments in the developing country since, they claim, the applied policies are valid and future advancement in reforms will provide permanent economic growth and thus capital inflows [15].<sup>19</sup> Extrapolation of good times and stability into an infinite future in concert with flourishing optimism and confidence usually lead to inverted capital structure being seen as a rational way to lower financing costs over time.<sup>20</sup>

Meanwhile, in parallel with intensive capital inflows and the resultant advancement of market reforms, the externally financed, dynamic increase in aggregate demand leads to local price increases, especially, due to lack of international competition, in non-tradable sectors [24].<sup>21</sup> The rise in prices of non-tradable sectors further attracts new, mainly speculative investments and thus provokes a further increase in inflationary pressures. Increases in price level usually lead to appreciation

of the real exchange rate and thus a worsening of the trade balance.<sup>22</sup> Again, foreign exchange rate appreciation stimulates further inflow of speculative capital in search for capital gains by holding local assets, thus further supporting expansion of credit and aggregate output. Increases in the burden of interest and dividend payments in combination with a worsening trade balance lead to current account deficits. One more factor that may contribute to deterioration of the trade balance and appreciation of real foreign exchange rates is growth of real wages.

Taken together, the progressive worsening of current account and the increase in foreign liabilities, and in particular short-term liabilities denominated in hard currency, lead to a rise in the external debt to foreign exchange reserves ratio.

#### IV. FROM BOOM TO BUST

In the end, after several good and seemingly prosperous years, the system collapses under an unsustainable level of debt burden. Pettis [15], differentiates between two types of shock that can trigger crisis in emerging markets. The first one is the occurrence of a "not unusual" event [14]<sup>23</sup> in major financial markets after several good years that leads to a long-term sharp reversion of excess liquidity. The long-term retreat of risk-prone capital results in a rise in real interest rates, whereas the decline in global aggregate demand leads to a sharp fall in the commodity prices and export revenues of developing countries. Reluctance of international lenders to refinance debts and the sharp fall in export revenues may end in defaults and restructurings for sovereign borrowers. During a global debt crisis, refinancing problems affect all high-risk assets and borrowers.<sup>24</sup>

The second type of triggering event is a local "not unusual" event in an environment of internally accumulated financial difficulties reflected in a deterioration of the external balance, possibly (but not necessarily) in combination with some external shock which leads to a short-term collapse in financing at the margin. As a consequence of reversed market optimism, in fear of huge capital losses, international investors start en masse to sell risky and buy low-risk assets in developed financial markets thereby causing temporary capital outflow.<sup>25</sup> This type of crisis could, in the event of an internally built unstable (inverted) capital structure, lead to a solvency crisis,

<sup>17</sup> The immediate consequence of massive capital inflows is a sharp rise in demand for local currency. In order to prevent nominal exchange rate appreciation, central banks intervene in the foreign exchange market, i.e. buy foreign currency and sell local currency, which, in the final instance, leads to a rise in the money supply and foreign exchange reserves. However, in order to prevent inflation driven by such a rise in the money supply, central banks often conduct a process of sterilized foreign exchange operation in money markets. For example, by selling repos, the central bank withdraws domestic currency from circulation and in such a way as to leave the monetary base and money supply intact.

<sup>18</sup> Foreign capital facilitates financing of fiscal deficits, low-cost financing of local industries that oppose trade liberalization, building of new infrastructure etc. [22].

<sup>19</sup> Grabel [23] writes that the necessity to conduct neoliberal economic reforms in order to attract and maintain capital inflows leads to "compromised policy autonomy", i.e. policy autonomy constrained *ex ante* and *ex post*.

<sup>20</sup> An inverted capital structure amplifies the intensity of external shock so that debt obligations balloon in the short run, whereas, in parallel, due to the dramatic increase in uncertainty, the revenues of business units enter free fall. Inverted capital structure in developing country appears in the case when most of the debt is foreign short-term debt or debt set on a roll-over basis (floating-rate debt) and debt denominated in hard currency [11, 15]. For instance, share of short-term external debt in total external debt of the five Asian countries (Thailand, South Korea, the Philippines, Malaysia and Indonesia) in the year of crisis outburst (1997) was equal to 64% [9]. In the case of 14 emerging European countries, share of short-term external debt in total external debt was close to 30% and floating-rate external debt in total external debt was around 90%. Similarly, the rate of credit euroization in Ukraine, Hungary, Croatia, Romania, Bulgaria and Lithuania was around 60% and in Estonia and Latvia close to 85% [1].

<sup>21</sup> Construction, financial intermediation, real estate, renting, wholesale and retail etc.

<sup>22</sup> In the period between 2001Q<sub>1</sub> and 2008Q<sub>3</sub>, the real exchange rate in the case of floating Eastern European currencies (Czech Republic, Hungary, Poland, Romania, Russia, Turkey and Ukraine) increased nearly 60% and in the case of pegged currencies (Bulgaria, Estonia, Latvia, Lithuania, Croatia, Slovakia and Slovenia, whereby Slovakia and Slovenia were moved to this group two years before their respective Euro adoption) this increase was close to 30% [1].

<sup>23</sup> The term a "not unusual" event indicates that, as a result of excessive optimism and over-indebtedness, it is rational to expect, but hard to predict the occurrence of an event that will make visible the inescapable divergence between expectations and reality (for example, failure of some prominent financial institution or corporation, or, in the case of late global financial crisis, collapse of the U.S. subprime mortgage market).

<sup>24</sup> Examples of a long-term liquidity contraction are the Great Depression in the 1930s, the Great Debt Crisis in the early 1980s and the current Great Recession that started in 2007.

<sup>25</sup> Examples of short-term collapses are Mexico in 1994 and Asia in 1997.

i.e. market collapse and widespread defaults and bankruptcies. However, since these shocks occur in an environment of stable global liquidity conditions, if the market defaults are not devastating<sup>26</sup> or if an outside lender-of-last-resort timely injects liquidity aiming at preventing the debt-deflation from taking its toll, the recovery of a crisis-hit country can be unexpectedly swift.<sup>27</sup> In contrast to a long-term liquidity contraction, short-term collapses usually do not end in global defaults.

No matter whether the triggering event is a long-term liquidity contraction or a short-term flight to quality, their common feature is massive escape of international capital from local emerging markets, i.e. massive sale of local-currency denominated assets. Since in such a situation "there is no such thing as liquidity of investment for the community as a whole" [21, p. 194] the win-win strategy is to liquidate positions in local assets before one's competitors. In this beauty contest game, if an agent believes that the average agent thinks the local market will fall, in anticipation of a decrease in the price of local assets and currency, he will rush to sell local assets as soon as possible, in order to avoid capital losses and acquire accumulated capital gains [21, 25, 26]. If other agents form the same or similar expectations, they will all, in an attempt to remain one step ahead, rush for the exit, thereby pushing prices down. Even in the absence of evidence that the balance sheets of domestic financial intermediaries and corporations have deteriorated, the rush for the exit will cause a collapse of prices of domestic assets and thus deterioration in domestic financial conditions. The sale of domestic assets on a massive scale will put heavy depreciating pressure on the domestic currency.

The formerly heralded and praised government will try to reverse outflow and attract new inflows by further intensification of the restrictive policies initially adopted.<sup>28</sup> This strategy usually deepens the crisis and the situation may be further aggravated if domestic authorities are compelled to seek financial support from multilateral agencies [27].

In an unsuccessful attempt to protect the currency, central bankers will deplete foreign exchange reserves<sup>29</sup> and sharply raise interest rates aiming at stopping the dramatic fall. A dramatic fall in the value of local currency and a significant increase in interest rates when most of the debt is short-term or set on an adjustable basis and denominated in hard currency instantly melts the margins of safety.<sup>30 31</sup> Over-indebted units

<sup>26</sup> In case of correlated capital structure where majority of debt is medium or long-term fixed rate debt denominated in local currency [15].

<sup>27</sup> As the example of the Great Asian crisis shows, unnecessary restrictive policy measures imposed after the crisis erupted aiming at restoring foreign investors' confidence and reverting capital outflows actually aggravated the problems, and resulted in a full-fledged solvency crisis, i.e. massive bankruptcies and debt-deflation and consequently a drastic fall in imports which led to large current account surpluses [11, 12].

<sup>28</sup> What Grabel [23] calls constrained policy autonomy *ex post*.

<sup>29</sup> Meaning that the authorities actually give up the resources necessary for ameliorating the consequences of the coming economic downturn [23].

<sup>30</sup> Margin of safety is difference between expected cash inflow that investment will generate and the sum of financing costs and operating expenses [16, 17, 18].

<sup>31</sup> For instance, due to fact that expansive monetary and fiscal policy were not implemented in the period that followed financial markets crash, by January 1998 the currencies of the five Asian countries nominally depreciated

will sell domestic currency further, in an attempt to meet their hard-currency denominated debt commitments, and thus put additional downward pressure on the exchange rate, thus increasing the debt burden of borrowers. Fisher's [28] paradox sets in at this point: the more debtors try to reduce their debt, the more the value of their debt rises and the more the value of the local currency is reduced. In addition, domestic currency depreciation hits wage-earners dependent on imported wage goods hard, and makes the import of capital goods costly [23].

When the bust comes, local inhabitants' sentiments about market-led reforms reverse strongly. The backlash against financial and trade liberalization usually leads to calls for more inward-oriented development policy, protectionism and the birth or reanimation of populist and/or nationalist movements [22].

## V. CONCLUSION: HOW TO PREVENT DEBT-DEFLATION AND FINANCIAL CRISIS IN DEVELOPING COUNTRIES

According to Minsky, in order to prevent debt-deflation and a consequent sharp fall in investments, output, consumption and employment,<sup>32</sup> the government should abstain from the austerity measures and support aggregate demand and corporate profits through massive deficit spending.<sup>33</sup> Government deficit spending impacts economy through: "...the *income and employment effect*, which operates through government demand for goods, services, and labor; the *budget effect*, which operates through generating sectoral surpluses and deficits; and the *portfolio effect*, which exists because the financial instruments put out to finance a deficit must appear in some portfolio. [18, p. 24]. Simultaneously, the central bank, as a lender-of-last-resort, has to provide liquidity to indebted units: "...An institution that performs a lender-of-last-resort function guarantees that the terms of some contracts will be fulfilled, regardless of market conditions or the business situation of the particular debtor. Thus, a lender of last resort diminishes the risk of default of the assets it guarantees. Assets with low default risk are readily marketable-they are liquid." [18, p. 47].

by somewhat more than 50% relative to their July 1997 value (immediately before the crisis erupted) [9, 12]. On the other hand, thanks to timely and massive liquidity injections and fiscal stimulus conducted by the international financial institutions and governments of developed countries, this doom and gloom scenario has been avoided so far in the Eastern European countries. In 14 emerging European countries, the average foreign exchange rate depreciation against the euro was 24% over the period of six months following the Lehman shock. At the same time, the foreign exchange reserves dropped by approximately 21% over the 2008Q4-2009Q3 period. Some countries like Russia, Ukraine and Latvia lost almost one third of their pre-crisis reserves [1].

<sup>32</sup> One year after the Great Asian crisis had seriously shaken the world economy, unemployment rate in the five Asian countries increased from 4% to 6%, the share of investments in GDP fell from the average 35.1% to 23.2% and the average growth rate of real GDP declined from 4.1% to -7.7% [12]. Similarly, one year after the Lehman shock in 2008, final and private consumption in 14 Eastern European economies fell 3%, gross fixed capital formation 20%, industrial production nearly 40% and GDP around 10% [1].

<sup>33</sup> In a word, government should try, by all means, to avoid constrained policy autonomy *ex post*.

However, since most of the debt in emerging markets is denominated in foreign currency and the stability of the exchange rate has to be preserved, the central bank's function as a lender-of-last-resort in emerging markets is severely constrained. As a result, massive financial support is needed from developed countries and international financial institutions. Unfortunately, the IMF, as the international bailing-out institution, usually imposes restrictive fiscal and monetary policy measures in order to restore a sustainable balance of payment dynamics and avert inflation spikes, thereby amplifying debt-deflation difficulties.

Of course, Minsky was well aware of the fact that government intervention, i.e. socialization of losses, increases the moral hazard in the future and induces ever-riskier behavior in market participants. But, on the other hand, if the system is on the verge of crisis, abolition of rogue corporations and financial institutions is the only possible way to avoid deep depression. That is why, in time, after each new bailout episode, crises tend to erupt more frequently and tend to be more severe.

One more important question for any open developing country is what it can do in order to prevent or mitigate crises. Certainly, there is no doubt that sustainable economic growth is the most efficient mean to offset future external shocks in the long run. In a world payment system as it is now, economic growth of small economies is sustainable if it is based on expansion of exports, income, employment and, at the same time, steady and decreasing external debt and, on average, continuous generation of trade and current account surpluses, i.e. domestic savings. As Reinert [29] points out, it is of utmost importance for small developing economy to specialize in industries of producing goods and services with a high-added value, which generates economies of scale, technological innovation and synergies. Economies of scale emerge in industries with high fixed costs where entrance barriers are high. At the same time, it is of crucial importance to control increase in external debt in the first place and in the second to minimize share of a short-term debt or floating-rate debt and debt denominated in hard currency in total debt as much as possible. There is no universal recommendation for the level of sustainable country indebtedness. It depends on the earning power of the economy, which is determined by its economic diversity (economies of scale, technological innovations, synergies) and the sensitivity of its economy to global business cycles. One of the options for minimizing negative impacts of external shocks can be a return to the capital controls. They proved useful during 1960s in preventing massive inflows or outflows of short-term foreign currency investments. Also, capital controls are capable of preventing financial contagion which are consequence of mechanical implementing trading strategies of buying in rising and selling in declining markets.<sup>34</sup>

Measures of capital controls include reserve requirements on banks' liabilities, the Tobin tax, such as taxes on short-term foreign exchange operations that were recently implemented by Brazil and Taiwan, and the outright prohibition or limitation of

the capital flows.<sup>35</sup> Recently, even the IMF, known as a fierce enemy of the capital controls in the past, recognized that developing countries have to stand ready and use all available tools and even keep an open mind concerning the capital controls in order to stem the unproductive and disruptive capital inflows, which exacerbate boom and bust cycles [32].

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<sup>34</sup> Margin buying, portfolio insurance, derivative contracts [30].

<sup>35</sup> For the opposite opinion on potential effectiveness of Tobin tax see [31].

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# Acess to formal credit and shadow economy

A study based on perspectives from experts and shoe manufacturers from Bogota

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**Abstract**—The financial sector of many countries of the world has been under constant criticism during the last years, being considered one of the sparkers of the current economic crisis, while it faces difficult times. In contrast, in Colombia, during the previous years the financial system has shown unprecedented strength and record earnings. This article tries to analyze the possible role that the formal Colombian financial sector can play to help informal companies to become formal. It is based on the findings on a research for a PhD thesis by Salcedo (2012).

**Keywords**- *informal economy; shoe manufacturing industry; financial system, formalization strategies*

## I. INTRODUCTION

The informal or shadow economy can be defined as the activities not regulated by the Government operating in environments in which similar activities are regulated [1]. It is important to clarify that when referring to shadow economy, illegal activities are not taken into consideration; legal activities performed without regulation are one thing and illegal activities are another thing [2]. Only legal activities fall into the category of shadow economy.

The current percentage of informal workers in Colombia is high, above 50 percent [3]. By the year 2005, 36.4 percent of the Colombian GDP was produced by the shadow sector of the economy [4]. All countries of the world have, to some degree, a share of their economies driven informally; however, in countries like Colombia the weight of informality in the economy is high, becoming an issue to be addressed in order to increase productivity and modernity.

To try to find possible solutions to reduce the size of the informal sector, a study was conducted, focused on shoe manufacturing producers located in the city of Bogotá, Colombia. The reason to choose this sector for a research on the informal economy is that even when there are not specific studies aimed to measure the size of informality in the shoe manufacturing industry, levels are high (Salcedo, 2012). When asking entrepreneurs about the advantages of being formal, they mentioned the possibility to get access to credits from financial institutions, making it worth having a deeper analysis on what the Colombian financial system could do in order to reduce the size of the informal sector. At this point is important to mention that to reduce the informal sector more than just the financial sector is needed. Other actors of the economy must be included in a fully comprehensive strategy to reduce the size of

the informal sector in Colombia, but this article concentrates only on strategies of the financial system.

## II. FINANCIAL SYSTEM AND CREDIT IN COLOMBIA

Colombia has a very strong financial sector at the moment. After the crisis that affected the industry by the end of the 20<sup>th</sup> century, the beginning of the second decade of this century finds the Colombian financial system in one of its best times. In the year 2012, net profits for the 23 biggest banks increased 13 percent to a total of 6,561,562 million pesos [5] equivalent to about 2.733 billion euros. Only two banks had losses (both being foreign banks operating in Colombia), and three major groups, named Bancolombia, Grupo Aval, and Davivienda control over 60 percent of the assets in the industry [5]. Colombian banks have gone overseas to invest to other Latin American countries. Colombian banks control 13.03 percent of the banking industry in Costa Rica, 21.02 percent in Honduras, 21.9 percent in Nicaragua, 2.8 percent in Guatemala, and 19 percent in Panama [6]. Such data shows the good moment of the Colombian financial system.

The banking system is important for the industry, given the fact that it has the necessary resources companies need to operate. Goldsmith (1969) states that the better a financial system works in a country, the more it helps the economic development of such country [7]. However, some numbers can show that, Colombia still has a long path to fully integrate small businesses with the formal banking system. In the case of informal entrepreneurs, 29.1 percent of them consider that their main problem is the lack of access to the formal financial system [8]. It is important to notice that nine out of ten SME's in Colombia wish to grow but have no knowledge about financial payment tools for entrepreneurs [9].

By September 2012, 510,000 firms in Colombia had at least one financial product, 2 percent more than one year earlier; 164,000 firms had commercial credits, compared to 148,000 a year earlier; 70,000 had credit cards, 1.4 percent more than a year earlier [10]. The numbers show that more companies have relations with the formal financial system, however, access to credit, even when is growing, is available to less than 50 percent of companies that have at least one financial product.

In the year 1998, with the national financial system in crisis, the Colombia government approves a tax of 0.2 percent on financial movements; it was supposed to be a temporary tax, just until December 1999, once the financial system solved

the problems it was dealing with at that time [11]. However, fourteen years later, that tax is still in effect, and now, it was increased to 0.4 percent (however, the additional 0.2 percent is not used to help the financial system. Experts such as Guillermo Perry, ex Minister of Economics, considers that such tax increases the informal sector, and Sergio Clavijo, president of the National Association of Financial Institutions, consider that such tax is one of the reasons why people do not bank [12].

When companies cannot get credits with the formal banking system, they might take the choice of getting them with informal lenders. By the year 2007, 400,000 entrepreneurs had any type of informal credits, with rates that were as high as 300 percent APR (when the highest rate in the formal system was 31.89 percent) [13]. Such numbers show that in Colombia the informal banking is an important source of credit for entrepreneurs who do not get access to formal credit and, as many other industries in the Colombia, when it comes to banking, informality is a visible phenomenon.

### III. METHODOLOGY

Fifteen entrepreneurs of the shoe manufacturing industry in Bogota were interviewed to know about their opinions and perceptions on entrepreneurial matters, including formalization, and possible strategies to become part of the formal sector of the economy. The interviews were applied from October 2007 until March 2008. With the results of the interviews and the review of literature, Salcedo (2012) proposed a model of formalization in which four actors were necessary to have a successful formalization strategy: the industry, the formal banking system, the academy, and the government [14]. Then, a Delphi questionnaire, with 60 affirmations was prepared, and applied to 21 experts in topics of entrepreneurship, the shoe manufacturing industry, and formalization. The Delphi questionnaire is a technique based on asking experts about a specific topic [15], very useful in situations of uncertainty [16]. Experts were chosen from the four different sectors of the economy considered necessary to have a successful formalization policy: government (six experts), industry (five experts), banking (three experts), and the academy (seven experts). Two rounds of answers were necessary to have both consensus and stability, the two conditions necessary to conclude a Delphi study [17]. For the study, an interquartile range variation of 0.125 or less was considered enough to consider that stability was achieved. In the second round, 48 affirmations achieved such condition, with 33 having a variation of 0, considering that stability was achieved. Also, consensus was achieved in the second round, with 16 experts that changed 10 or less answers, 11 of which did not change any answer, achieving consensus. The Delphi methodology considers 21 experts a valid number for a study [17]. The first round of the Delphi questionnaire was answered by the experts in the year 2010, and the second round in the year 2011.

Experts had to evaluate every affirmation, having 5 choices using a Likert scale as follows:

1. Totally disagree
2. Disagree
3. Indifferent
4. Agree
5. Totally agree

To analyze the results, a descriptive analysis was conducted, and finally a cluster analysis to find out the similarities between different groups of respondents.

The objective of the study was to design a strategy to reduce the size of the informal sector, tailored to the shoe manufacturing industry, but that could be applied to other sectors with the characteristics of such industry (high levels of informality and low entry barriers). So, based on the results of the Delphi questionnaire, different measures were suggested to each of the four sectors of the economy considered necessary to conduct a successful formalization policy.

It is important to take into consideration that the purpose of this article is to present the possible measures that the formal banking system can take in a successful formalization policy. Therefore, only the questions asked to entrepreneurs, and the affirmations presented to the experts in the Delphi questionnaire related to the financial system will be taken into consideration in the numerals ahead.

### IV. MANUFACTURERS' OPINIONS

Experts were asked if they started their companies formally or informally. Out of the 15 entrepreneurs interviewed, 80 percent started informally, and 20 percent started formally. Those who answered that they started informally were asked about the reasons they had or might have to become formal.

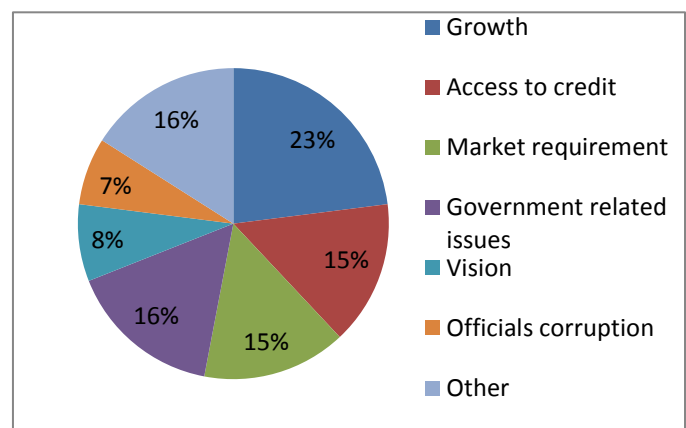


Figure 1. Reasons to become formal. (Source: authors based on Salcedo, 2012)

The possibility to grow and the access to formal credits were mentioned as the most important reasons to become formal. The growth is identified with more production and sales, for which in many cases credits are necessary. Twenty-three percent of the entrepreneurs mentioned the possibility to grow, and fifteen percent the access to credit. Market requirement (formal companies that require their suppliers to be formal) was an answer given by 15 percent of the entrepreneurs. These answers show the importance that credits have for entrepreneurs when it comes to become formal.

Entrepreneurs who started their business in the formal sectors mentioned as reasons to stay in the formal economy:

the vision (66 percent), and access to credit (33 percent), showing again the importance they give to access to loans for their companies, and how they associate it to the formal sector of the economy.

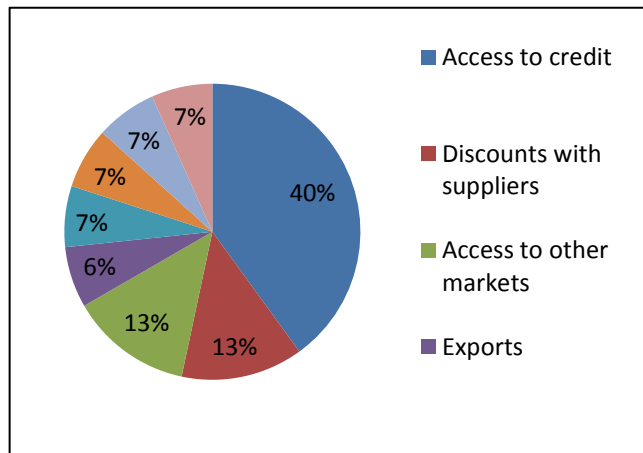


Figure 2. Advantages of formality. (Source: authors based on Salcedo, 2012)

Entrepreneurs were asked about the advantages they found in being formal. The main answer was again the access to credits, with 40 percent stating it as the most important advantage of being formal. Both questions show that the access to credit is a reason why informal entrepreneurs could become formal, as well as an advantage once the company is formal already.

## V. EXPERTS' OPINIONS

With the answers of the entrepreneurs, the following five affirmations related to the Colombian financial sector and formalization of companies were included in the Delphi questionnaire:

Affirmation 29: the strict requirements that the formal financial sector imposes entrepreneurs when they ask for loans are a factor that increases the size of the informal sector.

Affirmation 30: Due to the world economic crisis, the financial sector will impose more strict requirements on loans, which will increase the size of the informal sector.

Affirmation 31: The formal financial sector grants loans to a person easier than to shoe manufacturing company.

Affirmation 33: Access to lending for entrepreneurs will be easier in the future.

Affirmation 37: The Colombian financial sector is committed to reduce the informality in the economy.

It is important to notice that all experts answered the questionnaire, however, some of them decided not to answer some specific affirmations, reason why not all affirmations have necessarily 21 answers.

TABLE I. DESCRIPTIVE STATISTICS AFFIRMATION 29

	first round	second round
Median	4.00	4.00
mode	4.00	5.00
std deviation	1.20909	1.017
variance	1.462	1.148
interquartile range variation		-0.125

Source: Salcedo, 2012

The median was 4 in both rounds. The mode in the final round was *totally agree*, with a standard deviation of 1.071. Nine experts totally agreed with the affirmation, and seven agreed; two experts were indifferent, and only 3 disagreed. Academics in general agreed or totally agreed with the affirmation (6 out of 7); two bankers totally agreed and one was indifferent; government officials in general showed dichotomy, with four experts agreeing, and two disagreeing; members from the industry agreed in general (four out of five) with one expert being indifferent. The two only experts that disagreed with the affirmation were government officials. This shows that overall, experts from the four groups, have a strong agreement that the Colombian financial system imposes strict requirements to access to loans, what increases the size of the informal sector.

TABLE II. DESCRIPTIVE STATISTICS AFFIRMATION 30

	first round	second round
Median	4.00	4.00
mode	4.00	4.00
std deviation	1.01653	0.845
variance	1.033	0.714
interquartile range variation		0

Source: Salcedo, 2012

The median in the second round was 4, and the most answered choice was *agree*; the standard deviation was 0.845, and the variance was 0.714. Three experts totally agreed with the affirmation and 11 agreed; five were indifferent and only two disagreed. Academics in general agreed or totally agreed with the affirmation (five out of seven), as well as bankers two out of three), government officials (four out of six) and experts from the industry (three out of five). The two experts who disagreed were one from the academy, and one from the government. The experts in general agreed that it is likely that due to the economic crisis, the formal financial system will impose higher requirements to lend money, therefore, increasing the informal sector.

TABLE III. DESCRIPTIVE STATISTICS AFFIRMATION 31

	first round	second round
Median	3.00	3.00
mode	2.00	2.00
std deviation	1.25656	1.196
variance	1.579	1.432
interquartile range variation		0

Source: Salcedo, 2012

The median for the second round was 3, meaning *indifference* and the mode was 2 *disagree*. The standard deviation was 1.196, and the variance 1.432. Six experts agreed and six disagreed with the affirmation; four were indifferent, one totally disagreed, and three totally agreed. Academics showed dichotomy in their answers with three who agreed or totally agreed, two who disagreed or totally disagreed, and two who answered *indifferent*. Experts from the government also showed dichotomy with two experts who agreed and four who disagreed with the affirmation. Two experts from the financial system and two from the industry agreed with the affirmation and one from the financial system and two from the industry were indifferent. There was not information to give a final conclusion, taking into consideration that experts from were divided among their opinions. It is not clear for the group of experts who is more likely to get a formal loan in a bank: a person or a firm.

TABLE IV. DESCRIPTIVE STATISTICS AFFIRMATION 33

	first round	second round
Median	3.00	4.00
mode	4.00	4.00
std deviation	0.90238	0.865
variance	0.814	0.748
interquartile range variation		-0.25

Source: Salcedo, 2012

In the second round, the median was 4, and the most answered choice was *agree*. The standard deviation was 0.865 and the variance was 0.748. Ten experts answered *agree* and one answered *totally agree*; six were indifferent and four disagreed. Three academics agreed, three were indifferent, and one disagreed with the affirmation. All the experts from the financial system agreed or totally agreed with the affirmation. Three experts from the government agreed, two disagreed, and one was indifferent. Two experts from the industry agreed, one disagreed and two were indifferent. In general, experts agreed that access to credits will be easier for entrepreneurs in the future.

TABLE V. DESCRIPTIVE STATISTICS AFFIRMATION 37

	first round	second round
Median	2.00	3.00
mode	2.00	2.00
std deviation	1.16479	1.147
variance	1.357	1.316
interquartile range variation		-0.1666667

Source: Salcedo, 2012

The median for the second round as 3, and the mode 2; the standard deviation was 1.147 and the variance 1.316. Only two experts either agreed or totally agreed with the affirmation, while nine either disagreed or totally disagreed, and six were indifferent. Only one academic agreed with the affirmation, four disagreed or totally disagreed, and two were indifferent. Two experts from the financial system agreed or totally agreed and one was indifferent. Four out of five experts from the government disagreed and one was indifferent. One expert from the industry agreed, one totally disagreed, and two were indifferent. In general, experts consider that the formal Colombian financial sector does not have a commitment to reduce the informal sector of the economy. When comparing the sectors to which the experts belong, it is interesting to notice that bankers in general have a different opinion to experts from all other sectors.

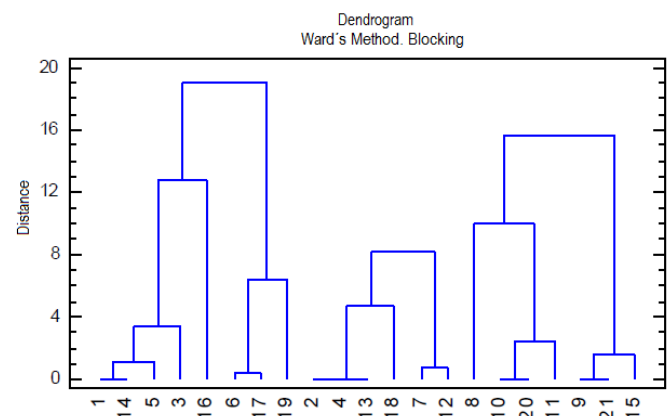


Figure 3. Cluster analysis (Source: Salcedo, 2012)

A cluster analysis was performed to have a better insight of the possible groups of experts who share similar answers. After the second round of answers, three clusters were identified. The first cluster was composed by eight experts, three academics, four members from the government, and one from the industry. The second cluster was also composed by eight experts, three academics, two from the financial sector, two from the industry, and one from the government. The third cluster was composed by one expert from the academy and one from the financial sector. Academics are located in all clusters with three in each of the big clusters and one in the last cluster, while government officials fit mostly in the first cluster. Bankers are mostly in the second cluster, and members from the industry are in both clusters. The difference in answers between the first and second clusters is the degree of agreement with the affirmation 29. The second cluster has stronger opinions regarding the agreement with such affirmation. The fact that

most of experts from the government were grouped in the first cluster while most of experts from the financial sector were grouped in the second cluster, what can lead to think that they had different opinions regarding the affirmations.

## VI. CONCLUSIONS AND RECOMMENDATIONS

Entrepreneurs consider access to formal credit as an important advantage of having a formal business, and a reason to leave the shadow economy to become part of the formal sector of the economy. Therefore, facilitating the access to formal lending can be an important tool when designing a policy of formalization. The Colombian financial system is performing well, with record earnings while expanding to other countries in the Latin American region.

Entrepreneurs are not getting the fullest from the financial system. The number of firms that have some type of financial tool with banks is increasing; however the percentage of companies that have any type of loans with banks is still low.

There is a perception that the Colombian financial system is not committed to help reducing the size of the informal sector. Moreover, the strict requisites that formal banks ask from entrepreneurs are seen as a factor that might increase the levels of the shadow economy. Colombian small firms are using informal lending, paying high interests, because they cannot have access to formal credit or do not know about financial payment tools.

Another factor that does not help to reduce the size of the shadow economy is the 0.4 percent tax on financial movements. Such tax is considered a problem since keep many people and companies away from banks. The perspective to pay an additional tax every time a financial movement is done is not attractive.

The financial system can play an important role to help companies become formal. Entrepreneurs see the access to formal credit as an advantage for a formal company. However, when that advantage is not available (because of high requirements, difficult and in many cases impossible to fulfill for many entrepreneurs) and banks have fees and charges (to manage a card, to get a checking book, to withdraw money, etc), the entrepreneur can perceive the bank as a cost with little or no benefits, preferring not to bank.

Banks should try to find ways to facilitate access to credits to formal companies, and also, to reduce the costs of banking. Both, banks and entrepreneurs will benefit. The financial system will have access to more resources, entrepreneurs will have more opportunities to get the loans necessary to operate, increase productivity and sales, and, easier access to loans will motivate entrepreneurs to leave the shadow economy and be formal. Of course, the authors are not proposing that everybody must get credits; banks need to study every case taking into consideration the risk associated to each customer, but also be realistic about the situation of small companies and the requirements they can fulfill. Banks should create lines of credit and requirements tailored to the needs and realities of small businesses.

Banks should reduce the costs associated to banking. Banks charge to withdraw money, to manage a card, to buy a

checking book, etc. People consider those costs to be high, keeping them away from banking. Banks should look at those costs and make an effort to reduce them. By keeping such high costs, they are losing potential customers both people and firms; also, people who already bank in many cases prefer not to use cash and not using the bank when they can.

The 0.4 percent tax is an additional cost to all others associated with banking, that prevents people from banking. The higher the value of a financial movement, the higher the amount of tax paid, keeping many firms away from banking, or using cash for high amount transactions. It is recommended to derogate such tax. Bankers cannot decide about that tax, but they can ask the government to derogate it.

The financial system, along with the academy, government, and the industry, has an important role when reducing the size of the informal sector. The combined efforts of those four sectors can lead to a successful formalization policy. To help leading the fight against the shadow economy, the financial system should ease requirements on credits, be more flexible and realistic about the realities of small companies, be more productive and offer new alternatives that decrease the costs of financial transactions, and create products designed to the specific needs of small companies.

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# Economic Branch Structure Like Cause for Regional Disparities: the Evidence from Latvia

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**Abstract**— as one of the factors hindering economic development in Latvia high regional differentiation between Riga region and other regions of the country is considered. As shown by the statistics dispersion of GDP per capita in Latvia is one of the highest in the European Union [10, 13]. As the result Riga region continues actively to develop and leverage resources from other Latvian regions, thereby reducing their opportunities to improve their position and impair the country's competitiveness. In conformity with the regional development policy till 2020 in Latvia it is necessary stimulate the economy at regional level and increase the activity of regions in processes of using potential in regional development [13]. Author evaluates the branch structure of economy in Latvian regions as a factor that affects the formation of regional differentiation. The research results indicate that the branch structure of economy is an important factor, which affects and promotes regional differentiation in Latvia.

**Keywords-** *economic structure; regional differentiation; Latvia.*

## I. INTRODUCTION

Latvia is characterized by high differentiation in regions by level of economic development.

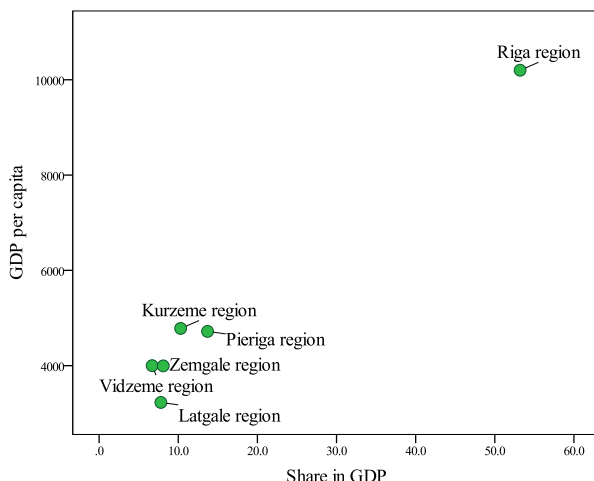


Figure 1. Regional differentiation in Latvia in 2010.

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Gross Domestic Product by statistical region, city and district (NACE Rev.2)

Riga region produces more than half of the Latvian GDP and has twice higher level of GDP per capita (see Figure 1). The remaining five regions of the country show more or less

equivalent level of economic development, but this achievement is well behind the Riga region.

As a result the Riga region in Latvia is a resource that is actively used in positioning the country in the global economic space. However, despite the high performance in economy in the Riga region compared with other regions of the country and using of this success for develop the country, radical inter-country differences reduce opportunities to improve overall competitiveness.

As the key problem following issue can be mentioned: Riga region actively collects resources from other regions, therefore opportunities of other Latvian regions for receiving foreign investments for economic development significantly decrease.

Consequently, the use of country's potential significantly reduces, what does not increase the overall competitiveness.

Reduction of regional disparities is one of the objectives of the European Union, and almost half of its budget is spending on promoting regional competitiveness [9].

European Union structural funds and other support programs are used for mitigate high inter-regional economic differentiation in Latvia. Thus, it may be noted that measures to reduce regional disparities are being taken in Latvia, but in general they are not directed towards activities that encourage certain economic sectors or support the reorganization of economic structure.

Author supposes that one of the main causes of the strong regional differentiation the branch structure of economy should be noted. The author evaluates the branch structure of economy in Latvian regions as a factor that affects formation of regional differentiation and its increase in Latvia.

In this paper author shows that despite similar trends in the economy, as well as despite similar changes in branch structure of economy and linkages between these changes among regions, different specialization is developing in Latvian regions. Based on the research findings it will be possible in further studies to assess experience, opportunities and success of regions to be able to answer the question - which branch structure of economy could reduce regional differentiation?

The paper is organized as follows: in second section author provides short theoretical background of a problem of regional disparities and describes methodological approach which is used in the paper, in third section author presents empirical

research results, as well as fourth section contains conclusion and questions for further studies.

## II. THEORETICAL AND METHODOLOGICAL APPROACH

### A. Economic Structure and Regional Disparities

Regional differences are formed during economic development under influence of such factors as geographic location, policy, history and economy. As is indicated in studies regional differences are the future of the world, especially in countries with low and middle incomes. They can occur in any country, but especially in large countries in terms of territory and population [19]. For example, studies on China indicate bright examples of regional differentiation [1; 11; 20; 22].

Despite the fact that European countries are smaller in many times than China both in terms of population and in terms of territory, Europe also is characterized by regional differences. High regional disparities exist among European regions and not only across national borders, but also within many countries [14]. The European Union actively works to reduce inequality in territorial development, but studies on the European Union indicate that convergence between countries is not conducive to regional convergence [15]. Especially important this issue is between the new member countries of the European Union [16].

As main reasons for high regional differentiation the effectiveness of regional policies, mobility of capital, and polarization of economic activity could be mentioned. Branch structure of economy is mentioned relatively rarely, but importance of this issue should be noted.

The issue of branch structure of economy in process of creating high regional disparities is important, because the results of economic activity are reflected in it; consequently, branch structure of economy is important indicator of the stability, sustainability, competitiveness and rational economic activity in conditions of limited resources.

Given the impact of globalization and the global economic downturn the strategy "Europe 2020" offers to build economic growth on innovative branches, within which high value added is generated [8]. This is why in most European Union member countries, including Latvia, adjustments in the structure of the economy should be made. At regional level, this process can be supported through regional policies and definition of priority industries. It should be noted that the unequivocal opinion on these instruments does not exist.

In many countries, it is accepted practice select priority sectors or regions and in their direction creates a national-level development policy. However, it is difficult to predict which sector or region in the future prove to be successful, because usually a new sector, as well as progress develops spontaneously, and each region has its own potential [2].

### B. The Data and Methodology of Research

In order to assess the role and impact of the branch structure of economy on formation of strong regional differentiation, the author uses the structural changes index (SCI) [17; 18], which is reflecting changes in the relative

significance of economic sectors, as well as Location Coefficient (LQ) [12], which allow to assess regional specialization.

The assessment of structural changes is often based on calculations of Structural Changes Index (SCI), which is expressed by the following formula:

$$(1) \text{SCI} = \frac{1}{2} \sum |x_{i,t} - x_{i,t-1}| \quad [17; 18].$$

The SCI for output may be defined as half the sum of the absolute value of the differences in value added shares over time. SCI values vary between 0 and 100, where 0 indicates on the absence of structural changes, while the 100 indicates on the complete change of structure [17; 18].

Using Location Coefficient (LQ) provides comparison of the regional economy with country' economy and as a result indicates specializations in the regional economy. Calculations of LQ are based on ration between data of local economy and the economy of country [12]. LQ can take values, which are equivalent with 1.0, as well as which are smaller or bigger than 1.0 [12].

The general view of the LQ formula could be generated as follows:

$$(2) \text{LQ} = (\text{data about industry X in region} / \text{data about industry X in country}) / (\text{total data about region} / \text{total data about country})$$

LQ often is used with employment data. In this paper author calculates LQ with data about value added produced within branches.

All calculations are based on data on economic sectors according to NACE 2 Rev. from the Latvian Central Statistical Bureau.

For achieving the objective of the study correlation analysis is implemented using IBM SPSS Statistics 19 software.

Correlation matrix for SCI values in Latvian regions allow us to indicate whether structural changes in branch structure of economy were linked or not, as well as calculations of correlation coefficients for GDP and value added produced within branches show relative importance of branches in regional economy.

## III. RESEARCH RESULTS AND DISCUSSION

In today's post-industrial economy service sector gives substantial contribution to the processes of economic growth, however, taking into account recent tendencies in global economy the need for reindustrialization should be noted.

The branch structure of economy in Latvia reflects modern economic trends. Service sector provide approximately  $\frac{3}{4}$  of the country's GDP. It should be noted that changes in the structure of economic sectors in Latvia is mainly based on two processes: a relatively rapid increase in the share of the tertiary sector, and fall in the share of the primary and secondary sectors.

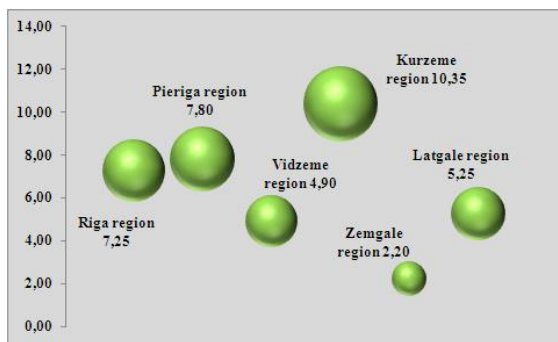


Figure 2. SCI values in economic sectors in regions in Latvia in 2010.

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices)

Figure 2 data indicate that changes in the structure of economic sectors in Latvian regions were equivalent and SCI values do not show that a fundamental changes in branch structure of economy occurred, while the changes in share of the branches note the significance of these processes.

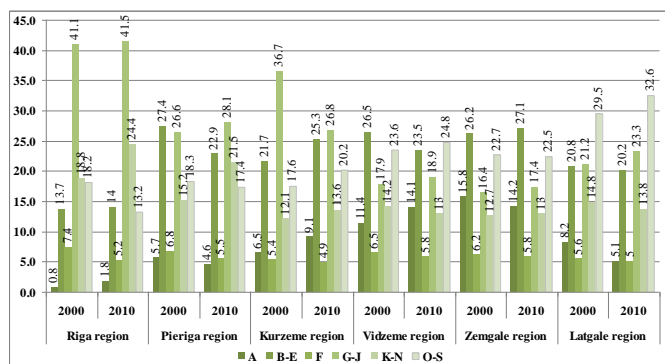


Figure 3. Shares of economic sectors in regions in Latvia in 2000 and 2010.

A - Agriculture, forestry and fishing, B-E - Industry and energetic, F - Construction, G-J - Trade, accommodation and food service activities, information and communication, K-N - Financial, insurance, scientific and administrative activities; real estate activities, O-S - Public administration and defence; compulsory social security, education, human health and social work activities, other activities.

Source: Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices)

It should be noted that although the overall trend in the country (a significant increase of proportion of those services, which are mostly oriented on the domestic market and is characterized by a relatively low level of productivity) regions show different changes in the structure of the economy. In Riga region and Pieriga region the largest share in economy service branches have, and those, which are characterized by the above mentioned properties, while in Kurzeme, Vidzeme, Zemgale and Latgale regions the importance of manufacturing and agriculture sectors is observed.

Despite the differences in the branch structure of the economy between Riga region and other regions, interconnections between changes in the structure of economic sectors in regions is observed.

Table 1 data suggest that changes in the branch structure of economy in Latvian regions have been linked. The closest correlation is observed between SCI values of Kurzeme and Pieriga regions, Zemgale and Pieriga regions, as well as

Kurzeme and Zemgale regions. Statistically significant, but the weakest one correlation between SCI values of Zemgale and Riga regions can be estimated.

TABLE I. CORRELATION MATRIX FOR SCI VALUES IN LATVIAN REGIONS

	Riga region	Pieriga region	Vidzeme region	Kurzeme region	Zemgale region	Latgale region
Riga region	1	.706*	.812**	.764*	.648*	.740*
Pieriga region	.706*	1	.730*	.970**	.943**	.867**
Vidzeme region	.812**	.730*	1	.701*	.734*	.885**
Kurzeme region	.764*	.970**	.701*	1	.926**	.864**
Zemgale region	.648*	.943**	.734*	.926**	1	.835**
Latgale region	.740*	.867**	.885**	.864*	.835**	1

\* Correlation is significant at the 0.05 level

\*\* Correlation is significant at the 0.01 level

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices)

Despite similar changes in the branch structure of economy and the linkage between these changes, the importance and meaning of branches in regional economies differ.

TABLE II. CORRELATION COEFFICIENTS BETWEEN GDP AND VALUE ADDED PRODUCED IN ECONOMIC SECTORS (IN MILLIONS LAT) IN LATVIAN REGIONS

	Agriculture	Manufacturing	Construction	Services
Riga region	.550	.966**	.918**	1.00**
Pieriga region	.950**	.990**	.439	.999**
Vidzeme region	.883**	.982**	.185	.994**
Kurzeme region	.685*	.986**	.519	.983**
Zemgale region	.949**	.976**	.022	.994**
Latgale region	.459	.739**	.541	.590

\* Correlation is significant at the 0.05 level

\*\* Correlation is significant at the 0.01 level

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices); Gross Domestic Product by statistical region, city and district (NACE Rev.2)

Table 2 summarizes the correlation coefficients between GDP and value added by sectors in Latvian regions. The calculations lead to the following conclusions:

- in all regions manufacturing plays an important role in the economy, a little weaker importance is observed in the Latgale region;

- in all regions, except Riga region and Latgale region, agriculture plays an important role in the economy;
- only in Riga region construction plays strong role in the economy;
- in all regions, except Latgale region, a strong link between GDP and services has been observed.

To sum up the above mentioned information, based on the author's calculations, it can be concluded that in Riga region's economy the agriculture has a little importance, while in other regions construction. A special situation is in Latgale region, where a strong link is only between GDP and manufacturing, and other sectors have a smaller role in the regional economy.

Evaluating the changes in the branch structure of economy in Latvian regions, author notes that these changes were similar and inter-related, but economic sectors have different role and importance in regions.

In order to more accurately assess the contribution of branches to the regional development, the author calculated the LQ coefficients, because in spite of similar changes in the branch structure of economy, specialization between Riga region and other regions differs.

Sectors that make up the region's specialization can also contribute to the export flows outside the region, as well as maintaining employment levels and provide possible increase in employment levels.

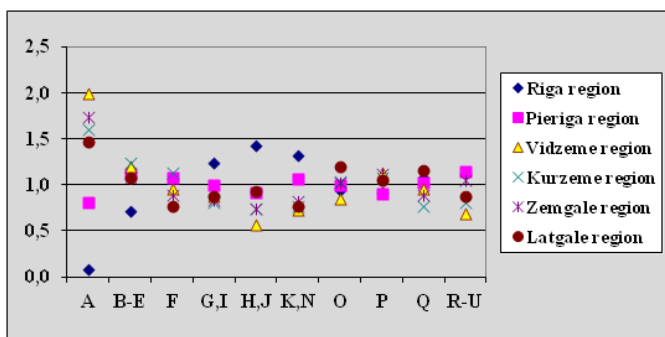


Figure 4. LQ values in economic sectors in regions in Latvia in 2010.

A - Agriculture, forestry and fishing, B-E - Industry and energetic, F - Construction, G,I - Trade, accommodation and food service activities, H,J - Transportation, storage, information and communication, K,N - Financial, insurance, scientific and administrative activities; real estate activities, O - Public administration and defence; compulsory social security, P - Education, Q - Human health and social work activities, R-U - Other activities.

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices)

Figure 4 indicate that specialization in Riga region consists of Transportation, storage, information and communication sector (H, J), which is export-oriented (transit), as well as oriented on development and application of high technologies (information and communication), as a result high value-added is produced within sector.

Calculations of LQ indicate that Pieriga region do not has regional specialization. By LQ values close to the region's specialization, however, like branches of local importance, Industry and energetic (B-E) and Financial, insurance, scientific and administrative activities; real estate activities (K-N) can be defined.

Agriculture, forestry and fishing (A) forms specialization in other Latvian regions, while Industry and energetic sector (B-E) is positioned, like sector of local importance.



Figure 5. Specialization in regions in Latvia in 2010.

\* Map from [21]

A - Agriculture, forestry and fishing, B-E - Industry and energetic, F - Construction, G,I - Trade, accommodation and food service activities, H,J - Transportation, storage, information and communication, K,N - Financial, insurance, scientific and administrative activities; real estate activities, O - Public administration and defence; compulsory social security, P - Education, Q - Human health and social work activities, R-U - Other activities.

Source: authors calculations by Central Statistical Bureau of Latvia (2013). Total value added by kind of economic activity (NACE Rev. 2) and its share by statistical region (at current prices)

Economic success of Riga region could be explained by:

- Transportation, storage, information and communication (H, J) sector forms specialization of the region. This sector is oriented on export, as well as met needs of big domestic market in Riga region (transportation, storage), as well as is oriented on development and application of high technologies (information and communication);
- strong and statistically significant relationship between GDP and construction, which can be explained by active use of the European Union structural funds and through this provide high implementation of region's potential.

In other Latvian regions except Latgale region, a strong and statistically significant relationship between GDP and agriculture has been detected. It should be noted that this sector forms a regional specialization.

As a negative aspect, which can be termed as one of the major causes for low level of regional economic development in Latvia, high importance of agriculture in regional economy could be mentioned, because of low value added generated within this sector, as well as high dependence on the European Union's Structural Funds and limited outlets for both domestic and foreign markets because of high competition level.

#### IV. CONCLUSIONS

Evaluation of the changes in branch structure of economy in Latvian regions shows that changes in economic structure were similar and inter-related, but importance of the branches and regional specialization differ.

Riga region, which is significantly ahead other regions by economic development, specializes in the service sector, which

is export-oriented, meet needs of large domestic market, as well as within which high value added is created.

In other Latvian regions agriculture plays important role in economic structure. The agricultural sector has a strong statistically significant relationship with GDP, as well as forms specialization of Kurzeme, Vidzeme and Zemgale regions.

It should be noted that within agriculture sector relatively low value added is produced, and the sector is highly dependent on the European Union's Structural Funds.

Calculations of SCI and LQ, as well as results of correlation analysis suggest that the branch structure of economy is an important factor, which affects and promotes regional differentiation in Latvia.

Given the importance of branch structure of economy in promoting regional differentiation in Latvia, it would be useful in further research to study causes of formation such structure, as well as to assess possible changes of this structure in regions for reducing such bright regional differentiation.

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# SECTION 4.

*Public service, Law*

# Rethinking Macedonia's capacity to deal with trafficking: some recommendations for parliamentarians

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**Abstract** — According to the annual **Trafficking in Persons Report** of US Department from 2012 and other gathered reports from the country, Macedonia is a source, transit, and destination country for women and children trafficked for the purpose of commercial sexual exploitation and forced labor. Crimes related with trafficking sometimes consist terrible acts such as torture, use of force, rape, underpin human right and represents real concern about national and international security. Trafficking is a highly quoted and profit organized criminal activity for which there is practically inexhaustible market and covers all areas of the world. Parliament and other state institutions must deal with this problem and act as soon as possible. In this paper I have identified some key problems and proposed some recommendations to be taken by Assembly of Republic of Macedonia and other state institutions that deal with this problem.

**Keywords:** *parliament, trafficking, crime, victim, government.*

## I. INTRODUCTION

In general, trafficking is still perceived and treated as an isolated social and criminal phenomenon that can be addressed separately from other problems (Trafficking in Persons Report 2010). Although we know about the root causes of trafficking - poverty, unemployment, discrimination, violation of basic human rights, violence in the family, and demand in the countries of destination. Trafficking it undermines the principle of equality and dignity of all human beings in light of the fact that traffickers control victims by use of violence and intimidation for the purpose of exploitation for economic gains. It constitutes a modern form of slavery and at society level it puts a question mark on the rule of law and fundamental democratic values.

As a body that represents the people, parliament should supervise the policies of the government in fulfilling the needs of its citizens. The concept of democratic control of public authorities is to guarantee internal stability of the country and is a tool to keep the state and its agencies accountable to its citizens, the rule of law and human rights are protected, that the state institutions serve to the interests of the population. Establishing a system of accountability of the institutions who deals with trafficking is also democratic and efficient, is one of the most difficult challenges facing states, especially transitional states.

During the year, authorities reported an increase in undocumented foreign migrants in the country, a group vulnerable to trafficking. A 2011 labor sector assessment found the prevalence of labor exploitation to be greatest in Macedonia's textile sector, mostly in southeast Macedonia, and significantly prevalent in civil engineering, tourism, catering, and agriculture. Trafficking offenders increasingly used false marriage, particularly among the ethnic Roma population, as a tactic to lure victims into forced prostitution (Trafficking in Persons Report 2010).

According to the US Department of States Trafficking in Persons report for 2012 the Government of Macedonia fully complies with the minimum standards for the elimination of trafficking. The government sustained its vigorous prosecution and conviction of trafficking offenders, and proactively investigated trafficking complicity. The government failed, however, to provide adequate financial resources for victim care in the shelter, and did not provide critically needed resources for reintegration. The government continued to identify only a small number of victims relative to the rest of the region. The lack of results in victim identification continued to suggest some front-line responders and other officials lack a full understanding of the complexities of trafficking and the required skills to identify potential victims, thus failing to ensure victims full access to their rights and protection under Macedonian law.

Political conflicts, ethnic, religious, cultural, various types of wars, poverty, and various natural disasters have prompted more movement and displacement of people from their permanent residences at places and regions which are considered safer and hope for better life. Several legal obstacles always follow this form of movement because large numbers of trafficked persons already presents serious problem for "dreamed" states.

Trafficking is high profitable business and very low risk (at least if you compare with drug trafficking) to be covered from institutions who fights this type of crime, and this will remain the main reasons why we have and will have trafficking in the Republic of Macedonia and the Region of Southeast Europe.

## II. ANALYSIS OF PROBLEM

Trafficking is very much an international phenomenon, which affects not only Republic of Macedonia and Eastern Europe but also every region of the world. Trafficking is a problem that also concerns Macedonia. Macedonia is a source, transit, and destination country for women and children trafficked for the purpose of commercial sexual exploitation. The problem of internal trafficking is nowadays becoming more visible. The main concern is the growing numbers of internally trafficked persons, Macedonian women and children mainly recruited from eastern rural areas with purposes of their exploitation in the urban areas in northwest of Macedonia. Macedonia does not provide with any data about internally trafficked persons. Another characteristic is that victims are mostly minors 14-18 which is big concern. The exploitation is conducted in night bars, which is done by forced prostitution and labor exploration.

Victims trafficked into Macedonia are from Kosovo, Moldova, Ukraine, Albania and other Eastern European countries, and are routed through Macedonia en route to Serbia, Montenegro, Albania and Western Europe (the entrance points in Macedonia are identified on the Kosovo, Serbian and Bulgarian borders, Tetovo near Kosovo, Kumanovo near Serbia and Kriva Palanka, Strumica and Delcevo close to the Bulgarian border) while for exit are used Dojran and Gevgelija near to the border with Greece and Struga area to the Albanian border). The routs used by traffickers are complex and varied, and they are able to respond to market demands or obstacles such as increased border control, passed new legislation which required different form of control from current form.

The Report on Human Rights of the State Department suggests that at any given time around 2400 to 2600 women are staying in Macedonia either waiting to be trafficked in to Western European countries or continue to be exploited in various ways, most commonly sexually, in the local bars and brothels. Children, primarily ethnic Roma, are trafficked for the purpose of forced begging within the country. Victims are trafficked for the purpose of forced labor in Macedonia's service sectors. Traffickers' *modus operandi* continued to evolve in response to law enforcement tactics, including increased use of more hidden, private sectors, such as beauty salons and massage parlors.

Some trafficking victims are recruited through advertisements of work abroad, such as waitressing, and then forced into prostitution. While the majority of women and girls trafficked from other countries, transit the country on their way to other countries, some women who are considered by traffickers as less desirable in Western Europe are left in the country without money and forced to work as prostitutes (Crime and Society 2013), or to work for minimum or without salaries.

The Government of Macedonia fully complies with the minimum standards for the elimination of trafficking. While the government could strengthen its performance in certain areas, the government improved implementation of the anti-trafficking statute to obtain convictions of trafficking offenders and continued to expand the usage of its victim-centered standard operating procedures for the treatment and protection

of trafficking victims. Government of Republic of Macedonia together with NGOs as partner provide victim assistance in shelter centers, but government failed on providing financial funds for victims and did not provide needed support such as various programs for reintegration in the society. In the aspect of fighting this type of crime government did not achieve results as neighbor countries achieved, we still have small numbers of identified victims and small numbers of identified perpetrators by state institutions that fight this type of crime.

Identifying the local context and the specific mechanisms of trafficking that are taking place within a country are essential to creating a strategic response (Handbook for counter-trafficking 2008). Prevention, protection and prosecution efforts tend to be the primary pillars on which many comprehensive counter-trafficking strategies are built. Prevention activities are extremely important in combating trafficking.

How Republic of Macedonia prosecutes cases of trafficking we will see from table below. We will analysis data for period 2002 – 2010 obtained from Ministry of Interior because from 2002 criminal law prohibits trafficking in the article 418 – a.

TABLE I. . REGISTERED CRIMINAL OFFENCES AND REPORTED PERPETRATORS IN THE MINISTRY OF INTERIOR FOR PERIOD 2001 – 2010

	Registered criminal offences	Reported perpetrators
2002	18	33
2003	42	78
2004	19	42
2005	12	40
2006	3	4
2007	3	4
2008	1	4
2009	1	1
2010	-	-

Source: Ministry of Interior of the Republic of Macedonia, Criminal offences for period 2001 – 2010  
<http://www.mvr.gov.mk/DesktopDefault.aspx?tabindex=0&tabid=396> (24 May 2013)

The numbers in the table above indicate that trafficking in the Republic of Macedonia from year to year is in decline. The data shows that at the beginning when trafficking become criminal act in the first two years trafficking was growing the number of offenses committed and the number of perpetrators for this crime. From 2005 onwards we have a very large decline moving up these crimes to a symbolic numbers, and in 2010 Ministry of Interior has not discovered any case of trafficking. This situation raises many questions which Republic of Macedonia, institutions and others involved in fighting this crime should provide clear explanation does this situation is the result of a real war of state institutions and other measures taken and from the other actors or is the result of inefficiency of institutions in fulfilling their duty to fight this crime. I am convinced that the figures above do not reflect the

true situation and that it is a great distress for Macedonia specifically the Ministry of Interior.

Trafficking is organized crime, presented everywhere in the world. From data in the table we can see that this crime is committed by 2 and more perpetrators, and this mean that this crime is organized, and is main part of the organized crime. Is criminal activity and enact as serious threat for security of the country. Because of the fact that human trafficking is the third largest organized crime activity (According to the International Organization for Migration (IOM) global trafficking generates up to 8 billion US dollars every year, making it the third largest International Organization Crime after arms and drugs trafficking), it can be a factor for weakening and destabilizing the sometimes fragile stability in a country. For Republic of Macedonia trafficking is also big problem because view it as transnational organized crime and represents its profitable activity. According to its nature, human trafficking is always organized, for at least three sides including sellers, buyers and transporters. On the other hand, is a complex criminal activity that consists in the use of violence or threat of violence, fraud, and encouraging use of other illegal means by which a person is placed in a subordinate position for exploitation. Organized trafficking is associated with massive corruption in various government structures: police, immigration services, customs, influence politicians, the private sector and other actors with aim to facilitate the organization of trafficking and protection from prosecution.

Besides the progress of Republic of Macedonia in strengthening the rule of law, security and institutional reforms, trafficking in persons remains a form of organized crime that is a danger to the safety and stability of the Republic of Macedonia, which is currently a country of origin, transit and destination. Republic of Macedonia has to achieve a common understanding on the key tasks and essential values of human rights in combating trafficking in human beings. Its mission is to establish strategic priorities in the fight against trafficking, to define specific tasks of the relevant institutions/organizations and to harmonize inter institutional activities for achieving the set goals locally, nationally and internationally (National Strategy for Combating trafficking in Human beings and illegal migration in the Republic of Macedonia 2012).

The work involved in combating trafficking in persons is fraught with many challenges, and there are significant regional variations in countries' compliance with international standards. It is no easy matter to implement laws; doing so requires resources, continuous oversight, monitoring and evaluation. The investigation and prosecution of cases of trafficking is a complex and time-consuming process that necessitates rigorous training and the commitment of law enforcement agencies and judicial authorities, whose work may also be hampered by corrupt practices. Another obstacle is the identification of victims, who often fear deportation or reprisals from traffickers (Combating in Trafficking in Persons 2009).

As vulnerable group and potential victims of trafficking that should be given special attention in the future are children and young people with low or no education aged 10 to 22 years, from poor and dysfunctional families, children without parental care.

### III. THE ROOT CAUSES OF TRAFFICKING

Answer of the question what causes the appearance of human trafficking will require a very long explanation but the main factors would be: lack of legitimate and fulfilling employment, feminization of migration, gender-based discrimination and gender-based violence, traditional community attitudes, women's perceived suitability, growing demand for foreign workers, the lucrative nature of trafficking, demand for women's sexual services, lack of access to legal redress, devaluation of human rights (Trafficking in Women 2003), poverty, armed conflict and gender discrimination which as push factors in the countries of origin and on the other hand the demand for cheap labor and sexual services in the countries of destination. Macedonia also faces with lack of adequate legislation, political will, difficulties in gathering evidence to prosecute traffickers, poor data for victims of trafficking.

As part of South East Europe Macedonia has impact from process of globalization on employment and international migration, impact from facilitating international travel and communication. Globalization has also had the effect of "feminizing labor" by opening up avenues of employment abroad for unskilled women to become wage earners. Consequently, there has been an increase in the number of women from the East migrating to take up employment in richer countries, particularly as sex workers, mail order brides, in the domestic service or manufacturing industry. The fact that the majority of trafficked women come from poor countries is evidence of a link between trafficking and poverty (Ndiaye 2005).

The role played by restrictive immigration policies, enforced by major countries of destination, in encouraging human trafficking also needs to be highlighted. It has been observed in Europe, for instance, that stringent immigration policies applied by the EU member states, vis-à-vis countries in Central and Easter Europe, coupled with the demand for labor in irregular sectors, have contributed to fuel incidents of human trafficking in the region. Trafficking victims suggest that nationals from countries with automatic or facilitated access to the EU through temporary visa schemes, as in the case of the EU Accession Countries, are less likely to have been trafficked. Even when found working in the sex industry, such nationals are more likely to be doing so voluntarily, in control of their wages, freedom of movement and choice of work, and consequently not as victims of trafficking (Scanlan 2002).

Macedonia as part of Southeast Europe serves as a major source, transit and destination region of trafficking in women and girls for sexual exploitation, with complex routes, for instance from Albania or other countries through Eastern Europe and eventually into the European Union (Rehn and Johnson 2002). The main reasons why victims from this region leave home are because of a false job offer. In most of these countries, trafficking thrives with the complicity of the police or border officials, who are willing to turn a blind eye for bribes. It has become increasingly apparent that trafficking in women represents an expanding area of transnational organized crime, where trafficking of drugs and arms have expanded their trade to include human trafficking (Nadiaye 2005).

Republic of Macedonia has launched the National Strategy and National Action Plan 2013 – 2016 to combat human trafficking and illegal migration and is third one. Strategy and Action Plan represents comprehensive policy to combat trafficking with coordinated action of all relevant institutions and organizations. Key innovative features of the National Strategy and Action Plan are to provide strong preventive measures to act on the causes or origins of human trafficking and work with vulnerable groups in order to prevent this occurrence. According to this document institutions will work on raising awareness among the general population, especially among youth, economic empowerment of vulnerable groups to facilitate access to the labor market and organizing campaigns to reduce the demand for using the services of victims of trafficking. According the consist of this document Republic of Macedonia will fulfill all national and international required obligations, and what is more important will change the life of victims of this crime.

#### IV. ROLE OF PARLIAMENT IN FIGHTING TRAFFICKING

Macedonian Assembly plays crucial role in fighting trafficking. Parliament is the only elected body in national level that can speak for all citizens to defend their interests. When parliamentarians take into account trafficking issues, which include an understanding of the different aspects of trafficking, victims, they strengthen respecting mainly human rights and dignity of persons. Very importance on trafficking issues has parliamentary committees who through their powers can explore important questions from all areas. The Assembly establishes permanent working bodies. The working bodies review draft laws, draft-regulations and other acts passed by the Assembly, as well as monitoring over the implementation of the acts of the Assembly as well as other duties and debates on issues of its competence. The Chairs, Deputy Chairs, members of the working bodies as well as their deputies are elected from among the Members of the Assembly. The Committee cannot exercise investigative and other judicial functions. The Committee's findings are the basis for starting a procedure for accountability of public office-holders.

Parliament tends to be regarded as a less suitable institution for dealing with trafficking issues, especially given its often time-consuming procedures and lack of full access to the necessary expertise and information. However, as with any other policy area, parliament is entrusted with reviewing and monitoring the executive. There are at least four reasons why such oversight in trafficking matters is crucial: a cornerstone of democracy to prevent autocratic rule, no taxation without representation, creating legal parameters for trafficking issues, a bridge to the public (Parliamentary oversight of the security sector: Principles, mechanisms and practices 2003).

Parliament should establish a parliamentary committee on human trafficking to oversee and guide government policies on the protection of trafficking victims (Combating in Trafficking in Persons 2009).

Reports may be made both to and by parliamentary committees charged with oversight of the government's

performance in combating trafficking in persons and authorized to investigate government action in this regard. Such committees can either be specific to trafficking in persons or may be broader in scope, such as committees addressing foreign policy, human rights, women's and children's rights or other related topics. Importantly, such parliamentary action creates the perfect forum for consulting civil society, as these committees can hold public forums and invite NGOs concerned with the issue of trafficking to provide their recommendations on policy directions. In addition, parliament can make use of its ability to make motions or declarations to attract attention to trafficking and related concerns, raising both parliamentary and public awareness of the issues. (Combating in Trafficking in Persons 2009).

#### V. OPTIONS

- a) Macedonia is part of the region, and this problem requires regional approach. In this contest there is need to recognize the new situation and develop a comprehensive human rights-based system for counter-trafficking activities (including prevention, protection and prosecution) relying on government-owned, flexible structures, acknowledge the changing modalities of trafficking and the fact that that current assessments are based on limited information and that there is need to improve information gathering, research and dissemination systems, and, acknowledge the need to set up standards and procedures for anti-trafficking work.
- b) In order to enhance the regional combat against human trafficking, the other countries in the region must increase their performance in this field by complying with the act's minimum standards for the combat and of trafficking, and thus make progress. Therefore, Macedonia should actively be involved in the process of sharing its positive experience with the countries in the region. This could be done with government meetings and intensified cooperation between civil sectors from the region.

#### VI. SOME RECOMMENDATIONS

1. Macedonia should step up efforts to detect domestic and foreign victims of trafficking and the victims not to be punished and deported as a result of trafficking.
2. The government made important progress on the implementation of the new standard operating procedures on victim referral, however, additional work is needed to ensure they are implemented fully and consistently throughout oversight of ministries by Parliamentary Committees, to require from Government to increase the collaboration between schools and the community, increasing the impact of teachers and administrators on child trafficking and conducting information and education campaigns in schools.

3. The government has yet to provide direct funding or resources for victim assistance to the current domestic victims' shelter. It has drafted legislation that will allow it to create a new government-funded/NGO-run domestic shelter, but some NGOs have expressed concerns over how this plan will ultimately affect protection and assistance for victims.
4. Parliament must require from Government, as a transit country to work more on strengthening border control and provide continued training to officials such as judges especially trial judges, prosecutors, police officers, to enable them to deal with such cases and identify sub-groups of trafficked persons within larger migrant groups moving through their country, legally or illegally.
5. The government did not fund or initiate any awareness campaigns to reduce demand for forced labor or commercial sex in 2008, however, it used some IOM-funded materials aimed at demand during its anti-trafficking week. Parliament should allocate funds for awareness campaigns and require from Government to prepare public awareness programmes designed to educate potential victims of trafficking in persons and their families of the risk of victimization, educate citizens about the dangers of sex tourism.
6. Require from Government to improve coordination and cooperation between government structures and NGOs by defining responsibilities and accountability for each actor and require from Macedonian Government provide any direct financial support for NGOs conducting anti-trafficking prevention activities.
7. The Macedonian Government should be provided with the capacity to guarantee full protection to detained third country and Macedonian trafficking victims, including the establishment of sheltering services and a witness/victim protection program.
8. Members of Parliament must take part actively in all activities that deal with trafficking such as campaigns, workshops, seminars, conferences etc., and should encourage and give support all institutions engaged with anti-trafficking activities.
9. Establish a special parliamentary committee on combating trafficking in persons.
10. Active role of parliamentarians in monitoring and reporting on anti-human trafficking activities

#### CONCLUSIONS

Trafficking is a major global problem that also concerns Macedonia because this type of criminal activity in the first plan violation of fundamental rights and freedoms of the people who are being trafficked for exploitation of any kind, prostitution, exploitation of labor and other. The Government

of Macedonia made tangible but uneven progress since the release of the 2008 annual report from National Commission. However, the government has yet to implement certain important improvements in the areas of victim protection, assistance and trafficking related corruption needed to demonstrate appreciable progress in its anti-trafficking efforts.

Evidently, over the past few years, Macedonia has made significant progress in terms of its legislation plan concerning the fight against trafficking, but there is need to do much more in practical side. Number of cases of trafficking is symbolic if we compare with assessments for numbers of victims of trafficking. Also, numbers of people accused adult perpetrators for trafficking in Macedonia are not consent with the real number of people involved in this type of organized crime. This indicates that there is essential importance of capturing a greater number of offenders.

It must be stressed that without a stronger emphasis on prevention and the involvement in anti-trafficking work of institutions that are able to address the root causes of trafficking, a successful attack on trafficking is not possible.

The fight against human trafficking has three components: the prosecution of traffickers, the protection of trafficked persons, and the prevention of trafficking. In addition, and cutting through these "three Ps", national and international cooperation among the various actors constituting the counter-trafficking security sector is needed (Friesendorf 2009).

No one person, agency or organization alone can combat trafficking in persons effectively. Multi-sector cooperation is imperative given the complex nature of the crime, whether it is internal or international. Countries of origin, transit and destination must work together to recognize the mechanisms of trafficking, properly identify and assist victims, and prosecute and punish traffickers.

Macedonia has Tier One status by U.S. State Department 2012 Trafficking in Persons Report, this position is good sign that Macedonia is fighting this type of crime but is far from that how should be situation in the field. Macedonia has yet a lot of to do, and this should be done among the others factors always to be included and Assembly of Republic of Macedonia as body who represents the will of people.

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# Comparative situation of professional liability insurance of architects in Europe

## Urgent need for unified regulation about the liability insurance for the architect in Europe

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**Abstract—** The characteristics of the professional practice of architecture, cause economic, social, cultural and even political consequences, which have an important impact in architect's professional responsibility, mainly liability.

These characteristics often require the architect -depending on cases and countries-, to take out professional insurance which guarantees the economic liability risks. In some European countries, this kind of insurance is part of the legal package that should have the architect in their daily practice of the profession, and in others, however, this is something just voluntary, depending on each professional.

Analyzing the cases of countries which represent the European Union, we will see how civil liability situations are very different from one country to another; so defining aspects are analyzed actual cases of liability insurance, checking differences in some aspects like configuration and application of liability, the dependence of the architectural form of contract, the years of security to be sure the architect in the exercise of their profession, and even into the requirement to have economic products (insurance) to support their professional work.

The analysis of frameworks that define professional responsibility, culminates with the comparison between the amounts to treat specific figures and actual periods, to define clearly the last quantifiable aspect of this analysis: the economic translation that responsibility affects the architectural profession.

Nowadays, there are no guidelines -at European level- to regulate this aspect of vital importance for the practice of architecture; this is the reason because it seems clear that from a thorough analysis of reality industry professional, must produce a right proposal to unify the current situation of heterogeneity in the conditions of the architect's liability insurance, with European professionals living in an increasingly united Europe socially and economically.

**Keywords:** Professional liability, insurance, risk, warranty, economic analysis.

### I. ZONING AND SYNTHESIS OF THE EUROPEAN SITUATION.

The first difficulty in the analysis of the legal situation at European level, is the heterogeneity existence about liability of architecture in Europe, with its 27 countries. However, the common tradition of law and the construction sector in different European countries, allow to identify similar

countries, so that by their common legal traditions, as well as other factors such as cultural norms, socio-economic and geographical peculiarities, allow us to treat them similarly. This way, we can establish a territorial classification, that would subdivide the European influence in four areas of common characteristics, from the point of view of liability:

- Nordic-Scandinavian area, which would bring together countries like Denmark, Finland, Norway and Sweden, with a long architectural tradition shared.
- Central Europe, which under the influence of Germany, would also include Austria, Belgium, Holland and Luxembourg.
- Anglo area, which include principally the countries comprising the British Isles, Ireland and Britain.
- Roman-Napoleonic Zone would include France, Italy, Spain, Portugal and Greece.

All other countries in the European Union, are based on regulations mixed with influences from some of the above, or their codes are still very primary and there is much deregulation.

This poses a structural question of synthesis, being necessary to reduce the scope of the study and compared in terms of architectural and legal traditions what occur in Europe. Thus, this paper will compare the realities of the five countries, which are representing the main groups that comprise the different conceptions of civil responsibility in Europe, namely: <sup>1</sup>

- Denmark, on behalf of the Northern European countries and therefore to treat specific example trend Nordic legal liability.
- Germany as a typical example to compare as representing the Central European legal tradition.
- UK architectural world as a representative of Anglo and its corresponding condition to the concept of liability Saxon.
- France and Italy, as two key different cases to understand the concept of the south european architect, governed by Roman-Napoleonic legal regulation.

Therefore, we will study the reality in these "model" countries, analyzing significant key frames of professional liability.



Figure 1.

## II. PROFESSIONAL INSURANCE OF ARCHITECTS IN EUROPE.

The legal situation of responsibility in architecture is very different all along Europe, varying the configuration and application of liability, the dependence of the architectural form of contract, the years of warranty to be sure the architect in his practice, and even the obligation to have insurance to support their work practice:

### A. *Mandatory of liability insurance, and responsibility of different actors in the construction.*

In the case of Denmark -representation of the Nordic countries- although historically there is no legal requirement in order to force the architect professional liability insurance at general level, the responsibility of the architect is well regulated and limited. Depending on the task that is engaged, the insurance may be required depending on several factors, but not required themselves to take out insurance only for the exertion of architect. The requirement depends on exercising roles of this professional, his responsibilities and his contract actions. It also depends on the contractual form chosen, and what is agreed upon responsibilities of one or the others agents in the contract.<sup>2</sup>

However, on the 1st of April of 2008, came into force the new Law on General Insurance Obligation that made mandatory to "general construction insurance" for professionals or companies that build new buildings. This new norm is a strict regulation in relation to cases where an insurance is obliged to respond to the damage of the building.<sup>3</sup>

This regulation is at the forefront of European legislation in this regard, as it is also compulsory subjects as pass regular inspections of homes in the insurance period (1 to 5), control of insurance by municipalities to grant planning permission, and the general publication of the companies that have caused most damages by negligent work.

But in Germany, currently is very clear the categorically required to hire a permanent professional liability insurance. The obligation to be insured is not only for architects; just the statutes of the "*Bundesarchitektenkammer*" allotted insurers responsibility to report if a member of insurance status changes.

In the AngloSaxon world-represented by Britain-, the liability of architects has evolved throughout the years. In the late 1960, the architects worked under contract forms below which had all the responsibility for the work, which, on the one hand gave them full control over the building, but the level of responsibility was excessive. This evolved periodically, until it has become something continuously revisable as part of the dynamic professional architect. Nowadays the architects are responsible of their actions, decisions and omissions by a time - dependent case- by which respond civilly.

Therefore in the UK, architects are required to hire a liability insurance to ensure malpractice costs. This is part of the Conduct Code, which makes compulsory to be registered in the "*Architects Registration Board*" (ARB) in order to work as an architect. This requirement is for all ARB registered architects, not only for those who work on their own, or exercise liberal practice of the profession.

Italian Civil Code also regulates the legal issues that concern to the professional responsibilities, indicating that all the works have a warranty period, which reponds the builder, the architect and all professionals who participated in it. However, despite the clarity with which the law defines the warranty period of construction professionals, the law not strictly require the purchase of insurance to cover liability of the technical professionals, and specifically, the architect. At least, is not generally forced to buy insurance only for exercising architect. Only is mandatory civil insurance in the case of professionals working for the government, like any other Italian public sector worker. However, the ethical guidelines of the Italian "*Ordini*" reflect the obligation to meet the responsibilities acquired.

However, the Italian architects expect soon the new law to mandate hiring the insurance. The bill in this regard was approved by the Cabinet on December 1, 2006, but has not yet entered into force.

The legislative treatment of liability is not very different in France, where this concept evolved in a unique way from the adoption of the so-called "*Spineta Law*" (1979), which fix the responsibilities of all involved professionals in building. Besides establishing a period of responsibility, this legislation provides that all those involved in the building are responsible to the extent that it is up in relation to his performance in the building, plus the regulation makes it compulsory insurance is means that all involved in the building, and in case of disaster, must be secured.

The obligation and corresponding liability insurance treats "Giscard law" too, including the obligation to coordinate this aspect of the regional "Ordres". The importance of this topic for the law is clear, seeing how the normative requires attach the certificate of professional security (insurance) to all contracts signed by this technician.

#### B. Warranty Time Limits of liability in the European architecture.

In Denmark, the new Law on General Insurance Obligation, made mandatory to "construction insurance general" for professionals or companies who build buildings, so that it responds to the damage of the building during the first ten years, from the date of delivery to the owner. Therefore, these ten years is what we understand as warranty period required by construction professionals, to be covered by insurance in the Nordic legislation. The contractor must necessary sign this mandatory decennial insurance -just in case if it is a professional or a company- exerting a service as a builder, general contractor or directing a project of "turnkey", in other words, they should contract building in a professional way. In case of self-promoters of their own houses, or in the case of extensions or alterations of an existing dwelling, a compulsory insurance is not necessary.

In the case of Germany, previously to 2008 the architect was responsible for a period of five years (by contract type generally BGB), and only two years (through a construction contract type VoB). However, since the reform of the Civil Code in 2008, the architect has three types of responsibilities in terms of the warranty period:

- A period of two years, for planning and control of a work of maintenance or modification of a building.
- A period of five years, in a work of planning and control of a complete work of building.
- All other cases, the guarantee will have 30 years of general warranty.

However, the period for which you must be insured under the warranty terms in the UK, are from six years to twelve years (depending on contract) for contractual liability, and fifteen years for tort.

In the Italian case, the Civil Code regulates the legal issues affecting professional responsibilities, indicating that all works are guaranteed for a period of ten years on the builder, the architect and all professionals who participated in it, starting from the issuance of the Certificate of Occupancy (certificato di abitabilità).

### Warranty period of the architect's work

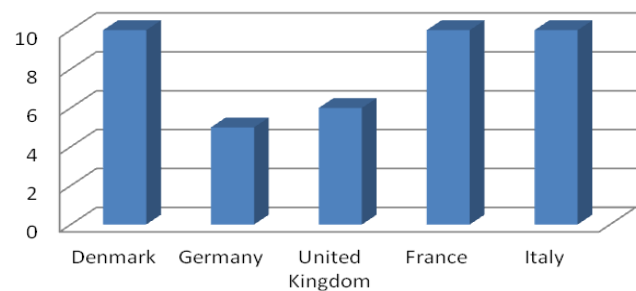


Figure 2.

However, despite the clarity which the law defines the warranty period of professional's construction in Italy, we must remember that in this country there is no legislation requiring any insurance covering professional's liability of these technicians, and specifically, the architect.

In France the commented law "Spineta" establishes a ten-year period of responsibility. In addition to establish that period, this legislation provides that all professionals involved in the construction are responsible, and have this responsibility on their facts and their performance of the building; besides that the regulation establishes a compulsory insurance, for everyone who is involved in the construction, and in case of disaster, must be covered.

There are other types of security affecting the construction, as establishing a guarantee of proper operation for at least two years from receipt of the work, or the Civil Code, which define that "guarantee perfect compliance" is the guarantee that the contractor exercises over a period of one year from receipt. Actually these types of liability does not affect as such the architect, whose responsibility is focused on the ten-year warranty. Actually these types of liability do not affect to the architect, whose responsibility is focused on the ten-year warranty.

#### C. Professional Associations and positioning existing European insurance against civil liability.

In Denmark, there are professional associations such as the "DANSKE ARK" (*Danske Arkitektvirksomheder*) or "FRI" (*Foreningen af Rådgivende Ingeniører*), which require professionals associated with insurance to receive his liability. The explained new normative approved by the Building Authority, has rules strict and clear on this aspect.

Also, municipal institutions must do the role of checking possession of compulsory insurance when applying for planning permission to run the building. If the municipal authority detects the absence of this insurance must not grant a license.

Similarly, in Germany, associations called "Bundesarchitektenkammer", force their members to take out liability insurance for certain minimum amounts, depending on each zone. In fact, the demand for professional insurance

forms is a prerequisite for enrollment in the associations of architects.

Also in the UK, professional associations guarantee mandatory liability insurance contract to ensure malpractice costs. This is part of the Code of Conduct "ARB", required to work as an architect. Also the leading professional association in the UK, the "RIBA", forces its architects to be covered by adequate insurance.

This requirement is for all ARB registered architects, not only for those who work on their own, or exercise liberal practice of the profession. Also employees should be insured, but in this case it is the responsibility of the employers to contract the insurance, and employees be aware that this happens.

In Italy, despite the lack of mandatory professional liability insurance to practice in the private sector, the ethical guidelines of the Italian "Ordini" reflect the ethical obligation to meet the responsibilities acquired.<sup>4</sup>

In France too, "Giscard Law" incorporates the obligation to coordinate this aspect by the regional "Ordres", which must issue a certificate of compliance to exercise certain architects who meet the requirement. The legislation also requires to attach the certificate of insurance in all contracts signed by architects.

Finally, professional duties Code (Code des devoirs professionnels) says that Ordres should control this kind of insurance, by a required certificate which ensures the validity of the professional insurance that cover the architect's work.

#### *D. Comparative economic analysis of liability insurance. Costs and coverage.*

The cost of such insurance for architects responds in part to the same situation of obligatory that it is living in these countries. Despite the difficulty of measuring this aspect -due to the difference of the concept and features of the insurance they have in different states-, in this work we have tried to simulate a common example of a study: an architect without employees (only architect), to secure for the period mandatory contract and tort, with an average income of 100,000 euros a year, previous works without casualties, with a zero accident rate, and ensuring maximum coverage-where available-from 300,000 euros.

The cost of insurance in Denmark is around 1.5% of the material cost of the execution of the work. In an example of a house of DKK 2,000,000 (268,400 Euros to change August 2010) general construction insurance would cost about 30,000 kroner (4,030 euros at August 2010).

In Germany the economic coverage mandatory minimum insurance, varies between different Länder, but the range is between 250,000 and 300,000 euros by material damage, and between 1.5 and 3 million euros by personal damage. It's necessary to differentiate between a professional liability insurance and a extended liability insurance, depending on different limitation periods marking the German Civil Code and depending on different type of contracts existing in Germany.

Regarding to the insurance premium, in Germany it varies greatly between one cases to others, depending on many factors such as the experience of the architect, the size of the work, the sums insured, the period of coverage, etc.. However, if we study the cases that the insurance companies are exemplified, we conclude that in a 2,000,000 euros personal injury covered (max. 4,000,000) with 300,000 euros in material damages (maximum 1 million), and with revenues of 44,000 euros, the premium would be around 1,400 euros, that mean about 3% of the amount received from the project.

In the UK, the ARB establishes the limit of coverage, but this should be sufficient in any case, and according to the size and risk of the practice of each architect, because a protection of 305,300 Euros (£ 250,000 August change 2010), can be clearly insufficient to accommodate the responsibility and the problems caused by many works of great volume.

The approximate cost of a professional indemnity insurance in the UK is £ 500 per year in the case of a study without entering employees, and a annual revenue of £ 80,000 that it is insuring the minimum required by ARB of £ 250,000 per project, with no problems of previous claims, without securing any previous work, and no added risk. It seems a rather small amount, which represents 0.2% of the maximum insured, that is a small amount to pay for at least six years / project (usually 15 years).

It doesn't exist in Italy, although it may seem obvious after the optional characteristics of this insurance, any indication -approximate or even advisable- about minimum quantities or appropriate that the insurance should cover. This depends on the decision and willingness of each professional.

With respect to the price of insurance in Italy, given the not compulsory recruitment and the strong competition that exists in this respect, is quite low compared to other countries. As in the other cases, we requested budget with similar characteristics, with a maximum coverage of 250,000 Euros for a small study of about 50,000 Euros annual turnover, we have get an offer for a budget of 450 euros / year, equivalent to a 0.2% of the maximum contracted coverage. In this case the maximum insured amount is the total of all claims, and not for each of them as in UK.

In France, there is a dual system that makes it really difficult to calculate estimates data for comparison with actual cases of other countries. Neither the maximum amount covered -that in the French case doesn't exist- or the fixed premium values have to calculate a percentage of the work intended to secure. However, the consulted sources tell us about costs of about 500 euros / year of compulsory insurance, and about 3,000 euros / year including tort coverage to a small study of 100,000 euros of turnover. Therefore, we estimate a cost of 0.5% insurance compulsory insurance billing, and 3% with the extra responsibility to others.

We understand that the scale of prices obtained perfectly meets the realities of legislative regulation of these countries. However, there are other variables studied that cast doubt, or factors that are not properly regulated, creating doubt and helplessness legal users.

The minimum amount of coverage is something that is only regulated in the UK and Germany (although the figure varies between the Länder), and is established as "unlimited" in France, while still no indication in Denmark and Italy.

Furthermore, it is important to highlight the case that occurs in the UK, for which insurance regulation obliges them to ensure the life of the architect, and not just a particular work itself, or another not, for a period of time or other. Thus, security and tranquility is common to users and architects, who know that by listing all the works they have done, past and present, is covered throughout their working life by insurance which take effect today. This is another reason for the increased cost of insurance in the UK, but is a factor in the public image of these professionals.

The minimum amount of coverage is something that is only regulated in the UK and Germany, and is established as "unlimited" in France, while still there is no indication in Denmark and Italy. Although the case of France with not limited guarantee can benefit the users, we understand that it causes a higher cost.

Europe, and therefore to justify the urgent need to develop a Community rules that governs this type of products which ensure the liability claim, that involves the exercise of architecture.

We have seen that responsibility legal situations are very different from one country to another, varying the configuration and application of liability, the dependence of the architectural form of contract, years of security to be sure the architect in his practice, and even in the obligation to have insurance in order to support the work practice.

From the positive side, we see that the periods of responsibility are extensive in all countries (between 5 and 12 years), according to the economic mounts of these kind of interventions, resulting in legal certainty to buyers, users and customers, and therefore, benefit of architects. Moreover and regardless of general laws, professional associations of all studied countries, require hiring another professional insurance attached to their architects, achieving the monitoring function and safety in the sector.

The cost of this type of architectural insurance varies among the countries analyzed. The higher cost is produced in the UK; situation that joint to other characteristics analyzed, show us the good health of the architectural profession in this country, that allows and encourages the extensive costs incurred by British architects. On average there are regularized countries, with compulsory insurance and variables coverage, such as Germany and France, contrasting with another states like Denmark, and especially Italy, where the voluntariness of this type of insurance requires insurers to offer competitive prices.

Furthermore, the concept of coverage is another issue that requires study and unification. It is necessary to regulate the convenience of hiering the mandatory insurance coverage for liability in all European countries, which currently leaves legal and responsibility vacuums in countries like France, where these insurances are optional.

Although the french case, with not limited guarantee could benefit the peace of mind of their architects, we understand that this situation provokes a higher price on a particular benefit in very specific cases, so we understand as adequate to ensure the minimum encrypt, and establish the economic steps under a mandatory scale according to the works, the accident rate and the turnover. This solution would provide the adequate tranquility to society, and justice and equity in the payment and coverage for architects.

### Annual cost for professional insurance income by € 100,000

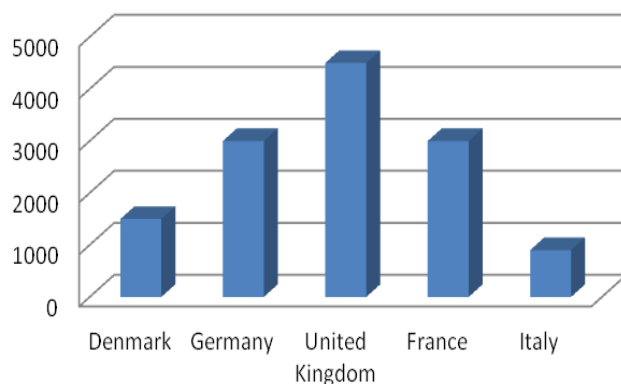


Figure 3.

### III. CONCLUSIONS:

The first conclusion of this study is to prove the situation of heterogeneity of architects insurance regulation throughout

TABLE I.

Insurance Situation	Type of Insurance	Duration of Insurance	Policy holder	Cost of insurance coverage depending on	Low coverage for personal injury	Low coverage for property damage
<b>Denmark</b>	Damage	10 years	Builder and / or contractor	1.5% / Construction	They do not cover personal injury	There is no mandatory minimum figures
<b>Germany</b>	Liability	5 years	Architect	3% / Project	€ 250,000 to 350,000 €	€ 1,500,000 to 3,000,000 €
<b>United Kingdom</b>	Liability	6 years	Architect	0.2% max. coverage / Year profession	£ 250,000	
<b>France</b>	Liability	10 years	Architect	0.5% -3% / Turnover	Everything is covered - No minimum or maximum figures	
<b>Italy</b>	Optional Liability	10 years	Architect	0.2% / 3% Maximum coverage	There is no mandatory minimum figures	

Furthermore, the appearance of the concepts of coverage is another issue that requires study and unification. It is necessary to regulate the convenience and treating unit, in all European countries, the mandatory insurance coverage for liability (or liability to others), which currently leaves loopholes and accountability in countries like France, mainly that plus this insurance becomes optional. The Danish case is not better in this regard, as the insurance in this country do not cover personal injury (liabilities thereof), and leaves a problem to architects practicing in Denmark.

It seems clear, that liability insurance should be compulsory for every architect that practice their profession (liberal or not), it must meet a minimum financial amount, as appropriate, covering all liability, contract and tort, that may need the European architect.

Crossing all the data with surveys questioning the level of prestige of the architect in these countries, we can see that in States where this kind of insurance is mandatory and is well regulated -as mainly UK, followed by Germany and even Denmark- is also in which architecture professional activity is socially best understood.

We can also see some positive singularities in certain legislation, such as the Danish, whose law plans to publish online a list of the companies that most problems have created to their customers and insurers because of poor construction, or the UK, where insurance regulation undertakes to secure the life of the architect, and not just a particular work for a period of time

It seems clear that the path followed by European regulations go to a liability insurance mandatory for every architect in his practice, which covers a minimum monetary amount and all responsibility, to protect contract and tort that the european architect can drop. It would also be necessary to create specific insurance associations for European architects which promote their prices to cover a

large number of professionals, and unify their conditions, allowing technicians mobility throughout Europe.

In summary, if European integration is important in some aspects, one of the most important is certainly the professional liability and insurance, which gives real and legal security to users, and that has an effect on in the image and prestige of the architects in European societies, that allow better competition against other technicians.

Therefore, it is considered sufficient justification for the urgent need for a Europe-wide regulations, governing the framework of the professional liability architectural insurance, over the whole continent, increasingly united politically, socially and economically.

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# Europeanization of internal security. The case study of the Internal security strategy for the European Union and the National Crisis Management Plan

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**Abstract**— A sense and need of security is one of the main values that shape the behavior of individuals and thus affecting the internal and external policies of the state. An important place in the process of creating security at both central and local levels are the comprehensive programs to protect citizens against threats that are made in Poland for example by the Government Security Centre. In the presented paper the author wants to consider to what extent the phenomenon of Europeanization influences the national security system, which is still not yet sufficiently present in the literature. The author will try to answer the question to what extent prepared by the Government Security Centre "National Crisis Management Plan 2012" includes trends proposed and included in the "Internal security strategy for the European Union 2010".

**Key words**—Security; European Union; crisis management; Europeanization; internal strategy; Governments Security Center

## I. INTRODUCTION

For many years the concept of security has been interpreted from its military dimension. This was caused by the Cold War's rivalry determined by the two superpowers, the United States of America and the Soviet Union which started the arms race. At the beginning of the nineties the democratic changes in Central and Eastern Europe began, which underlined a number of scopes and new aspects of security that had not remained in the area of interest. The dominant, military approach has now become only one of the possible scopes to analyze security issues. Scientists and experts have devoted more and more attention to its ecological, agricultural and energy dimension. This phenomenon has direct impact on the documents introduced both at the European Union and Member States level.

The purpose of this article is to draw attention to the process, which has been the subject of numerous studies conducted by sociologists, economists, political scientists and cultural theorists. Europeanization is in fact a multidimensional phenomenon, which must also be evaluated from the perspective of security studies

In the presented article the author attempts to answer the following research questions: which areas of the Polish internal security have been influenced by the mechanisms present in the European Union? In which dimensions are they adapted within the Polish safety management system and how do they

contribute to strengthen it? The sources for this dissertation were two documents - released in March 2010 - "Internal security strategy for the European Union" and the "National Crisis Management Plan" that has been released in Poland, in 2012.

Rafał Riedel claims that the studies of Europeanization have a hidden potential which has the ability to reorganize the current political studies [1]. This statement, in author's opinion, should be extended because such development of research perspectives may result also in new approach to security studies.

## II. EUROPEANIZATION AND PUBLIC SECURITY

The phenomenon of Europeanization has many definitions which evolved together with the development of the European Economic Community and its successor, the European Union (EU). Currently one may claim that Europeanization has become a kind of a key-concept frequently used by many scholars. This specific trend leads some researchers to question the utility when using this term to describe phenomena that are well known and to doubt whether such theory describing all possible consequences of the increasing Europeanization is needed [2]. However one must remember that this process affecting the security policies has not been comprehensively analyzed. For the purpose of this article the author finds very useful the attempt to systematize the various definitions of Europeanization made by Johan Olsen. Especially one statement is crucial when trying to define the influence of European regulations on a Member State's policy, that Europeanization can be interpreted as central penetration of national and sub-national systems of governance. The phenomenon of Europeanization seen as Olsen explains "involves the division of responsibilities and powers between different levels of governance. All multilevel systems of governance need to work out a balance between unity and diversity, central coordination and local autonomy. Europeanization, then, implies adapting national and sub-national systems of governance to a European political center and European-wide norms" [3]. In the author's opinion it also refers to the issue of security and safety norms.

One must agree with Bartłomiej Nowak and Rafał Riedl that in order to fully understand what is the process of Europeanization a look at it from the perspective of informal

and non-institutionalized processes necessary for complete adaptation to the internal process of European integration would be important [4].

The relationship between Europeanization and internal security seems to be relevant to the discussion about the importance of the management of national security. Europeanization as understood in this dimension should be analyzed from the top-down perspective which "interferes the national governance systems, but with respect for the institutional structure and patterns of political behavior"[5].

Considering the impact of Europeanization on the potential change in the functioning and responsibilities of the institutions responsible for creation of internal security one must define what is actually a public safety. It has been studied since the late twenties of the last century but is not defined as state of absence of risks that may threaten the organization of a state and its interests. The area of special attention is concentrated on how to provide security in communications, road, railway and air at the time of a natural disaster, epidemic or any other catastrophes [6]. Public safety should therefore be interpreted as a part of a wider concept, which is internal security. The main difference is that internal security concerns not only on legal actions and individual units but also on political actions and importantly on actions undertaken by private institutions [7].

The Europeanization of internal security is a constant process that accelerated since 1999 when the European Council meeting in Tampere was held. The program that had been adopted strives to constitute a European internal security space that would not be separated from the policies of individual EU Member States and which would take into consideration the changes occurring within them.

Impact of Europeanization on security issues can also be studied from the perspective of securitization. This process, which reacquires a separate study, attempts to identify what people see as a threat and why they receive it as a potential danger [8].

### III. INTERNAL SECURITY STRATEGY FOR THE EUROPEAN UNION

Adopted in March 2010, during the Spanish Presidency of the Council of the European Union, the internal security strategy may be interpreted as a complement of the "European Security Strategy" from 2003, which, however, was devoted to external threats including the proliferation of weapons, terrorism and organized crime, energy security and climate changes. The common strategy for internal security within the EU has been the issue discussed by the European Council in December 2009 when the Stockholm Programme has been introduced. One of its main goals was to improve the security level in the EU and to develop common internal strategy for fighting organized crime, terrorism and other threats[9].

The authors of the analyzed strategy already in its initial section defines how internal security should be defined and that it has to be understood as a "broad and comprehensive concept which straddles multiple sectors in order to address major threats and others which have a direct impact on the lives, safety and well-being of citizens, including natural and man-

made disasters"[10]. Internal Security Strategy for the European Union in particular emphasizes the need to develop principles and a framework for effective coordination of rapid and appropriate responses to natural disasters. Establishing such a model, according to the author, will allow the further development of Europe based on the principles of solidarity and transparency. Another important element of the European security model is the involvement of many sectors, particularly the political, economical and social ones [11].

The "Internal Security Strategy for the European Union" listed the principles that are vital to improve security in the EU. In accordance with the accepted principles, internal security should be formed through a combination of judicial cooperation, border management and civil protection [12].

Developed on such basis and principles, security model for EU provides a multi-dimensional definition of danger. The horizontal dimension focuses on the involvement of political and economic sectors, social institutions and NGOs. Transparency and integration allows whereas the right and appropriate response on the vertical dimension of internal security. It takes into account the characteristics of the interaction between international cooperation, initiatives taken by the EU regional policy and, finally, the internal national policies of the Member States [13].

The most important security challenges for the EU security are terrorism, organized crime, cyber crime, cross-border crime and, more importantly, natural disasters. However the main emphasis in ensuring an adequate level of internal security of the EU has been placed on prevention and anticipation of crime and natural disasters. A key element of this system should consist of continuous exchange of information and as easy as possible access to it. The effectiveness of the action taken should also be ensured through a network of early warning systems and other analytical tools. In accordance with the accepted principles, internal security should be formed through a combination of many variables [14].

Internal security can be ensured only in situations involving many different institutions, including public security services and experts at both national and local levels. Internal Security Strategy for the European Union is a document containing a comprehensive approach to security. It is, however, at a certain level of generality becoming the only kind of beacon for the Member States in which direction they should adapt their own internal regulations.

### IV. NATIONAL CRISIS MANAGEMENT PLAN

The management plan has been developed and prepared by the Government Security Center (GSC), which in Poland is one of the main institutions responsible for effective crisis response. The plan is an important tool that allows for quick orientation in the responsibilities of the various authorities in case of an emergency or other threat. Much emphasis has been placed in the document on the aspect of predicting which helped to create a tool with which it is possible to predict the occurrence of a danger and its scale especially potential floods, epidemics, chemical contamination, radiation and social unrests. The data collected in the document is also a valuable source for conducting a further studies.

Such a broad approach to challenges which threaten internal security of Poland is clearly an implementation of the statement included in the "Internal Security Strategy for the European Union" that "security should not only focus on criminal aspects, but should also include all the potential dangers that may threaten the safety of citizens" [15].

A comprehensive approach in relation to issues of potential risk included in the analyzed National Plan enables efficient collaboration between the forces necessary to manage a crisis, defines procedures for emergency response, and more importantly introduces the procedures necessary to use forces and resources enabling the full implementation of the taken action. Another very important aspect included in the "National Crisis Management Plan" is the crucial role of cooperation between the different actors involved in a crisis situation. According to the plan the aim is to "synchronize the activities of all bodies of the crisis management system, so that at each stage of the proceedings, especially in the response phase, the taken action would be most effective" [16].

An important role in creating a coherent system of internal security in Poland is played by monitoring carried out both at the ministerial, central and local government level. The Internal Security Strategy for the European Union specifically highlights the need for effective diagnosis, evaluation and analysis of threats and risks [17].

Introduced by the GSC, the "National Crisis Management Plan" from 2012 also upheld and applied the European guidelines detailing the responsibilities of the government and local authorities in the field of monitoring. The collected data are described from the perspective of seven categories: the legal basis of the person responsible for the necessary action, the scope of monitoring and the method used, the type and frequency of data collection and information sources with attachment how to use them adequately [18].

The "Internal Security Strategy for the European" stressed out also the importance of innovation and new technologies for efficient communication between the various bodies responsible for security at central and local levels. The organization of the monitoring and alarming system has been recognized in the "National Crisis Management Plan" in a comprehensive manner specifically indicating the leading subjects responsible for monitoring, alerting and alarming in case of emergency [19].

The creation of a complete and coherent model of information exchange should contain policy that allows an easy access to it. Such network would help the authorities to act as quickly as possible with the maximum amount of necessary information preventing the escalation of threats. According to the document to every emergency situation a leading authority with essential knowledge and experience has been assigned. The person responsible for communication is the spokesman or the head of the organizational unit [20].

It is very important that the message contains consistent information from all authorities. The authors of the "National Crisis Management Plan" while dealing with an emergency situation provided the establishment of the crisis press office

consisting members from the GSC, Government's Information Centre.

Much space in the "Internal Strategy for Europe" has been devoted to threats that may result from terrorist activities which, according to the document, are becoming the most important challenge for the united Europe. The management plan created by the GSC also provides response to this kind of danger. It should be clearly highlighted however that in comparison with the characteristics of other threats, the risk of a terrorist attack had been presented in a very general way. It has been explained that "Poland is not the primary target of a terrorist attack [...] but one should not ignore the risk of a potential terrorist attack on the facilities located in the state or on Polish citizens abroad" [21]. Such overall statement can be explained by a limited chance of occurrence of such risks and some Polish politician's reluctance to get involved in projects that they consider unrealistic to happen [22].

#### SUMMARY

In conclusion, it should be noted that the Europeanization is a constant process also of building coherent security regulations. Implementing European regulations helps to strengthen Polish national security rules. One of the examples of successful adoption of European regulations into Polish crisis management system is, as evidenced in the text, the crucial role of information and broad approach to security issues involving experts from different fields of research. Such attitude towards potential threats helps to define them before they appear and enables resources necessary to fight them more efficiently.

It should also be remembered that an additional process occurring during the Europeanization is the process of securitization. However, the further evolution of this practice should be the next field of research of sociologists, psychologists, historians and political scientists.

Without any questions it has to be mentioned that the Europeanization of the Polish national security contributes also significantly to creating a safer European Union. Both of documents, "The Internal Security Strategy for the European Union" and the "National Crisis Management Plan" contains the essence of modern security already included in the "United Nations Development Programme Report" from 1994. The "Human Security" concept which was one of the results of the programme underlined that "for too long nations needed weapons to keep them safe. For most of today's societies insecurity arises more often as a result of daily life threats"[23].

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# THE EU ENLARGEMENT AND THE REPUBLIC OF MACEDONIA – QUEST FOR POSSIBLE OUTCOME

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**Abstract-**This paper analyses the most important aspects of the EU enlargement, having in mind that this is a very complex process that covers a number of elements, subjects and processes. The paper puts the emphasis on the legal aspects of the enlargement, particularly on the novelties that are foreseen with the Lisbon Treaty and which are in direct correlation with this extraordinarily important process, both for the EU and for the aspiring candidates. Also, having in mind the new and enhanced role of the EU in the process of mediation among disputed countries that aspire to join the Union, this paper offers a possible solution for the 20 year old dispute between Greece, as an EU member country and Macedonia as a candidate country to join the Union.

**Key words:** EU enlargement, Lisbon Treaty, Copenhagen criteria, Common Foreign and Security policy

## INTRODUCTION

The EU enlargement is **not only a historical benefit of the EU, but also its obligation**, having in mind the fact that the Union has set this issue as its **highest priority**. The success of the enlargement depends not only on the vigor of the collective efforts that the member countries are making in this field, but it is also related with the support to this process from the citizens of the countries that want to join the Union. This is why the enlargement must be a fully prepared and transparent process that will see its success only if there is democratic support from all sides<sup>(1)</sup>.

**The enlargement is a complex economic, political and legal process.** This paper will take into consideration the legal dimension of the EU enlargement, as defined and interpreted by the EU institutions, in order to provide better understanding of the characteristics and the dynamics of this process.

The paper will also try to offer an outcome solution for the two-decade long process that Macedonia has with Greece over the name of the country, which imposes a direct obstacle for the country's EU integration.

## I. ABOUT THE LEGAL ASPECTS OF THE EU ENLARGEMENT

The legal aspects of the accession process are clearly listed in all of the founding treaties of the European Community, i.e. of the EU<sup>1</sup>. More specifically, the Lisbon Treaty clearly states

<sup>1</sup> The legal basis for the enlargement of the EU can be found in Articles 49 and 6 of the Treaty on European Union (exArticle O TEU). Article

that "every country – applicant for EU membership is subject of specific, legally defined accession process(3)."

In order to develop a successful strategy for EU accession, every applicant country must be aware of the legal nature and of the dynamics of the accession procedure, which is taking place parallel with the development of the EU itself<sup>(4)</sup>. The accession procedure is determined in the founding treaties and refers to every European country that wishes to join the Union. Parallel with the legally dimensioned accession procedure, the following elements are of great importance:

a) Political considerations about where the EU is going,

b) Considerations about the dynamics of the enlargement and the enlargement strategy, and particularly

c) Position of the EU member-countries about the "absorption capacity" of the EU, as a political process. Lately, the functioning of the institutions and the realization of the EU policies have transformed the concept of "absorption capacity" into "integration capacity."

Some believe that the Lisbon Treaty is creating an unfavorable climate for the EU enlargement process. Fortunately, the unfavorable provisions may not cause some major changes in the enlargement practice established thus far. For example, this treaty foresees the new basis for the enlargement and accession processes when it speaks about:

a) promotion of EU values,

b) better informing of the national and of the EU parliament, and

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49 TEU includes an additional requirement for membership to be fulfilled by the applicant state in comparison with the pre-Amsterdam enlargement procedure, namely the reference to the basic principles of the EU enunciated in Article 6 TEU. Article 49 requires that 'any European State which respects the principles set out in Article 6(1) may apply to become a member of the Union'. The principles stated in Article 6 are 'liberty, democracy, respect for human rights and fundamental freedoms, and the rule of law'. It is important to stress that Article 49 begins with the word 'European', thus first establishing a geographical condition to be fulfilled by the applicant state. The interpretation of this geographical condition is quite open, since there is no legal certainty regarding the borders of the European continent, and the case of Turkey clearly shows the difficulty of dealing with states who's political, historical and cultural boundaries may be interpreted differently by the rest of the EU Member States. See: [2]

c) explicit conditions that should be met by the EU candidate country, and which are verified by the European Council.

The countries that respect and promote the European values are eligible to apply for membership, and the Lisbon Treaty highlights that the decision to accept any application is of the EU. The provisions of the Lisbon Treaty which refer to the cooperation between the European Parliament and the national parliaments, as well as the provision on the conditions which the European Council can set for the new members, can be understood as an actual codification of the existing practice in the enlargement process, rather than as a restraining moment.

Even though the demand for respecting and promoting certain additional EU values and discourage the future EU candidates or applicants, and in that context the stricter "conditionality" can burden the enlargement process, the EU enlargement still remains dependent on the EU Council's policies, as it was always the case.

Even for those countries that have already received the candidate status, as in the case of the Republic of Macedonia, their "European perspective" and their accession process will probably remain long and quite strict. What should the EU do about these countries?

It is fundamental for the EU to create new ways, i.e. new tools in order to provide better management of the relations with the candidate-countries, as well as with those who still do not have that status, having in mind the new article in the EU Treaty, which speaks about the special links that the EU has with the "neighboring countries," without offering accession perspective, something which was until recently considered as an efficient tool for the EU to make "soft pressure" on its frontiers.

EU is constantly highlighting that its doors remain open for any European country that will meet the political and economic criteria for membership. The rest of the Western Balkan countries (Albania, Bosnia and Herzegovina, and Kosovo are recognized as potential candidates for EU membership, although the time for their accession varies from country to country.) Despite the high level of EU skepticism regarding their possible joining to the EU, the EU still hopes that the membership possibilities will speed up the reforms in these countries, which will provide better security and stability. Countries such as Georgia and Ukraine also expressed their desire to join the Union, but probably on a longer run<sup>2</sup>.

On the other hand, the "enlargement fatigue" becomes more evident in Europe. After the official acceptance of Croatia in the European family in July of 2013, some European experts are quite reserved about the future of the EU enlargement, particularly with regard to Turkey or the wider Europe

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<sup>2</sup> In comparison with the "deepening" of the European integration process, enlargement and its effects seem easily forgotten, especially when taking into account that widening has never significantly changed the modes of governance on the national levels – whereas the "deepening" of European integration, i.e. the inclusion of new policies, the broadening and intensifying existing ones and the reform of institutions and decision-making procedures, has. However, enlargement represents a phenomenon which would justify a much more systematic and comparative analysis. See: [5].

countries (Ukraine, Moldova and the South Caucasus countries: Georgia, Armenia and Azerbaijan), underlining in that context the "integration capacity" of the Union.

## II. THE LISBON TREATY AND THE EU ENLARGEMENT

The Lisbon Treaty does not introduce new political areas or new political models to which the candidate countries should adjust. This treaty also does not encourage the enlargement process of the Union, nor does it create a climate to secure this process.

Still, one positive thing that this treaty offers is institutional reform that can significantly alter the EU approach to the candidates for membership (6). The EU approach to these countries has two dimensions:

1. First, its role as an "active player" in the part of mediation in conflict resolution processes if they appear on the path of the countries from the region, and

2. Second, the EU works as a framework that will enable participation of these countries in the process of decision making and will provide new models of governing and new political options.

The EU is a normative and cognitive framework for the Balkan countries who demonstrate clear orientation towards their European integration and who accept the "Europeanism" as a process that is directly related with certain political, democratic and economic requirements, as well as with the adoption and with the implementation of the acquis. There is an ongoing academic debate about the influence of the enlargement, i.e. the level of the EU influence within the candidate countries. Most of these debates refer to the reasons for the EU enlargement as well as to the acceptance of the EU conditionality by the EU. Here, this conditionality is based on two principles: the rational approach, which is used to explain to the applicants their place, with cost-benefit calculations and how these countries are ready to join the Union; these countries implement the reforms in accordance with the promised awards. The second approach is a constructive one, which highlights the identification of the EU candidates with the Union, based on debates and persuasion(7).

Both these approaches pose danger to the conditionality, because they both view the conditionality as a pretty static category. The Europeanisation is not an issue of the enlargement theory, but a practical model that helps the people analyze their own policies in the accession process. This model embraces five mechanisms for transformation of the candidate country into a member-country:

- Institutional and legal harmonization;
- Assistance and technical support to the system;
- Determining of criteria, monitoring and their implementation;
- Advisory and twinning assistance, and
- safeguard mechanism (the process at the beginning of the negotiations and other steps in the accession process.)

Through the conditionality, the EU candidates are being kept in front of the EU gates, at least until they fully meet the three main Copenhagen criteria: implementation of the rule of the law, transformation of the economy into a market one and development of the state capacities so that they can compete on the labor market.

The Lisbon Treaty is a rather complex document that brought three major changes with regard to the enlargement:

1. It altered the capacity of the new foreign policy led by the EU institutions (the role of the President of the European Council and of the High Representative for Common Foreign and Security Policy).

2. It brought democracy in the system (by introducing the right to legislative initiative by 1/4 of the member-countries, which increased the scope of issues on which the EP actively decides and which also gave a new role to the national parliaments, and

3. It launched the application of the European Charter on Human Rights.

The accession process forces the candidate countries to adjust even more to a specific institutional model in order to open their national elite to the EU influence. The Lisbon Treaty offers certain institutional reforms which can significantly alter the EU approach to the candidate-countries, which will bring even higher level of European influence on the Western Balkan countries, since this treaty is designed to promote a new and improved EU approach to the foreign relations.

The Lisbon Treaty helps the EU to work more efficiently and more consistently, especially with regard to the candidate-countries. The pressure will no longer come only from the enlargement commissioner, but also from the President of the Council and from the High Representative for Common Foreign and Security Policy.

These three structures will develop a consistent policy for each and every candidate country, and they will make consistent pressure on the candidate countries, having in mind the new role of these institutions within the EU. The Lisbon Treaty additionally highlights the conditionality for the acceptance of the European Charter for Fundamental Rights, having in mind the fact that Macedonia, Croatia and Turkey are signatories of the ECHR, hence the candidate countries will have to respond institutionally to the new rights incorporated in the Charter, and which refer to the protection of the personal data, the bioethics and the right to good administration.

The most important implication from the Lisbon Treaty will be the national decision making process. With the enhanced role of the European Parliament and with the new involvement of the national parliaments in the monitoring of the legislative process, **the Union is expected to demand proactive role of the national parliaments in the decision-making process in the candidate-countries.** The absence of involvement of the national parliaments so far will have to be eliminated in the process of any future enlargement(8).

The marginalization of the legislative house in the process of preparing the EU-labeled laws and other acts had certain implications on the democratic deficit, as well as on the idea of

creating stable democratic institutions and quality national parliaments.

The Lisbon Treaty faces the need to resolve many internal EU problems, which is why it brought in new measures to improve its structure, as well as the representation and the targeting of the EU goals. The Lisbon Treaty has three main effects on the future EU enlargement:

a) Changes in the part on who will introduce the EU conditionality for the candidate-countries (three representatives – the enlargement commissioner, the president of the European Council and the High Representative for Common Foreign and Security Policy); The implementation of the Lisbon treaty and the creation of the European External Action Service (EEAS) are supposed to stimulate an internal logic towards more EU integration and burden-sharing in foreign policy.

b) changes in the part on who is expected to be actively involved in the development of the European policies (The EU expects an active role of the European Parliament, for the national parliaments, as well as higher inclusion of the non-state players in the process of policy creation, such as the NGOs, the various interest groups etc.)

c) Changes in the legislation (introduction of new rights protected by the Charter).

The Common foreign and Security Policy is directly related with the enlargement process, both from formal and from informal aspect, since the Lisbon treaty determines **the principles on which the Union's foreign action is based, and these principles are described as "principles inspired by our own creation, development and enlargement and are recognizable in the rest of the world:**

- democracy,
- rule of the law,
- universality and invulnerability of the human rights and the basic freedoms, and
- respect for the principles of the UN and the International Law Charter."

The Union is leading the policy in this field by defining general directions and by implementing decisions (when we say decisions of the Lisbon Treaty we mean joint strategies, joint positions and joint actions). The Treaty also brings about a new section titled: "Provisions for the Common Foreign and Security Policy," which lists the provisions adopted by the European Council in 1999. The new common foreign and security policy is described as an integral part of the Common foreign and security policy, which foresees missions outside the Union aimed at "preserving of the peace, conflict prevention and strengthening of the international security in accordance with the principles of the UN Charter." With the Lisbon Treaty, the Union became a single player and the three-headed structure disappeared, i.e. the high Representative for Common Foreign and Security Policy received an authorization to provide increased coherency among the EU institutions and the institutions of the member-states.

### III. KEY CHALLENGES FOR THE UNION REGARDING THE ENLARGEMENT

Key moment for the success of the future enlargement is maintaining the credibility of this process. This commitment is crucial for keeping the momentum in the reforms in context of the Copenhagen criteria. It is crucial to have an ongoing debate on the enlargement so that the public is continuously informed about its impact on the development of the individual countries. In this context, the principle of knowing ones' personal values is very important. The individual path of every candidate country towards the Union is based on meeting these criteria. Therefore, the enlargement by definition is introduced as a multi-level process, based on solid and sustainable implementation of the reforms by the given country. The joining of Croatia to the EU this year, the start of the negotiations with Montenegro, the candidate status of Serbia all demonstrate that the EU is meeting its obligations when the country fulfills the criteria. There are positive results in context of Macedonia as well through the High Level Accession Dialogue which narrowed the focus on the reforms by the authorities.

Which are the key challenges for the EU?(9)

- Putting the emphasis on the rule of the law in the enlargement process. The candidate countries must pay more attention to the areas of judiciary and the fundamental rights, as well as to the justice, freedom and security as suggested in the 2012 Strategy Paper.
- the countries must demonstrate greater ability to strengthen the practical realization of the values on which the Union is founded, literally in all levels of this process. Key challenges for the candidate countries in this process are the following:

a) in the part of the judicial system, the candidate countries ought to provide independent, non-partisan and responsible judiciary, capable to provide free trial; the judicial systems must function efficiently, without delaying the procedures; certain progress has been made in the part of strengthening the independence of the national judicial councils;

b) The corruption remains an issue in most of the candidate countries;

c) The fight against the organized crime remains key priority for the candidate countries;

d) Reforms of the public administration, respect for the human rights and freedoms, etc.

Based on all above said, we may conclude that keeping the momentum of the enlargement and the reforms in the candidate-countries are the two sides of the same coin.

### IV. REPUBLIC OF MACEDONIA AND THE EU

It is a fact that Macedonia will not be able to continue on the road to the EU if it does not find a mutually acceptable solution on the 20 year-long name issue with Greece. It is also

a fact that the European Commission is giving positive recommendation for start of the accession negotiations with the country for four years in a row, however, because of the name issue and the veto from Greece in the European institutions, Macedonia cannot start the negotiations with the Union. Is there an exit solution for this status quo position? Can the EU become actively involved in the process of finding a mutually acceptable solution on the name, which will ultimately enable for the Macedonian citizens to feel the benefits from the new enhanced EU foreign policy that the Lisbon Treaty brought along? The answer is, of course, yes.

A. *Why the European institutions (particularly the European Commission and the Council of the EU) should be involved in the search for solution for the name issue?*

1. Because of the objective inefficiency of the talks that have been led for 20 years under the UN auspices.

2. In order to intensify the need from regular meetings between the prime ministers and the ministers of foreign affairs of the two countries in the framework and with the support of the EU institutions (the European Commission and the EU Council).

3. Because of the fact that in the European Commission report for the Republic of Macedonia the regional issues and the international obligations are put in the group of political criteria which also cover the name issue.

4. Because of the commitment of the European Commission expressed in its strategy paper from 22 September 2009(10), while on the bilateral issues "when it is possible, the Commission is ready to help in finding solutions, at the request of the interested parties." This good practice of involving the Commission is neither new, nor uncommon. In wider sense, the bilateral issues in the Union were always viewed as part of its common foreign and security policy, so the success in solving these issues is not only a success of the national governments, but also success of the common foreign and security policy<sup>3</sup>. We can list several examples:

a) Direct involvement of the Commission through a non-paper in the dispute between Slovenia and Croatia about the borderline, which served as a good basis for the already ratified arbitrary agreement, as well as for the negotiations that were led between the two prime ministers;

b) Successful non-paper approach was also demonstrated in solving of the issues between Poland and Russia<sup>4</sup>, Estonia and Russia, the Litvinenko case, etc.

c) The recently signed agreement between Serbia and Kosovo.

<sup>3</sup> "Despite the strictly bilateral character of the disputes, the issues that are subject of these disputes attract the EU attention, because they have specific influence on the EU policies". About the specific direct involvement of the Commission in the bilateral disputes, see: [11]

<sup>4</sup> At the beginning of the dispute, Poland discretely asked for involvement of the EC in the dispute it had with Russia, without putting this issue on the agenda of the Foreign Trade Policy Committee within the EU Council.

5. In order to "develop and intensify the political dialogue" within the Union, which means among all member countries, including Greece and Macedonia as candidate, which comes as an obligation from the Association and Stabilization Agreement between Republic of Macedonia and the European Community (article 7 and 9)(12);

6. Because of the commitments enlisted in article 6 of the EU treaty, which says: "the Union is based on the principles of freedom, democracy, respect for the human rights and the fundamental freedoms, and the rule of the law" and because the Union respects the fundamental rights guaranteed with the European Convention for Protection of the Human Rights and Fundamental Freedoms and the rights that come from the constitutional traditions of the member states. Also, because the Union respects the national identity of its member countries, which means of its candidate-countries with whom it has regulated legal status;

7. In order to provide guarantees that the talks will be within the predefined framework of the Resolutions 817 (1993) and 845 (1993)(13) and the Interim Agreement from 1995(14), which says that subject of the talks is **the name, and only the name**, and

8. In order to abandon the old position that the Republic of Macedonia is a passive participant in the dispute, i.e. to give the country a proactive role so that it can offer solutions based on its position in the dispute.

#### B. Which instrument should be used for solving the dispute?

1. With a non-paper, prepared and initiated by the Macedonian prime minister, which should be submitted to the President of the European Commission, and through the Commission to the Greek prime minister.

#### 2. Contents of the non-paper:

a) Detailed presentation of the chronology of the problem, following the example of the Slovenia-Croatian non-paper(15) (the UN resolutions, the Greek embargo, amendments to the Macedonian Constitution, the Interim Agreement, the veto in Bucharest, the positive outcome for Macedonia from the International Justice Tribunal),

b) Defining of the problem in accordance with the UN acts, finding solution for the name and determining the scope of its application. Determining a position that by finding solution to the name the issue between the two countries is closed, which means a guarantee from both prime minister given and verified in front of the EU mediators that any future attempt for opening new, additional issues in sense of burdening the identity, language, culture etc. is unacceptable for any of the sides;

c) Based on these guarantees, the Republic of Macedonia ought to express readiness to solve the name issue with Greece in a shortest time possible (as an alternative, latest in six months starting from the day of accepting the non-paper) and in return, Greece will not block the positive recommendation from the Commission for start of the talks in the EU Council, it will not block the negotiating process, nor it will block Macedonia's entry in NATO.

3. In accordance with the EC Rulebook(16), the President of the Commission "can establish an ad-hoc group composed of Commission members" to be involved in the solving of the name issue, following the mediation in the dispute between Croatia and Slovenia<sup>5</sup>.

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<sup>5</sup> For example, the EU Enlargement Commissioner Olli Rehn called Maarti Ahtisaari to lead the experts' group for solving of the Slovenia-Croatia dispute. Mr Ahtisaari accepted the role of mediator. The EU did not stop using the means of the so-called "silent diplomacy".

# SECTION 5.

*Financing and Accounting*

# Disclosure level evaluation and disclosure determinant analysis: a literature review

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**Abstract—** This paper reviews the literature about Disclosure Quality measurement in order to highlight the strengths and weaknesses of disclosure level evaluation and disclosure determinants analysis.

**Keywords-** *Disclosure level evaluation; content analysis; disclosure indices; disclosure determinants analysis.*

## I. INTRODUCTION

The literature on accounting disclosure has investigated a wide range of issues, such as: corporate disclosure practice looking at either obligatory or voluntary items as well as both; determinants of voluntary disclosure or determinants of compliance with regulation; the economic consequences of disclosure; financial analysts' use of information etc.. While many disclosure studies have investigated corporate disclosure for private sector companies, others studies have looked at the public sector as well as non-profit organizations. In all these studies, accounting disclosure plays a key role and could be measured in some way. However, disclosure is a theoretical concept, with it being very difficult to measure directly. Thus the literature on disclosure offers a variety of potential proxies that purport to measure disclosure.

In recent years, the demand for disclosure of listed companies has increased and the failures of large companies listed on the most important financial markets have placed extra pressure on both listed companies as well as standard setters to increase the quality of corporate reporting. As a consequence, disclosure studies have increased and many topics have been investigated focusing on the regulation of disclosure, determinants and consequences of disclosure. The importance of this review is derived from the importance of studying accounting disclosure to researchers, professionals, market participants, companies, standard setters and regulatory bodies in general.

By presenting a critical review of different approaches proposed by Scholars to measure disclosure, this study highlights the strengths and weaknesses of disclosure level evaluation and disclosure determinants analysis.

This paper is articulated as follows. The next section reviews the literature concerning the object of disclosure quality, while the third section presents different proxies of disclosure employed in previous studies. The fourth section describes the determinants analysis. Finally, the fifth section presents some conclusions as well as limitations of the study.

## II. THE OBJECT OF DISCLOSURE QUALITY MEASUREMENT

Generally speaking, companies can disclose information through different means such as annual reports, conference calls, analyst presentations, investor relations, interim reports, websites, etc.. The corporate annual report is considered a very important official disclosure vehicle [1], [2], although on its own it is not sufficient in the capital market context [3], [4], [5], since other disclosure vehicles (such as conference calls and interim reports) can provide more timely disclosure. This means that firms frequently jointly refer to different means, even though some of them are mandatory, while others are provided on a voluntary basis.

Mandatory disclosure refers to information revealed in the fulfillment of disclosure requirements of the statute in the form of laws and professional regulations in the form of standards and the listing rules of stock exchanges. Voluntary disclosure concerns any information revealed in excess of mandatory disclosure.

Many researchers have focused their studies on the accounting mandatory disclosure [6], [7], [8], [9] because of regulations that provide the content, the format of information and the variety of the data included in the financial statements. Thus, financial statements represent the only formal source of financial information available to users [10]. This approach may appear less logical: if firms are obliged to disclose certain information, what are the reasons why some firms disclose more information than others? However, many studies have found significant differences on (mandatory) disclosure level, due to the flexibility firms have in choosing the way and level of disclosing required information [11].

Other researchers have focused their studies on accounting voluntary disclosure because the disclosure of other corporate reports in addition to the minimum requirements, could reduce information asymmetry and agency conflicts between managers and outside investors [12], [13], [14].

From a different perspective, both mandatory and voluntary disclosure can be investigated by adopting two different approaches. The first deals with a general disclosure level, investigating whole financial statements or financial reporting; the second focuses on several more specific types of information such as: segment information [15], [16], [17], disclosure about specific items [18], and ratio disclosure [19].

Notwithstanding these differences (mandatory vs voluntary disclosures), the previously mentioned studies mainly dealt with listed firms; there are very few papers which have investigated the disclosure of small and medium size entities (SMEs), consequently a gap seems to emerge: SMEs represent a key driver for growth and innovation in Europe [20], [21] and, consequently, research that investigates this area appears highly desirable.

Similarly, international literature has mainly addressed healthy firms, while many firms, especially in this period of acute economic and financial crisis, are going bankrupt. Consequently, a second gap emerges, even though few studies on the topic [22] have highlighted that the business crisis is a significant variable in explaining both mandatory and voluntary disclosure.

Finally, the review of the studies concerning both mandatory and voluntary disclosure highlights how there is a lack of attention on public sector entities.

### III. DISCLOSURE QUALITY MEASUREMENT

Prior literature has investigated the disclosure of financial statements in two main directions: i) *disclosure level evaluation*, analyzing the approach firms have towards accounting (mandatory and voluntary) disclosure; ii) *disclosure determinants analysis*, investigating the reasons why some firms disclose more or less information than others (see section IV). Focusing, in this section, on the first topic (disclosure level evaluation), there are two main approaches to developing a scoring scheme to capture levels of disclosure: content analysis and disclosure indices.

#### A. Content analysis

A good general discussion of this approach is provided by [23], [24], [25], [26]. This method consists of a research technique for making inferences from data replicable and valid to their context [24]. For valid inferences to be drawn, it is important that the classification procedure be reliable (i.e. different people code the text in the same way) and valid (i.e. the variables generated from the classification procedure represent what the researcher intended it to represent) [25]. Three types of reliability can be identified:

- *stability* (the extent to which the same coder is consistent over time when coding the same content);
- *reproducibility or inter-coder reliability* (the extent to which different coders produce the same results when coding the same content); and
- *accuracy* (the extent to which the classification of text corresponds to a standard or norm; [24]).

Since stability is a weak measure of reliability and standard codings seldom exist, the most frequently reported measure is inter-rater reliability.

Generally speaking, content analysis can be partial or comprehensive. Partial content analysis covers part of the document or selected items of information or key words, while comprehensive content analysis covers the whole document. Therefore, content analysis of the text can be employed using

two complementary approaches with different objectives: thematic and syntactic.

Thematic content analysis is a research tool used to determine the existence or frequency of certain key words or concepts within texts or sets of text. Generally speaking, this analysis focuses on the number of words [27] or sentences [28] used to describe a particular item or how many times an item is mentioned in the annual report. In more specific terms, this analysis codifies qualitative information in literary form into categories in order to derive quantitative scales of varying levels of complexity. This approach consists of the attribution of the incidence of an event as indicated by the mention of the event under question in the literary document that constitutes the raw data. As a consequence, the dichotomy is the only level of measurement that may be achieved for each category. However, if more than one category is subjected to a content analysis, a more complex level of measurement may be achieved through the summing of the results for each category. Thus, if each category is assigned a score of zero or one, indicating the absence or presence of the attribute investigated, the resulting scale varies between zero and the number of attributes being considered [29]. However, the allocation of scores along the continuum is somewhat subjective [30].

In contrast, syntactic analysis analyzes the readability of the text [31]. Narratives have traditionally been evaluated using readability formulas as the primary measure of narrative usefulness and quality [32]. Formulas predict “whether a target audience is likely to be able to read a prose passage” [32]. This is determined by analyzing characteristics of word and the length of each sentence. A general description of these formulas is that difficulty levels increase with the number of syllables that words contain and the length of sentences [32].

Despite their objectivity and reliability, the application of readability formulas to accounting narratives highlights some problems [31]. First of all, readability scores focus on word and sentence-level features and ignore aspects of the text as a whole. Secondly, these readability formulas, which were originally designed to evaluate narratives for children, are not appropriate for adult based writing, especially the technical narratives that exist in annual reports. Finally, the motivation and interest of the reader were also not considered [32].

These two approaches can be conducted either manually or automatically or using both methods. Some studies have employed manual content analysis [33], [34], [35], one of the main limitations of which being that this method is a labor-intensive data collection process, which inevitably restricts the sample size employed by prior studies [36]. Therefore, the use of automated content analysis has been developing ever since with different content analysis software [37], [38], [39]. This last analysis, on one hand, is an economic technique in terms of time, effort and money, that can be easily used to conduct a comprehensive content analysis covering sizable samples. On the other, the use of automated content analysis highlights some problems as listed below. First of all, when using the frequency of words or key words, all the possible synonyms and words with multiple meanings should be included [40]; in addition, using words or key words in isolation of the meaning of the whole sentence, the method does not provide a sound

unit of analysis and can give misleading results [41], [36]. Secondly, the use of inappropriate or insufficient key words could lead to an over or under estimation of disclosure level. Thirdly, the list of terms is formulated by a panel of expert researchers and it is possible that the use of more search terms would have produced more observed disclosures.

### B. Disclosure indices

Generally speaking, disclosure indices are extensive lists of selected items, which may be disclosed in a company report [3]. A disclosure index is a research instrument to measure the extent of information reported in particular disclosure documents by a particular entity according to a list of selected items of information.

Prior studies have showed a great variation in the construction of a disclosure index, principally referred to the type of information disclosed and the number of items of information included in the index.

The type of information selected can cover mandatory disclosure [42], [43], or voluntary disclosure [44], [45], or both [46], [47], [48], [10], [49]. The number of items included in disclosure indices varies from a few items [50] to a few hundreds of items [51].

In addition, the degree of the researcher involvement in constructing a disclosure index varies from no involvement to full involvement. No involvement means that the researcher depends on available disclosure indices from prior studies or professional organizations. Full involvement means that the researcher controls the entire process of constructing a disclosure index from selecting the items of information to be included in the index, to scoring these items.

The first approach (*no involvement*) uses interviews or questionnaires to reflect the analysts' (or other user group) perceptions about the firms' disclosure practice rather than the disclosure policies. The most common example of using disclosure survey is the results of two surveys conducted by the Financial Analysts Federation (FAF) and the Association for Investment Management and Research (AIMR) which have been used as proxies for disclosure quantity and quality in a number of prior studies [52], [53], [54], [55]. The FAF/AIMR measure of disclosure reflects the evaluations (ratings) of a number of leading specialist financial analysts for companies' aggregate disclosure (mandatory and voluntary disclosures) within three categories: annual published and other required information; quarterly and other published but not required information; other aspects of disclosure such as investor and analyst relations. The final disclosure score of a particular firm is calculated as a weighted average of the three categories' ratings. However, these scores are now out of date, given that they were discontinued in 1997 after ranking the fiscal year 1995 [56].

In sum, this approach has the advantages that the disclosure scores constructed are not labor intensive and can be obtained for a sizable sample of firms compared to other types of disclosure proxies such as the self-constructed disclosure index [3]. However, the quality of the design of the research instrument will affect the quality of the results obtained [57] [58] [59]. For example, a poorly designed questionnaire could

result in misleading inferences about disclosure. Furthermore, the objectivity of the views of the investigated user group could be questioned, on the grounds that no one can know their incentives to report their ratings as well as the kind of biases that might be included [59].

Regarding the second approach (*full involvement*), international literature prevalently has adopted an item-based approach using a dichotomous procedure in which an item scores of one is attributed, if it is disclosed and zero otherwise. In the most common approach, the concept of 'disclosure index' was first used by Buzby [46] and Stanga [60] and formalized by Cooke [61]. The determination of the index can be summarized as follows:

$$\text{Disclosure index} = \frac{\text{Actual disclosure}}{\text{Total possible disclosure}} = \frac{\sum_{i=1}^m d_i}{\sum_{i=1}^n d_i}$$

Where:

- $d = 1$  if the item  $d_i$  is disclosed (0 otherwise);
- $m =$  numbers of items disclosed;
- $n =$  maximum number of disclosure items possible.

The Cooke index is based on unweighted items and each item is of equal importance. There is a general consensus about the unweighted items, such as the Cooke index, [50] [42] [43] [63] [64] because this approach reduces subjectivity [65].

However, some researchers [46], [60], [66], [12], [67] prefer to apply different weighting to each item on the ground that some items could be more important to users than others. In general, there are different ways to identify weighting factors. Some authors stress that certain items are more important to users than others, and send a questionnaire to a sample of users, asking them to evaluate the importance of each item [46], [60], [66], [12], [67]. Alternatively, the weighting factors may be predetermined subjectively [68]. In this case, the researcher takes into consideration the type of information (quantitative or qualitative) in assigning weights to different items of information [44], [69]. Finally, the weighted items may be taken from prior studies [70].

This last approach generally uses small samples due to the labor-intensive data collection process. Another potential limitation of using a disclosure index to measure the level of disclosure is that the results are only valid to the extent that the index used is appropriate [49]. In addition, the construction of a disclosure index in studies to date does not explicitly account for the inter-relationships between different items of information, i.e. it does not take into account the incremental information content of each new item of information added to the index.

## IV. DISCLOSURE DETERMINANT ANALYSIS

Disclosure of information in corporate annual reports and its determinants have been identified as an important research area, attracting both analytical and empirical researchers in accounting.

Generally speaking, the decision to provide or not certain essential information is likely to be influenced by a variety of factors like firm size, leverage, financial performance, industry, listing status, audit firm size, and so on. Scholars have investigated the association between firm characteristics,

corporate governance attributes and the levels of corporate disclosure. The most common method used in literature consists of running a multivariate linear regression with the firm-based disclosure score as a dependent variable, and various (financial or other) characteristics of the related firm as independent variables. However, there is no one dominant practice to measure the quality of disclosure (dependent variable). Furthermore, the number and type of firm characteristics (independent variable) vary among studies.

Several pieces of research over the past decades have tested the influence of firm size on the level of disclosure. Generally, the firm size is operationalized using a number of measures, such as revenues, total assets or number of shareholders. While most researchers found a positive relationship between these two variables [7], [61], [71], other Scholars [41] [64] [71] did not find any positive association.

However, literature has supported the positive influence of firm size on the level of disclosure for several reasons. Firstly, the cost of accumulating and generating certain information is greater in the case of small firms than for large firms. As a consequence, larger companies might have sufficient resources to afford the cost of producing information for users, otherwise, small companies may not be able to afford such costs from their resource base [72]. Secondly, large firms have higher agency costs than smaller ones [73], also being more visible and, as a result, more exposed to public interest [74]. Thirdly, larger firms disclose more information than small firms in order to attract prospective investors in the capital market. In fact, more information provided in the financial reports enhances the confidence of the investors [75].

Others studies have considered the influence of profitability on the extent of disclosure. Generally, profitability has been measured by the return on revenues, return on total assets and return on equity [76]. Most researchers found a positive link between these two variables [43], [77], [78]. However, some studies observed a significant negative relationship and some other researchers found no relationship at all [79], [12].

According to prior literature, profitable firms will disclose more information in their annual report to differentiate themselves from poorer performers. In fact, a highly profitable firm is more likely to signal to the market its superior performance by disclosing more information in its annual report [61]. Moreover, agency theory suggests that managers of profitable companies disclose extensive information in order to show and explain to shareholders that they are acting in their best interests and justify their compensation packages.

Conversely, only a few researchers have found a positive association between some financial ratios (such as current ratio, quick ratio or acid test ratio and net working capital) and the level of corporate disclosure [43], [80].

A significant positive relationship has been found between leverage and the level of corporate disclosure [62]. Scholars [81], [82] have argued that highly leveraged firms may disclose more information in annual reports with the aim of reducing the monitoring costs of said firm. Therefore, financial leverage may be expected to influence the level of disclosure because a

heavily leveraged firm has a greater urge to satisfy the demand for information by its long-term creditors [83].

The level of a firm's disclosure may also be influenced by its age [71], [72]. Reference [72] has pointed out that long-established firms may disclose more information or be more compliant than newly-established firms. The age variable has been used in several research studies [71], [78], [84]. However, no significant association has been reported by these studies.

Finally, some researches have focused on the link between the level of disclosure and industry types hypothesizing that the first differs accordingly to industry type. They provide mixed evidence: [43] and [47] found that manufacturing companies disclose more information than other types of companies, while reference [72] provide no evidence of this association.

## V. CONCLUDING REMARKS

The aim of the paper was to perform a synthetic review of the literature concerning both disclosure level evaluation and disclosure determinants analysis, in order to understand what approaches have been used, what the main findings reached are and whether there are some gaps.

Regarding the disclosure level evaluation, the review of the literature has highlighted that Scholars have focused on both mandatory and voluntary disclosure, even though they have mainly investigated listed firms. This is probably due to the circumstances that these firms are more visible and exposed to public interest; however, the European context is characterized by the prevalence of SMEs, which are the key drivers for growth and innovation. As a consequence, I think that we need a better understanding of the disclosure level evaluation of these firms, taking into account that the bank system is its main stakeholder.

Furthermore, the review of the literature has highlighted another gap: a substantial lack of studies concerning public sector entities; once again, I think that this area of research has a great interest on the basis of the high level of indebtedness of many of them.

Regarding the disclosure determinant analysis, the evidence from prior literature is contradictory; variables such as size, leverage, profitability and age only in some cases are statistically significant, while many studies did not found any positive relationship between these (independent) variables and the level of disclosure.

This is probably due to the differences between the context where firms are investigated and the different periods analyzed by Scholars, which means that accounting standards could be modified from one period to another. As a consequence, studies are often not easy comparable.

This working paper represents a first step of wider research; it has tried to highlight the strengths and weaknesses of disclosure level evaluation and disclosure determinants analysis by synthesizing the main literature about corporate disclosure for private sector companies. The presence of some gaps suggest further research as well as a renewed interest in disclosure quality.

Future development of this research could be the examination of the disclosure of financial statements of unlisted firms as well as the disclosure level evaluation and its determinants about healthy and unhealthy entities. Furthermore, this study could be improved by analyzing the disclosure quality in public sector entities.

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# The Determination Of The Depositary And Registrar System Of The Financial Market And The Modern Problems Of The Russian Market.

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**Abstract**—The functioning of institutions of the financial markets and their interaction with a view to implementation of the main objectives of the market is provided by one of the constituent elements of the market, namely - the infrastructure of the securities market. The Russian securities market is going through a crucial point - provides a Central post-trading infrastructure. In this article the author defines the notion of the Depositary-Registrar system of the financial market, the preconditions of this system, the main actors and their roles in the implementation of the rights of investors and creditors on the securities market, as well as the place and role of the institutions of the Depositary-Registrar system.

**Key words:** *the infrastructure of the securities market, the Depositary-Registrar system, the custodian and settlement infrastructure of the securities market, the securities market, the Central Depositary, registrars, custodian, the Central Depositary, depositary activity, activity on management of registry of holders of securities.*

## I. INTRODUCTION

Today's financial market is a complex and multifaceted system, which sometimes develops rapidly, as at the expense of internal resources, and at the expense generated by the external conditions and incentives. The backbone of any economic system is its infrastructure, which allows you to seamlessly operate and develop. Thus, the functioning of the financial market is connected with the conduct by its participants of different kinds of professional activity in the market, in particular, asset management, brokerage services for execution of orders of the client for purchase or sale of securities, Depositary activity of securities safekeeping and account rights. The functioning of institutions of the financial markets and their interaction with a view of realization of the main tasks of the market is ensured by one of the constituent elements of this market, namely - the infrastructure of the securities market.

Thus, the infrastructure of the securities market can be defined as a specialized organization for the activities of professional participants in the financial markets, and providing the latest necessary services. The infrastructure of the securities market includes the systems of regulation of Depositary registration (or otherwise, «Depositary system») and clearing system, on-exchange and OTC trading systems, information and personnel system and the Agency. In broad

sense here also you can enable auditing infrastructure, information infrastructure (rating and information agencies), manufacturers of specialized information software.

The Depositary system is the whole financial «sub», which takes into account the rights on securities property and the rights of creditors to debtors enshrined in securities in all their complexity. Depositary system in the securities market is a set of Depositary institutions: organizations engaged in Depositary activities and organisations carrying out activity on maintenance of the register of securities owners.

For the first time Depositary institutes (depositories and registrars) emerged to facilitate settlements on the organized securities markets. Originally Depositary registration systems were created to service the stock exchanges on which professional participants of the market constantly carried out deals among themselves and where the requirements for the efficiency of the registration of change of ownership and the effectiveness of this procedure were especially high. As institutions that provide services on safekeeping of securities certificates and / or Depositary and transfer of rights on securities Depositary formed much later, in the first half of the twentieth century. Customers certificates deposited in the exchange Depositary, and change of ownership reflected in the accounts Department. There is no need to reissue of securities certificates, which were issued to the Depositary, and continued to be in his store. Thus, securities settlements steel cashless and was reduced to the changes in the securities account. In many cases, the issuers preferred to perform its obligations to investors by the Depositary. The Depositary, in this case played the role of mediator between the Issuer and the investor, helping the customer, deposited their securities, get accrued income, give all intended for him the information that came from the Issuer. Depositary also contributed to the acceleration of settlement of transactions on the organized securities markets. A pioneer in this area was Germany. In this country the certificates of securities began to mobilize in one place with the aim to exclude their physical movement during the transactions.

Improvement of the Depositary activity led to the non-cash securities. Securities in the form of a paper document is used less and less. The role of the document (certificate) confirming the right of the owner of the security, began to play a recording on a depo account. In recent decades, this trend, called

«securitization» (transformation of the debt securities), has become very widespread in the global financial market. In a number of countries, this was fixed by law. The depositor provided in accordance with the terms of Depositary agreement, the various statements or similar documents showing the status of the depo account. Securitization, turning ordinary obligation of the debtor to the creditor in property, gives these liabilities increased turnover ability puts them in a ready infrastructure of the stock market and ultimately makes financial relations in the economy more mobile, and the economy more flexible and efficient.

In most developed countries, organized a two-tier system of Depositary servicing. The upper level is represented by the Central Depositary. In Sweden such Depositary called VPC, in Germany - VCC. The biggest American Depositary DTC serves the organized securities markets. National Central securities depositories currently in operation in most of the developed world's financial markets. They provide services for securities delivery against cash payments. Possibility of membership in the Central national depositories usually provided only for banks and brokerages, which makes them wholesale Depositary organization. Lower level are the custodians Depositary — it Depositary organizations providing a very wide list of retail Depositary services to a wide range of clients, and in modern conditions more and integrated banking services. Such a two-tier system now lawmakers lead the Russian Depositary system.

Focusing all large share of financial assets, Depositary institutes play an important role in the stock market and in the economy as a whole. The importance of depositories is connected not only with the fact that they ensure the preservation of financial assets in the most liquid form. Such organizations lies in the fact that, constituting in the aggregate backbone infrastructure of the securities market and the economy in General, they provide increase the mobility and effectiveness of economic relations. The largest Depositary, in particular, from the simple to the custodians of financial assets have become organizations that provide the widest range of services on the stock market.

As a result of the analysis of the factors that led to the emergence of Depositary institutions as independent subjects of the stock market, we can distinguish the following basic conditions:

1. The emergence of depositories as the Institute of the securities infrastructure was due to the desire of participants of the stock market overcome the risks associated with the handling of paper certificates, which were certified by classical securities, such as forgery of a certificate or loss resulting from loss or illegal actions;
2. Immobilization and dematerialization of documentary securities allowed to sharply reduce the costs associated with the maintenance of a huge number of certificates. Eliminated the need for collection, verification of the authenticity, renewal of certificates for re-registration of securities on the new owner or in the implementation of corporate actions (share split or

consolidation, the issue of replacement of worn-out of certificates to new, etc.;

3. With the change in the method of fixation of the rights to securities (by refusal of certificates in favor of record on the depo account) increased the speed of circulation of securities, which positively influenced the liquidity of the entire stock market and gave further impetus for its further development.

In recent years, the rapid growth of the investments in securities. This is primarily attributable to the General growth of the financial resources of all subjects of the market economy and the global reorientation of free financial resources from other sectors of the financial market in the sphere of securities. This phenomenon was due to the considerable progress of technology and the infrastructure of the stock market, making investment in securities, and manage more simple, affordable and effective.

Taking into account these trends on the modern market, the main focus is on the creation and development of systems associated with regard to the rights of securities. Law on securities property and the rights of creditors to debtors granted by securities, are taken into account in all its complexity institutions Depositary system.

Depending on national traditions, a specific device, the features of the legislation and economic normative vocabulary of elements of this «sub-sectors» may be a different name (depositories, custodians, registrars, transfer-agents and etc.). For centralizing all such institutions (and their functions), and introduced the concept of «Depositary system» (hereinafter DS of SM).

The Task of the DS of SM - act as a «witness», verifying the existence and nature of legal relationships entered into by the subjects of civil turnover of about securities (referring to relations connected with the rights enshrined in securities and the rights to securities as property). Confirmation by the DS of SM is a predominant in the system of evidence in relation to all other ways of confirmation.

This task is expressed in the following two major («qualifying») features:

- (1) evidence of creditors ' rights stipulated by the securities
- (2) confirmation of property rights and other rights in REM) to the securities as property.

From this point of view, any person exercising these functions, carries out Depositary activity and referred to as «the Depositary».

Performing the functions of the DS of SM provides the participants of the securities market (creditors, debtors, owners and other), services related to the testimony of the existence and nature of relations at the securities. In the broadest sense of the functions performed by the Depositary system as a whole and its elements separately, constitute one of the key parties to the Depositary activity, defined as the activity of securities safekeeping and/or Depositary of rights on them. Thus it is quite legitimate to speak of any organization performing the

functions of the Depositary system in the securities market or its element as the Depositary.

Currently in Russia to such institutions refer register holders and depositaries. Combining them under the guise of the «Depositary system» helped to realize the simple truth that, despite all the differences between depositaries and registrars, General they have more.

The necessity of development of a DS of SM connected with the fact that at the present time, in countries with developed financial market entire turnover, or at least the major part of the turnover of securities occurs in non-cash form and, consequently, institutions, registering the turnover and retaining the rights to securities are at a high level development.

Russia in this regard cannot be an exception and, if we want our financial market corresponded to the best examples, and moreover, that it was formed as a World financial center, we just have to build an effective DS of SM.

Only the registrars and depositaries are in condition SM? And is it right to separate settlement infrastructure from the SM?

It is a matter of debate. Settlements on each deal concluded at the financial market consist of two parts: the settlement of securities and settlement of cash. In my opinion, it is impossible to separate Depositary and clearing infrastructure, as well as it is impossible to divide and two components of settlements on transactions in the financial market.

In this connection, it is expedient to speak about such sub-sectors of the financial market - «Depositary and settlement infrastructure of the financial market, which is essentially a set of Depositary institutes (depositaries and registrars), but also by the aggregate of clearing organizations.

Russian Depositary and settlement infrastructure is currently undergoing a major period in its development. If you now try to identify and formulate the main problems of the development of Russian Depositary and settlement institutions, then clearly we turn exclusively to those associated with the entry into force of new legislation in the period from 2010 through the end of 2012.

First, and perhaps the main problem connected with the activity of registrars, gain the question of the conflict of interests between the two Depositary institutes of depositaries and registrars who is not just escalated, but largely took off his clothes in connection with the introduction of the Central Securities Depositary for which introduced monopoly on opening nominee accounts in registers on a large number of securities. Thus, in connection with reduction of circle of clients, and also in connection with the introduction of certain procedures of interaction between the Registrar and the Central Depositary, registrars have to extend the range of rendered services, to revise the conception of running your own business and its positioning in the market, actually re-establish its place in the Depositary system of the financial market.

The Registrar is still an integral part of the centralized infrastructure.

The suggested by the Government the concept of construction in Russia the international financial centre involves the creation of a centralized Depositary system. And any centralized system - not necessarily financial - has a nucleus. And that's the core of the system Depositary and settlements will be the Central the Depositary. And this is true because such a system, first, will allow the Russian financial market closer to the international financial standards, secondly, will provide fast and efficient calculations within one operating subsystem and, thirdly, to increase the free float and, as a consequence, liquidity and attractiveness of our securities.

The main function of the representatives of the Depositary and settlement infrastructure - the function of a mediator in the securities market intermediary, which is the connecting link between one of the main participants of the market, the Issuer and the investor. Therefore, the main task is based on the existing and developed a legislative framework to build an effective operating model.

That will also allow registrars to remain on the market?

First of all, it should be noted that, in addition to the Registrar, on the Russian market, there is no institution which would work with issuers directly, knew their requests, demands and level of the required service, carried out their instructions, I did for them in work connected with the keeping and safe custody of the registry of the Issuer, servicing of meetings of shareholders, carrying out of corporate actions, worked with the registered persons, especially with minority shareholders. In the basis of Registrar activity - an individual approach to each client/

Accordingly, such an infrastructure unit, as the Registrar, the need of the market, otherwise the chain of interaction «issuers, registrars, Central Depositary, Depositary - broker – investor» may be disrupted as a consequence, would lead to disruptions, delays, and even to the blocking of the work of the whole infrastructure.

Speaking about the centralized system of calculations, we note that the appearance on the market of the Central Depositary are the new rules of the game, which we all have to adapt, where the Registrar and its client - Issuer become full participants in the centralized system settlements in which they must work together and interact with other participants of the market, configure the operating system and start working in them according to the Law on the Central Depositary.

Back to the interaction of the Central Securities Depositary and the Registrar. These two institutions are complementary institutions, the Central Depositary acts as the operational center and the place of the settlement of stock exchange transactions for the exchange infrastructure. The Registrar is also the center of providing various services to issuers and their shareholders who are not actively trade their securities and long-term store them on their personal accounts, or simply not used in trading.

Despite the fact that legislation exist certain norms, which can be freely interpreted by the market participants as priority issues requiring attention in the current term are such as:

- unification of operational standards for all market participants;
- formation of clear instructions in respect of the technical implementation of operations;
- approval of the inspection procedure;
- provision of operational interaction for corporate action.

Detailed study of these issues at the level of normative regulation can significantly improve the efficiency and sustainability of our system ensure the efficient and comfortable interaction between the Registrar and the representatives of the Russian stock market, which bring him and liquidity, and money. Debugging system in accordance with the criteria prescribed in the legislative acts, you may need to make changes in the current legislation and completion of the new accession into force of the documents. Therefore, special attention should be paid to a clear description of the processes in the adopted documents. For example, not sufficiently clear point - the access of the Issuer the information from the registry. Today in the legislative framework of this question is prescribed quite eloquently and difficult. Why the Issuer responsible for its shareholders, dealing with corporate matters, is not entitled to receive the information about all its shareholders at any time.

In addition, there is the issue of timely provision of information on the disclosure of the ultimate owners of the issuers. In accordance with the current version of the legislation this information will provide the Issuer, on the one hand, the Registrar (by analogy with the disclosure of information securities), and on the other (if the entries do not match) - the Central Depository. And what do the Issuer in such a situation? In any centralized system for coordinated work should be one entry point and one exit point. In this case, the Issuer must rebuild your system and your work? I want to believe that the market is to create conditions for the establishment of such an operating system that will allow the Registrar to work with the Issuer, and the Issuer is possible to obtain information from one source - from the Registrar.

If this does not happen, the Central Depository will be the second service organization for the Issuer. Question: whether it's the market? This will lead to the concentration of all operations on one party and concentration of all risks. On the market there already exists an optimal model, which only needs to adjust.

All this demonstrates that additional setup legislation is essential, since holding corporate actions without violations - unconditional duty of the Registrar, that no one has repealed.

It should be noted that for the last period of development of the Russian financial market from the beginning of the 90-ies of the last century to the current historical moment of the creation of Institute of the Central Depository we have made a great breakthrough that developed economies have done for centuries. Compared with already solved problems the solution of current issues is much easier.

In view of the development of electronic document circulation between the Registrar and the Issuer has already been prepared and discussed professionals of the market of the bill on amendments to the law «On joint stock companies», which enables a number of procedures related to preparing and holding the General meeting of shareholders, in electronic form.

Another one of the current problems is the problem of compliance of the standards of Depository activity of the national Central securities Depository of the Russian market of the international Deposit systems. The issue of opening of the Russian market of international depositories, global custodians and settlement systems is not necessary, the law on the Central Depository has established the necessity of opening of accounts with foreign operators. In this regard, NSD national settlement Depository established International consulting committee (ICC, the international Advisory Committee) as an Advisory body, oriented at the development of proposals and recommendations on the development of the post-trading infrastructure of the Russian financial market. One of the last and also the main issues is the issue of competition, which also makes boil market participants.

The Federal Antimonopoly service of Russia has expressed their comments during the discussion of the draft law on the Central Depository. But they remained without attention and FAS took a wait-and-see policy. Before the adoption of FAS put forward the proposal to change the draft law on the Central Depository, and forbade him to open nominee accounts of depot of owners of securities. According to FAS, ordinary Depository will not withstand the competition with a Central, if the bill will not be considered offering a service.

If we turn to the experience of developed countries effectively operating the antitrust laws (namely, the us market), even with an extremely conservative approach the Antimonopoly body decided that, in spite of the restriction of competition, creation and functioning of DTC (Central Depository USA) substantiated and justified by the market, and its presence and limitation of competition in this case will have a greater synergy effect for the development of the market than its absence.

So, now the Russian market solves a number of challenges on the way of building an effective Depository and settlement infrastructure of the financial market. And this new era, not be afraid of this word, development of the Russian market will show us readiness to the formation of a global financial centre on the basis laid the foundations of the registration and settlement institutions.

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# Environmental Accounting and Reporting – an Emerging Issue in Contemporary Economy

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**Abstract** – The paper considers the environmental accounting as an issue which is more and more often being discussed at the national and international scientific and political conferences and meetings. The problems of environmental protection and the harmful impact of companies on the environment are the important issues in today's global economy. The paper presents different approaches to defining the term of environmental accounting as well as shows the scope of environmental reporting in twenty biggest listed companies in Poland.

**Keywords** – environmental accounting, environmental reporting, CSR, companies' environmental activity.

## I. INTRODUCTION

The last decades have shown an increasing global concern for environmental protection. The harmful impact of companies on the environment has induced a growing pressure of ecologists and society for the businesses to consider the environmental effects of their activities. Very important is not only taking ecologically responsible operations but also informing about the amounts related to that operations, which means costs and benefits for the environment as well as for the company. The accounting is a great system equipped in all the necessary tools which enable it to measure, calculate and present the information about companies environmental activity. The aim of the paper is to identify the most accurate definition of environmental accounting proposed in the subject literature as well as to investigate and show the scope of environmental reporting in the twenty largest listed companies in Poland.

## II. THE ENVIRONMENTAL ACCOUNTING AND REPORTING – DEFINITIONS AND SCOPE

The term of environmental accounting has existed for about twenty years, but there is still not a widely accepted approach to defining them. At the same time in the subject literature there exist such names as: ecological accounting, green accounting, environmentally oriented accounting or environmentally modified (differentiated) accounting. Some authors treat these names like synonyms others define them differently. Table 1 includes the most often presented in the literature definitions of environmental accounting and its alternative terms.

TABLE I. DEFINITIONS OF CORPORATE ENVIRONMENTAL ACCOUNTING

Author	Definition
M. Stępień, W. Dotkuś	Environmental accounting as an accounting related to protection and restitution of the natural environment [4].
S. E. Sefcik, N. S. Soderstrom, C. H. Stinson	Environmental accounting is a course (or subject) that investigates how environmental issues affect traditional accounting subdisciplines [5].
P. Dhar	Environmental accounting is a method for improving business decision making in recognition of the increasing environmental challenges and opportunities facing businesses today. It does this by identifying hidden or misallocated internal and external environmental costs and allocating them to particular products or processes [6].
A. K. Pramanik	"Environmental Accounting is the process of recording and summarizing the value of environmental goods and services in monetary terms. It is a part of corporate social accounting and attempts to evaluate the impact of organizational activities on environmental resources." [7]
M. Houldin	Environmental Accounting can be taken as covering all areas of accounting that may be affected by the business response to environmental issues [1].
S. Schaltegger, R. Burritt	Environmental accounting is a system which covers issues in environmentally differentiated conventional accounting and in ecological accounting. The ecological accounting measures in physical terms (e.g. kilograms, joules) the ecological impact that a company has on the environment. The environmentally differentiated conventional accounting is a part of traditional accounting and measures the environmentally induced impacts on the company performance in financial (monetary) terms [2].
M. Bartolomeo, M. Bennett, J. Bouma, P. Heydkamp, P. James, T. Wolters	Environmental accounting is an inclusive field of accounting that provides the reports both for internal use (generating environmental information which can be used in management process of decision making) and external use (disclosing environmental information to the public) [8].
S. Sojak	Environmentally oriented accounting means conventional accounting enriched in ecological information especially about cost and revenues resulting from environment protection [9].

Source: Author's own elaboration based on the subject literature.

The widest scope of environmental accounting is presented in the definitions of M. Houldin [1], S. Schaltegger and R. Burritt [2] (see table 1). These definitions recognize the impact of company's activity on the environment as well as the impact of company's proecological operations on the company's performance. These definitions cover both the environmental financial accounting and the environmental management accounting. Similar point of view is presented by Bartolomeo et. al. [8]. Additionally, it is needed to mention that the US Environmental Protection Agency emphasizes that the

environmental accounting is a “flexible tool that can be applied at different scales of use and different scopes of coverage” [3].

Fig. 1 shows the dimensions of environmental accounting. According to this figure the environmental reporting is a part of environmental accounting at the company level. The presented perception of environmental accounting corresponds to generally accepted perception of traditional accounting system. It means that the environmental accounting can be treated as a part of traditional accounting and the information related to the natural environment might be calculated and revealed next to the traditional costs and benefits presented in the accounting system so far.

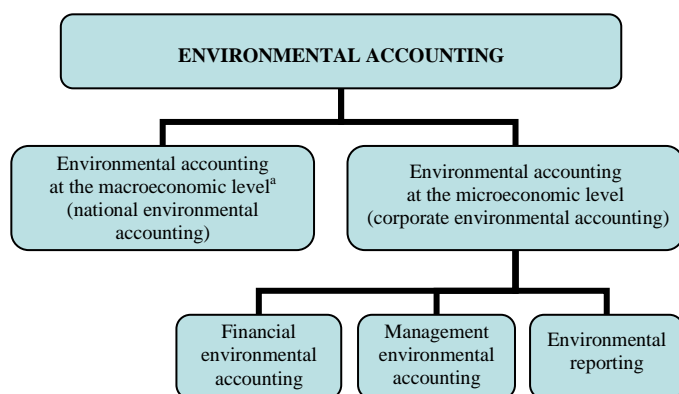


Figure 1. The Scope of Environmental Accounting

a. About national environmental accounting see more: [10], [11] and [12].

Source: Author's own elaboration.

### III. THE GROWING INTEREST OF THE COMPANIES' ENVIRONMENTAL REPORTING

Throughout 1990s, studying the vast majority of financial statement it was hardly to find any relevance of natural environment in companies' financial statements. There was simply no relevance of natural environment protection in the vast majority of organizations. Although there were countries that were the exceptions. For example, according to KPMG report in 1996 95% of the top 100 companies in Norway made some reference to environmental issues in their annual reports. In USA it was 86% of 100 biggest companies [13]. Nowadays the situation looks quite different. Companies inform their stakeholders not only about some ecological operations but also present the effects of these operations in separate documents. There are many reasons of this kind of phenomenon. One of them is increasing demand for revealing by companies the information about their impacts on the environment both in physical and monetary terms. Besides, shareholders are also interested in the data showing the influence of companies' proecological operations on their financial performance especially costs and revenues. In the USA in January 2010 American Securities and Exchange Commission issued new interpretive guidance that clarifies what publicly-traded companies need to disclose to investors in terms of climate-related 'material' effects on business

operations. The guidance is the first economy-wide climate risk disclosure requirement in the world. It is an answer for the formal requests that have been made by leading institutional investors for the SEC to require full corporate disclosure of wide-ranging climate-related business impacts - and strategies for addressing those impacts - in their financial filings [14]<sup>1</sup>. Also in Poland the institutional investors pay attention to the environmental activities of companies and environmental reporting practices. The results of the research made in 2012 in Poland by Warsaw Stock Exchange and Deloitte company have shown that the institutional investors consider companies' environmental activity as generating real benefits such as: cost savings, good image, higher trust of suppliers and financial institutions, loyal clients and better financial results [15]. The important point is that the number of environmental reports and the scope and quality of environmental information depend on the environmental and accounting law regulations which are different in different countries. If there is a clear legislation system which regulates the issues of revealing the financial environmental information like in Norway, Denmark or Sweden, there is also the higher percent of environmental reports. For example, researches conducted by S. Pahuja [16] in India have shown that three-fourths of the surveyed executives feel that compulsory environmental information disclosures will increase the seriousness of the issue and will lead to overall increase in environmental reporting by Indian companies.

### IV. ENVIRONMENTAL REPORTING IN TWENTY BIGGEST COMPANIES IN POLAND

The increasing pressure on companies to be responsible to the society for the environmental effects of their operations has influenced them to include the ecological aspects of activities to their business strategies. The information about companies' environmental activities are usually presented on companies' websites. More and more companies include such information also in the Annual Report (being more precised: in the report of the Board). Majority of companies include only qualitative information and descriptive characteristics of their environmental activities. But there are some companies which present also quantitative data about the amounts of ecological investments, ecological fees for using the natural environment resources or ecological charges for pollutants emissions. More and more often there are also prepared by companies the environmental reports or CSR reports. About ten years ago it was not common phenomenon in Poland. Nowadays it begins the era of environmentally conscious society and eco-oriented businesses. Table 1 shows the range of different aspects of environmental reporting in twenty largest listed companies in Poland (current as of the April 29, 2013). The study was carried out on the basis of companies' websites, companies' annual reports and CSR/environmental reports. Table 3 provides the summary of the study results.

<sup>1</sup> More than a dozen investors managing over \$1 trillion in assets, plus Ceres and the Environmental Defense Fund, requested formal guidance in a petition filed in 2007, and supported by supplemental petitions in 2008 and 2009 [14].

**TABLE II. THE ENVIRONMENTAL REPORTING IN TWENTY LARGEST COMPANIES IN POLAND IN 2012**

Name of company	Field of activity	Separate environmental or CSR report	Environmental information as a part of annual statement	Environmental or CSR section on company's website	Declaration of the implementation of CSR strategy	Financial quantitative environmental data in the report or on the website
PGE	Energy sector	No	Yes	Yes	Yes	No
TAURON PE	Energy sector	No	No	Yes	Yes	No
TP SA	Telecommunication	No	Yes	Yes	Yes	No
Eurocash	Retail	No	Yes	Yes	Yes	No
Asseco Poland	IT sector	No	No	No	No	No
Bogdanka	Raw materials industry	Yes <sup>a</sup>	Yes	Yes	Yes	Yes <sup>b</sup>
KGHM	Raw materials industry	Yes <sup>c</sup>	Yes	Yes	Yes <sup>d</sup>	Yes
JSW	Raw materials industry	Yes <sup>e</sup>	Yes	Yes	Yes	Yes
PGNiG	Fuel industry	Yes	Yes	Yes	Yes	No <sup>f</sup>
PKN Orlen	Fuel industry	Yes	Yes	Yes	Yes	Yes
LOTOS	Fuel industry	Yes	Yes	Yes	Yes	Yes
KERNEL	Food industry	No	No	No	No	No
SYNTHOS	Chemical industry	No	No	Yes	No	No
BORYSZEW	Metal industry	No	No	No	No	No
PKO	Banking	No	No	Yes	No	No
PEKAO	Banking	No	No	Yes	No	No
Citi Handlowy	Banking	Yes	No	Yes <sup>g</sup>	No	No
BRE BANK	Banking	Yes <sup>h</sup>	No	Yes	Yes	No
PZU	Insurance	No	No	Yes	No	No
GTC	Developer industry	No	No	Yes	Yes	No

a. The title of the report is "The report of the company's environmental impact".

b. In the consolidated annual report 2012.

c. The latest available report: "The CSR report 2010-2011".

d. The aspect of environmental protection are treated as a part (element) of company's strategy.

e. In the form of brochure including environmental data both in physical and financial (monetary) terms.

f. PGNiG presents plenty of quantitative environmental information but all of them in physical not in monetary (financial) terms.

g. There is a separate website about environmental activity of Citi Handlowy: <https://www.online.citibank.pl/las/posadz.htm>.

h. The latest available report: "The CSR report 2008".

Source: Author's own elaboration based on the companies' websites and reports.

**TABLE III. THE ENVIRONMENTAL REPORTING IN TWENTY LARGEST COMPANIES IN POLAND IN 2012 – RESULTS OF RESEARCH**

	Separate environmental or CSR report	Environmental information as a part of annual statement	Environmental or CSR section on company's website	Declaration of the implementation of CSR strategy	Financial quantitative environmental data in the report or on the website
<b>Number of companies</b>	8	9	17	12	5
<b>Percent</b>	40%	45%	85%	60%	25%

Source: Author's own elaboration.

## V. CONCLUSION

The increasing pressure on companies to be responsible to the society for the environmental aspects of their activity has influenced them to implement the eco-oriented management and eco-oriented business operations to their strategies. The results of the conducted research have shown that companies are aware of the importance of CSR aspects in today's economic reality (85% of twenty largest companies in Poland have a separate CSR section on the website). Although there is still few companies in Poland that are willing to undertake voluntary disclosures in the area of environmental costs (fees, charges, taxes), investments and benefits. Only 25% of twenty biggest companies in Poland present the environmental information in financial terms. More common phenomenon is describing qualitative characteristics of undertaken environmental activities in the annual reports (45% of researched companies do that) and in separate CSR or environmental reports (40% of companies). In Poland are no obligatory norm and standards making companies must prepare environmental reports. There are also no rules to be followed by companies preparing CSR or environmental report. If there were some law regulations probably companies would know what they must reveal and how to do this. The presented information would be comparable and there would no appear the situations when companies avoid showing the environmental negative aspects of their operation. That is the reason why environmental accounting and its tools are needed and why should be developed. There is no doubt that the environmental accounting and reporting have become an important dimension of corporate external information system in contemporary economy of 21<sup>st</sup> century.

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# How Hazardous to Health is it to be on Medication?

## An exemplary analysis of the cumulated side effects of medicine

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**Abstract**—Besides the healing effects striven for, every medicine encompasses side effects. These may affect the overall well-being of a patient. Though these effects are - according to many medicine package leaflets - occurring with a certain frequency, so far no attempt has been made to evaluate the total hazards a medicine potentially creates. The present article proposes an approach to close this gap and exemplarily illustrates the developed approach. The article closes with pointing out possible refinements for the procedure, and corresponding open information needs for package leaflets.

**Keywords** – hazard; medicine; package leaflets; side effects; cumulation

### I. INTRODUCTION

Every medicine has side effects or hazards associated with its use. Though so far any medicine package leaflet lists the side effects related with the medicine's application, all of the effects are, however, listed separately from one another, i.e. dependencies among the side effects are not taken into account.

To contribute to bridge this gap the present article not only develops a cumulation approach by referring to the statistical probability theory, and developing an illustration, but also applies it exemplarily on an arbitrarily chosen leaflet, before further improvements are named and discussed.

Thus, the article is separated into five sections. This brief introduction is followed by a literature review, which firstly concentrates on research related to medicine's side effects and secondly highlights the cumulation idea. The third section then presents the aggregation model developed, taking dependencies among the side effects into account. In the fourth section this approach is exemplarily applied to the package leaflet of a commonly used medical product, before the article concludes and gives prospects for further research.

### II. LITERATURE REVIEW

#### A. Research regarding medicine's side effects

Before introducing a new medicine to the public, it has to be tested, i.e. under supervision be applied by multiple people suffering from the disease the product shall cure. In addition to that normally is run a second test, in which the participants get placebos.

As Murgia, Jordan and Kahan (1996) do, the study cohort might also be differentiated into more, i.e. not just two,

subgroups. In their study Murgia et al. portioned the participants into four dose level groups: one getting a placebo, the second receiving just a low, the third a medium and the last a high dose. In this study multiple statistically significant side effects were established, but none was irreversible.

Twomey (2001) conducted an exploratory study, which analyzed the design factors contributing to the reading ease and comprehensiveness of medical information leaflets. Her analysis reveals (a) the complexity of the process needed for getting regulatory approval, and (b) further characteristics of leaflets which in the future should also be fulfilled.

All together, the side effects identified and established have to find expression in easily understandable package leaflets.

#### B. Publications on Cumulation

The concept of cumulation is discussed in various contexts. While Easterlin (1987) researched the cumulation of knowledge, Hering et al. (1998) considered the accumulation of an infection within families, and Morgan and Stocken (2008) studied information aggregation via polling.

But not only the contexts, in which the cumulation is researched, vary. Rather the aggregation approaches differ: The easiest approach surely is a simple summation of all items to be cumulated, but various other methods like the one considering dependencies, which is described in the following, exist.

### III. CUMULATING THE HAZARDS ENCOUNTERED

#### A. Formalizing any Hazard

A hazard represents any source of harm or adverse health effects, which occurs in a certain number of cases, i.e. with a specific probability for the person taking the medicine. The most prominent form of hazard surely is the moral hazard, which often is discussed in the context of the principal agent theory (Stevens and Thevaranjan (2010)).

Hazards are, however, not only discussed in the context of the agency theory. Rather, they often are equated with risks. Understanding the latter as possible target deviations induced by, at least, one potentially occurring event, the differences between risks and hazards referring to the formerly described understanding become clear. A risk is the broader concept,

which encompasses hazards, as the latter are more or less similar to the risk-causing events.

Consequently, hazards ( $h$ ) are characterized by the occurrence probability ( $p$ ) attached to them:

$$h_i = h_i(p_i) \quad (1)$$

These probabilities range from zero to one, i.e.  $1 \geq p_i \geq 0$ .

### B. Probability Profile of all Hazards

Hazards possess, as stated before, an occurrence probability between zero and one. While the latter probability signifies that the hazard is surely realized, the former denotes that the hazard does not occur. The probabilities between these two interval boundaries represent how likely the occurrence of a considered hazard is.

Regarding the possible side effects of any medicine and referring to package leaflets, generally the probability range is split up into five sections (see Table 1). Supposing that it is impossible to attach an occurrence probability to all possible side effects, a sixth category is added, in which all those effects, for which the probability is not known, are summarized.

Though in any package leaflet these categories together with the side effects belonging to them are just listed, an illustrative drawing is possible as figure 1 exemplarily shows. Such an illustration of the grouped side effects would certainly help patients and/or their relatives in understanding the hazards encompassed in taking a specific type of medicine and can be considered as one improvement proposal for leaflets.

TABLE 1. CATEGORIES OF SIDE EFFECTS' OCCURRENCE FREQUENCIES

Category no.	Categorization of side effects		
	Name of the category	Occurrence Probability - Description	Occurrence Probability - Formalization
I	Very common	More than one men in 10	(0,1; 1]
II	Common	1 to 10 men in 100	(0.01;0.1]
III	Uncommon	1 to 10 men in 1,000	(0,001; 0.01]
IV	Rare	1 to 10 men in 10,000	(0.0001; 0.001]
V	Very rare	Less than 1 men in 10,000	[0; 0.0001]
VI	Not known	Frequency not assessable based on the data available	

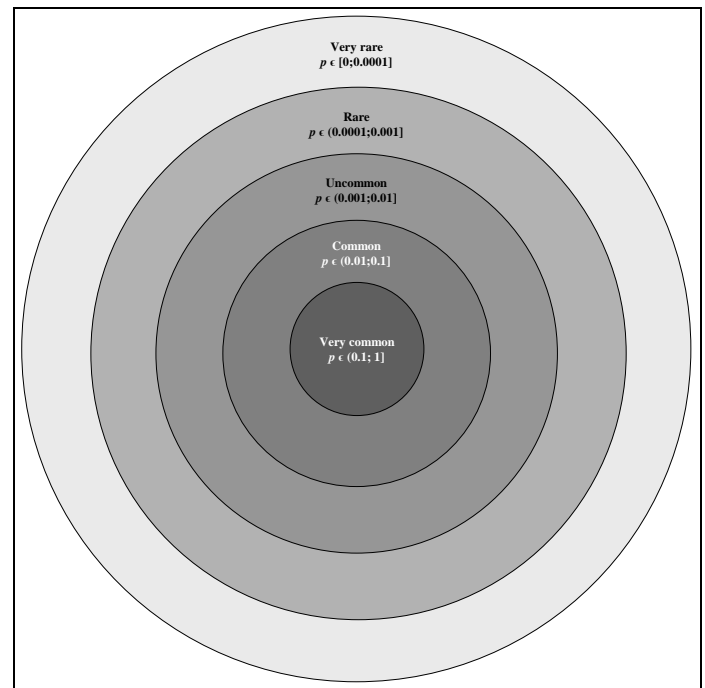


Figure 1. Probability Profile

A numerical evaluation of the total side effects proves, however, difficult, if not even impossible, because the consequences of each side effect on a patient's health and/or on other targets striven for when using the medication, cannot be determined without a quantification of the target(s), i.e. if the target deviation that occurs due to the side effect considered ( $\Delta t_{ij} | h_j$ ) cannot be quantified. Moreover, for every side effect just a range of the corresponding occurrence probability is known. Whether the danger for a certain patient is realized with a probability closer to the lower end or to the higher end of the interval is unknown. In the following, thus, the probability of each effect will be numerically represented by the mean of the side effect's probability range, i.e. by

$$P_i = (P_{i, \text{lower end}} + P_{i, \text{higher end}}) / 2 \quad (2)$$

Very common hazards, for example, are assigned an occurrence probability of  $0.1 + 1 / 2 = 0.55$ .

### C. Dependencies among the Potential Side Effects

This article has, so far, considered any hazard-inducing side effect independently from all others. Accordingly, it has abstracted away from potentially existing dependencies among the effects, e.g. from the relation between a very common effect and a just rarely occurring one.

Arbitrarily taking one pair of hazards into account, the realization of one may support or hinder the occurrence of the second effect. It is, however, also possible that the two effects do not affect one another, i.e. the realization of one has no influence on the occurrence of the second effect. In the first case the two effects considered are dependent, whereas in the second case they are independent. Referring to the statistical

probability theory, six forms of dependencies among side effects can be distinguished.

- occur as well, i.e. its probability reduces to “0 General positive dependency:  
If both hazards considered behave in this way, the realization of one affects the occurrence probability of the second and leads to a rise in probability for this second hazard.
- General negative dependency:  
If both hazards considered behave in this way, the realization of one affects the occurrence probability of the second and leads to a reduction of the probability of the second hazard.
- One hazard is part of another:  
If one hazard is part of another, the realization of the latter means the second one is also realized, i.e. its probability rises to “one”.
- Equivalency:  
Two hazards are called equivalent, if they occur with the same probability.
- Incoherency:  
If two hazards are incoherent, the realization of one means the second cannot”.
- Complementarity:  
Two hazards are called to be complementarily, if one is the exact opposite of the second.

According to that it would surely be helpful, if the dependencies among the side effects would also be listed in the package leaflet, at least, for each pair of side effects. It might, however, also be that this pairwise dependency alters, if more than two effects are considered!?

#### D. Aggregating the Hazards Taking Hazard-Dependencies into Account

The aggregation of all potentially arising hazards starts with choosing one hazard, whose occurrence is primarily supposed. For example, the hazard having the highest occurrence probability might be considered first. However, it is also possible to choose the hazard which has the most positive relations with all other hazards.

Having decided on one starting hazard, its occurrence is assumed, i.e. its probability is risen to “one”. Afterwards, it has to be considered how all other hazards, in particular their occurrence probabilities are affected by the first hazards realization, i.e. their conditional probabilities must be calculated.

In the next step a check has to be performed, i.e. if now another hazard exists, whose probability has risen to one, reflecting its certain realization. If this is the case, once again the effects this second hazard’s realization exerts on all other, so far not realized hazards have to be calculated. This process stops if there is no other surely realized hazard. Then the end condition, which should have been formulated before, has to be checked. One possibility for such a rule is that the occurrence probability of all other, not yet realized hazards are close to

zero. If this condition is fulfilled, the cumulating stops. Otherwise another hazard has to be chosen, whose occurrence is assumed.

All in all, the aggregation stops, giving an impression of the total hazard encountered by the medical product.

#### IV. EXEMPLARY CASE STUDY

Having highlighted the method developed in order to cumulate the side effects of a medicine, this section is dedicated to exemplary illustrate this approach. After the first subsection, in which the general layout of the case study is explicated, the second subsection presents the results gained. These together with the study’s layout are then discussed in subsection “C”.

##### A. Design

As mentioned before, in the following the leaflet of one medical product, in particular its fourth part, in which the potential side effects are named and ranked, is considered. The arbitrarily chosen example is given in the appendix, i.e. “GeloMyrtol® forte, a product broadly applied, is chosen.

Having decided on the afterwards scrutinized product, its side effects have to be listed in groups, for which then the average occurrence probability shall be calculated and given.

TABLE 2. SIDE EFFECTS OF THE CHOSEN PRODUCT

Category no.	Side Effects of GeloMyrtol® forte	
	Name of the category	Named Side Effects
I	Very common	--- <sup>a</sup> .
II	Common	--- <sup>a</sup> .
III	Uncommon	Gastrointestinal complaints
IV	Rare	Nausea, vomiting, diarrhea
V	Very rare	Kidney stones or gallstones become dislodged

a. “---” – No side effects belonging to this category are given in the leaflet.

After choosing a very common side effect as realized hazard (or in the present case: one of the highest ranged category, i.e. here, the gastrointestinal complaints), in the next step its effects on all other hazards have to be considered. Normally dependencies among the hazards then also have to be taken into account (see subsection III.D). However, none of these dependencies is listed in the package leaflet, and no study researching combinations of side effects of this medical product has so far been performed and made publically available. Thus, either suppositions have to be formulated, or the dependencies must be ignored. While the second proposition resembles the afore addressed summarization of the side effects, the first proposal shall here be exemplarily followed.

All together GeloMyrtol® forte may show five side effects (Table 2). Because the author does not possess any medical experience, it is assumed that most of the side effects’ occurrence are independent. Just the effects, whose occurrence is considered rare, are related. For instance, vomiting often

results from nausea, i.e. any realization of the second hazard encompasses also the occurrence of the first one (refer to the third dependency type explained above). A joint occurrence of one of these effects together with diarrhea is not necessarily given, i.e. these hazards can also be considered to be independent.

## B. Results

As just two side effects are assumed to be interdependent, the application of the technique described before, will start assuming one of these effects is realized. The occurrence of vomiting means that the sick is also nauseas, i.e. the former hazard is part of the latter. In this case assuming the latter realizes, does not necessarily impact the probability of the other hazard. If the occurrence of the former is, however, assumed, the later also realizes, i.e. its probability rises to "one". Accordingly, the realization of the vomiting and, thus, of the nausea are supposed.

In total the side effects then possess the following modified probability profile.

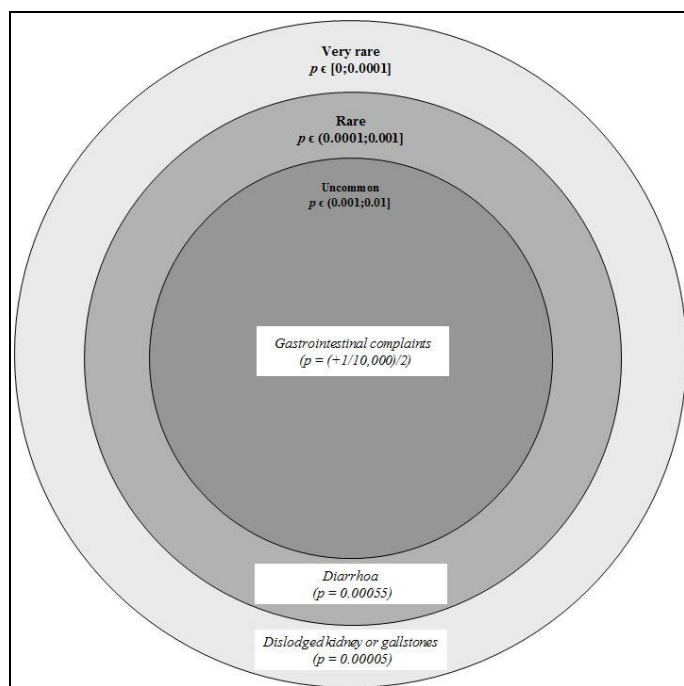


Figure 2. Probability Profile

As elaborated before, the two hazards missing in figure 2 now occur with certainty.

## C. Discussion

The afore presented approach of how to cumulate hazards concentrates on their occurrence probabilities and their assumed dependencies. If different assumptions are made, the probability profile changes. This should be kept in mind, when considering to integrate drawings or corresponding elaborations into a package leaflet.

Apart from that the considerations made before, do not take the time factor into account. Rather, it is assumed that all

changes in the probability profile occur directly and without any time lag.

The most important difficulty, however, is that the amount of the target deviations occurring due to the hazards considered are not taken into account. Thus, any user of the before described approach, will surely be confronted with the question, if a risk analysis would not be preferable to the hazard analysis.

## V. PROSPECTS AND CONCLUSION

As Twomey's analysis (2001) already revealed, the dissemination of information depends on its presentation and its design. The present analysis underlines this fact and thereto adds the demand for a graphical illustration in medical package leaflets.

Apart from that, the developed approach and the propositions delivered for the probability analysis and its illustration, need further considerations (e.g. an integration of the time factor). Moreover the proposed model is built on the base of the statistical probability theory, and, thus, will be confronted with the corresponding critique.

All together the proposed model surely has its merits and demerits, which should be further considered and discussed.

## ACKNOWLEDGMENT

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## APPENDIX

### A. EXEMPLARY EXTRACT OF THE PACKAGE LEAFLET: INFORMATION FOR USE – “GELOMYRTOL® FORTE”

**Package leaflet: Information for the user**

**GeloMyrtol® forte**  
 300 mg, gastro-resistant capsules, soft  
 Active substance:  
 Myrtol standardized to at least 75 mg limonene, 75 mg cineole and 20 mg alpha-pinene.

**Read all of this package leaflet carefully because it contains important information for you. This medicinal product is available without prescription. However, you still need to take GeloMyrtol® forte carefully to get the best results from it.**

- Keep this leaflet. You may need to read it again.
- Ask your pharmacist if you need more information or advice.
- You must contact a doctor if your symptoms worsen or do not improve after 10 days.
- If any of the side effects affects gets serious or if you notice any side effects not listed in this leaflet, please tell your doctor or pharmacist.

(...)

#### 4. Possible side effects

Like all medicines GeloMyrtol® forte can cause side effects, although not everybody gets them. The frequency of occurrence of side effects is based on the following categories:

Very common: more than one men in 10	Common: 1 to 10 men in 100
Uncommon: 1 to 10 men in 1,000	Rare: 1 to 10 men in 10,000
Very rare: less than 1 men in 10,000	
Not known: Frequency not assessable based on the data available	

#### Potential side effects:

In uncommon cases, gastrointestinal complaints may occur, in the stomach/upper abdomen region, for example, in rare cases nausea, vomiting or diarrhoea. There have been rare reports of hypersensitive reactions (e.g. rash, itching facial swelling, shortness of breath and circulatory problems). In very rare cases kidney stones or gallstones present may become dislodged.

Inform your doctor or pharmacist if one of the listed side effects affects you considerably or you notice side effects not indicated in this leaflet.

# SECTION 6.

*Psychology, Sociology and Pedagogy, Social Science*

# Estimation of Ambulance Personnel Generations Differences in Learning Needs Determination: Case of Latvia

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**Abstract-**One of the 21st century's challenges in a personnel management is personnel's aging. Times is coming, when 4 generations will work together. The purpose of the paper is to analyze the Ambulance personnel's learning needs differences to promote self-directed long life learning and to secure a maintenance of personnel's competence for all groups of ages. 1600 employees of the Latvian State Emergency Medical service (EMS) are included in the research – doctors, doctors' assistants and nurses, in ages of 21-70 years. To enhance self-directed and self-motivated learning of Ambulance personnel, EMS organizes yearly testing of their qualification at the work place. Research analyzes the results of yearly made testing of theoretical knowledge of the Latvian State Emergency Ambulance personnel for the years 2011 and 2012, their differences in a comparison to personnel generations groups and specialties. The results of the research show that the testing of personnel's knowledge on the regular basis enhances their ability to pass the test, but it does not motivate personnel's self-directed lifelong learning. The results of the research indicate on a necessity to integrate approaches to adult learning in medical personnel development programs by respecting differences in knowledge levels, experience and attitude to enhance lifelong learning, as well.

**Keywords-** adult learning, ambulance personnel, EMS, yearly testing, self-directed learning

## I. INTRODUCTION

In today's world employers increasingly put more emphasis on the development of human resources while in search of new methods to increase its efficiency. Emergency medicine is one of the newest medical specialties out there. It is developing at a very fast pace therefore the development of the personnel through training should be of particular importance. As suggested by Tagawa, qualified clinical competence needs long period of training and each physician has to continually learn as long as he/she works as a professional [1]. Self-directed learning is an important factor in adult learning. It is essential for the employers that their employees develop their skills by lifelong self-directed learning. To ensure that their staff has the skills and knowledge required, as well as to encourage learning, employers use annual proficiency tests to cultivate the further development of their workforce [2]. Wlodkowski compares these tests of employee knowledge conducted in the workplace to a carrot-and-stick approach to increase staff development [3]. Stolovitch suggests that testing is an excellent way to teach [4]. The key is to make it fun and challenging,

not stressful. Testing is a natural part of learning, it helps both learners and trainers confirm performance objective attainment or identify where something is missing and requires corrective feedback. It lets the learner try out her or his learning with a bit of a challenge. The importance of this study is set by the need to improve staff expertise while encouraging self-directed and self-motivated lifelong learning by all methods attainable through adult education. This is particularly important in a situation where a relatively large number of uncertified medical practitioners exists in all age and occupation groups. As shown in previous studies by the EMS [5,6], more than a half of the ambulance personnel believes that yearly tests are not required in the workplace and only lead to unnecessary stress. 18% of respondents believe that their knowledge actually improves while preparing for the yearly tests.

Given that experience is an essential factor in adult education [7,8] from which different habits are being formed, it is important to understand its impact on the overall improvement of the learning process. Individual development can be achieved through systematic training while the learning experience is used in terms of reference for the evaluation. [8] suggests, that employers generally want self-directed learners who are willing to take responsibility for their own learning. Still, in recent years, many management authorities have focused attention on differences in generations in terms of their attitudes about work, life, work/life balance. And even learning. The key groups to consider are Baby Boomers, Generation X, Generation Y, and Generation Z. [9,10]. Given the generational differences among adults and the aging of the labor force, it is essential to find an effective approach to learning and improvement for each generation of employees to ensure their actual development while learning. The surveyed personnel of Latvian EMS 48% (790) are from the generation of Baby Boomers, 26% are considered of Generation X (434) and 26% (439) – Generation Y.

The main objective of this study is to analyze the different approaches to forming programs for different generations of employees in the current Ambulance personnel.

During the second part of the study survey data were used to analyze the ambulance personnel views on the necessary changes to EMS course quality [5]. The survey was conducted during the time period from October 2012 until January 2013 using the Probability Sampling Methods.

The survey involved 294 respondents in the age group of 21 to 70 and over. 118 respondents are of the Baby Boomer generation, of which 99 are doctors assistants, 38 are physicians and 8 respondents are nurses. 108 women, 10 men. 21 doctors assistant and 3 non-certified doctors. There were 84 respondents the considered part of Generation X - of those 10 men, 74 women, 66 doctors assistants, 17 of them non-certified, five doctors, one of them non-certified, 8 nurses. Generation Y was represented by a group of 92 respondents of which 68 women and 22 men, 77 doctors assistants, of which 48 non-certified, 8 doctors, 4 of whom non-certified and only 1 nurse. Respondents cover all departments and all the occupational groups incorporated by the medical staff. This is 16% of the total number of Ambulance professionals. The data was examined using the IBM SPSS program.

## II. MATERIALS AND METHODS

The object of research is the EMS ambulance personnel - doctors, doctors assistants and nurses in groups broken down by generations of Baby Boomers (born between 1946 and 1964), Generation X (35-45 y/o) and Generation Y (20-34 y/o) [9,10,11]. The current medical personnel of EMS is 1663 employees. 1252 people which have taken yearly tests both in 2011 and 2012 were selected as the target group of the study. In 2011 yearly test was taken by a number of 1362 (88.3%) medical professionals of which 59 professionals were in need to retake the test again. In 2012 the yearly test was taken by 1186 (72%) medical professionals, of which 72 people did not pass the test first try. To determine changes in the yearly test results of the personnel classified according to their by generations, the test results were examined with IBM SPSS Statistics 20 program using non-parametric statistical methods such as the Kruskal-Wallis test. None of the six grade variables have a normal distribution (tested with Descriptive Statistics Explore). Given that experience is an important aspect of adult education, the skills and knowledge of the ambulance personnel is compared by generations. The comparison is done by taking the work intensity index into account while assuming that the part of personnel whose work intensity (the higher number of incoming calls during their shift) is higher will show better results in the yearly testing.

The aspects on which research was conducted are as follows: the improvement in the success  $\leftarrow \rightarrow$  Ambulance personnel age group  $\leftarrow \rightarrow$  intensity.

The intensity was determined by the number of calls to the front desk during the current shift divided into 10, 15 and 25, stating that 10 means "low" and 25 is "high". Improvement (the sum of all 3 grades in 2012 minus the sum of all three grades in 2011) Age Group (age\_gr2) Generation Y, Generation X, Baby Boomers):

## III. RESULTS

The yearly test consists of three stages, the first of which is the practical test during which medical personnel deal with a task as a team almost like at an everyday situation. This stage is performed by using a rubber doll and medical equipment. For each incorrect action during the task the final score is reduced by one. The first stage of the test is carried out successfully if

the score is 6 points or above. The second stage - recognition of heart rate and cardiac conduction disturbances along with the interpretation of an electrocardiogram (ECG). The person taking the test has to assess and define according to the name and characteristics, three heart rhythms or cardiac conduction disorders in the heart monitoring device. He/she also has to verbally explain the results of two ECG. The second phase of the evaluation is positive, if for each question one or more points are received. Two points are acquired on the proper interpretation of the ECG, 1 point if the ECG is interpreted poorly and 0 points if the ECG is interpreted incorrectly. The third stage - each medical practitioner shall provide written answers to 60 questions about the theoretical test EMA to patients while in life and health emergencies. The third stage of the test lasts 60 minutes and is successfully passed if 6 or more points are acquired during this stage. This means at no more than 12 incorrect answers are allowed. If a medical practitioner fails in any of the three stages of the test then the person is allowed to take the test for stage he failed two more times. The results for the rest of the test are tested.

To identify correlation between personnel's knowledge and experience knowledge examination mean results were compared with work intensity. Work intensity was described as average calls per shift per medical personnel. It was expected that a person with higher work intensity would have higher experience level, and, consequently better test results.

Out of calls to the front desk during the current shift divided into 10, 15 and 25, stating that 10 means "low" and 25 is "high". Improvement (the sum of all 3 grades in 2012 minus the sum of all three grades in 2011), see Figure 1.

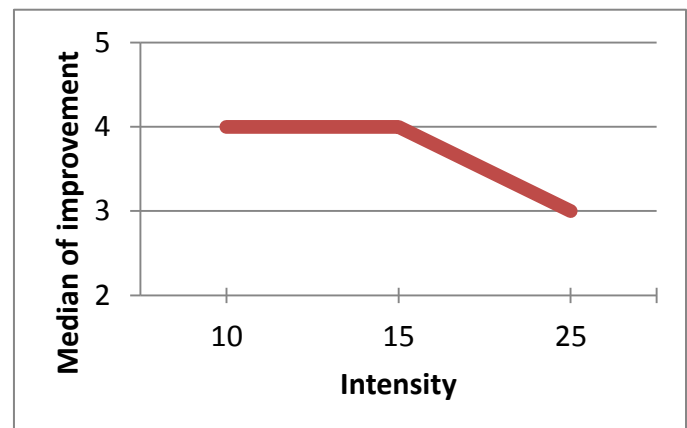


Figure 1. Yearly test result analysis, depending on the ratios of the work intensity

As it is seen on Figure 1, higher work intensity results in weaker test results. To identify if there are differences in knowledge examination results depending on intensity by different generations was analyzed improvement (the sum of all 3 grades in 2012 minus the sum of all three grades in 2011) Age Group (age\_gr2) Generation Y, Generation X, Baby Boomers). Higher work intensity for baby boomers, generation Y, and generation X results in weaker test results. As can be seen from statistical analysis, the differences can be

spotted everywhere, although the Generation Y p-value is close to 0.05 (0.049).

Comparison of yearly testing rank in 2012 and 2011 by generations indicates, there is no statistical difference between generations (p=0.081).

Comparison of yearly test rank in 2012 and 2011 by job title of medical personnel we can conclude, that doctor's face weakest proficiency comparing to nurses and even doctors assistants, see Figure 2.

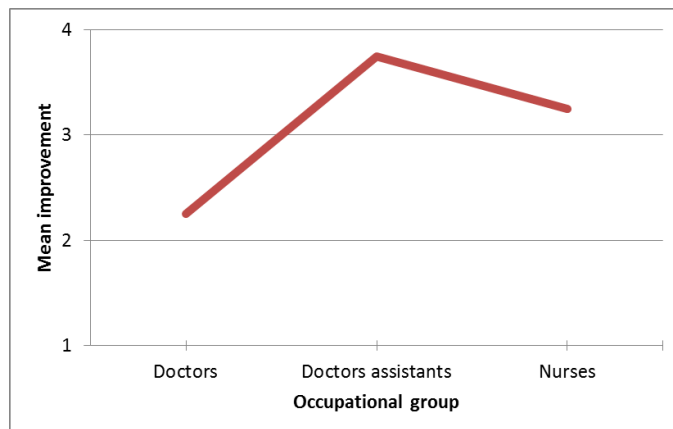


Figure 2. Comparison of yearly test rank in 2012 and 2011 by job title

Doctor's assistants are the leaders in proficiency increase in all generations. Baby Boomer nurses are outstanding in proficiency improvement comparing to other generation nurses.

Due to high P values job title and generation comparison cannot be taken into account for nurses in final conclusions. As less than 2% of EMS personnel are nurses this will not have effect on final conclusions.

#### IV. QUALITY ASSESSMENT OF PERSONNEL TRAINING

To determine the EMS Ambulance view on the factors that would contribute to EMS personnel self-directed long life learning questionnaires were analyzed. In particular, questions as "According to which criteria you make your choice to attend courses" and "How do you suggest to improve the quality of learning?" The survey included of 118 respondents from the Baby Boomers generation [5], 84 respondents from Generation X and 92 staff members from Generation Y. Ellen J.O' Connell stresses "Adulthood has arrived; the real world. Unlike our youthful days when educational subjects were forced upon us, most adults seek to learn because of a motivation to do so. Adults seek experiences that have an identifiable impact on life. However, the motivation for adult learning is not always from within; external forces also affect motivation. Adults sometimes seek education, not because they are excited about the subject, but because they know it is in their best interest" [8]. To find out the motivation of a choice for attending adult courses, the following question was set up: „According to which criteria you make your choice to attend courses?" Respondents could choose several answer options. Overall, 703 answers were received (Figure 3.) As shown, 76% (90) of the respondents considered as the BB generation selected external

motivation - scoring certification, with the need to attain expert knowledge. The majority of answers of respondents from Generation X and Generation Y indicates importance of the professional needs. Second for those of Generation X is the need for certification, while to Generation Y the second option is personal interests.

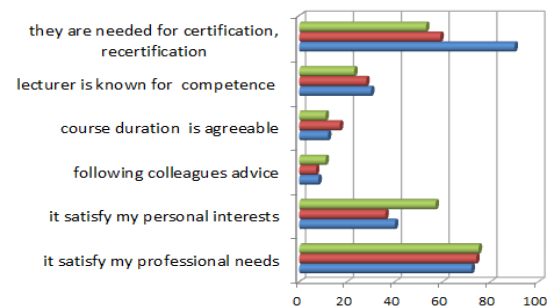


Figure 3. According to which criteria you make your choice to attend courses ?

The answers given by the respondents in those questions a person could individually choose to answer were proportionally similar, but it is interesting that significant differences can be found in their suggestions for choosing the answer "other". Baby boomers said they want more practical exercises, respondents considered Generation X implied that the course groups should be organized according to the level of knowledge and experience. That way new employees and more experienced professionals would not have to train and study together. Respondents that belong to Generation Y mentioned they would appreciate as many new training materials and to-date information as possible. They would also prefer these materials in digital format using video and other modern technologies, see Figure 4. Rogers [8] believes that experience is a crucial factor to the medical staff and its ability to achieve a more precise diagnosis and more effective treatment methods. Baby Boomers are employees with relatively more experience than others, but they are the ones that want more hands-on exercises. This could mean that the more new equipment in patient care is available, the more there is the need for continuous learning and additional practice.

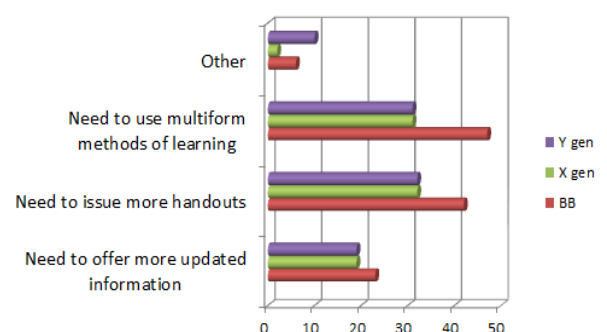


Figure 4. How do you suggest to improve the quality of learning ?

#### V. DISCUSSION

Knowles et al explained that real learning occurs in self-directed and problem-oriented processes for adults, and each

individual has to realize a “need to know” and be intrinsically motivated to learn. [12] To be a life-long learning physician, self-directed learning is the essential factor for effective learning [1]. Jarvis argues that everyday learning in the show is directly related to growth and development [13]. Boomers make up almost a half (48%) of Latvian EMS personnel. As suggests Rothwell “Boomers are generally known to have a demanding work ethic. They have worked hard for they achieved. They expect other people to be a responsible as they are. They have a sense of urgency, seeking to get results with a no-nonsense approach [9].” Coupland characterized people born during this time to be cynics. They lack motivation and are frustrated. They work ethic is not at all like the Boomers, who become upset with the attitude of Gen Xers. Gen Y-sometimes called millennials. They are hardworking people, like the Boomers, and are worried most about jobs, careers, health care, and being able to afford a lifestyle akin to that of the Boomers. They are serious and work oriented. Gen Y makes up about 26 percent of the EMS of Latvia Ambulance personnel. Generational differences must be understood in order to achieve a more successful involvement of adults in the learning process and motivate them to learn. Rothwell suggest, that “it is best to involve them in the process of deciding what learning is needed, how it is designed and developed, how it is delivered, how transfer of training is planned and embedded in the learning experience, and how results are evaluated. Still, are there general ideas or tips that can be obtained by examining the general characteristics of the various generations? Here are some suggestions – which will need to be checked against the individuals within any targeted group of learners – for designing and delivering learning experiences for these generations” [9]. For Baby Boomers it is essential to motivate them to learn, emphasizing their experience and what they have learned and gained from this experience. However, as seen in the study, in this generation it is the medics that do not show any improvement of their knowledge from the proficiency tests. Boomers like to learn from one another other. As noted by Brydges, self-directed learning is important, but there is also a possible threat that the learning process may lack the glossary and understanding that can be gained through the support of an actual teacher being present in the learning process.[14] Generation X is considered to be a generation of cynics, so it is important to achieve their interest in the training process by showcasing that what they are learning can benefit others as well as themselves. The major challenge in the learning process can be the discussions on the need for training at all. Krista Third of Tamm Communications has noted differences between those of X and Y generations. She suggests that Generation X wants to learn continually even after they will leave, but Generation Y still has an exam driven mentality. Generation Y is rapidly becoming a new breed of learners as they become ever more digitally connected. They are “digital natives” that speak “technology” without an accent, having grown up with computing and telecommunications devices as a natural part of their world [15]. Evidence is already mounting that the gap is rapidly widening between the

learning demands of these digital native learners and what they’re actually receiving in the more [16]. Digital natives think and act differently from “digital immigrants” (those born before ICT prevalence, who speak “technology” with an accent, such as printing out emails to read or not being adept at typing with thumbs [17].

## VI. LIMITATIONS AND FUTURE WORK

To identify the differences of the various teaching methods for different generations of Ambulance staff an inspection of annual test results was used. The test results that point out to educational achievements based on self-directed learning were selected for further analysis. However, this learning is mainly determined by the external rather than the internal motivation of adults. In future research of the subject it is recommended to analyze the different opinions of employees on the possible outcomes of specific courses attended. This needs to be done to gain a more complete outlook on the differences in training needs of different generations of Ambulance personnel.

## VII. CONCLUSION

The research results show that in spite of some of the employees dislike on taking any yearly tests the test results are improving in all three stages, thus we can conclude that the skills of the medical personnel improve as well. Given that this test is mandatory to all medical personnel, the preparation for the test cultivates self-directed and self-motivated learning among the personnel. However, the survey results show (Figure 3) that the EMS personnel drive to study is led by an external motivation - the need to obtain the points needed for certification or recertification. Different changes in medicine occur constantly. Methods of treatment and the outlook on different medication is changing constantly and the knowledge needed to perform the tasks given must also be improved continuously, not just once every five years by recertification. Preparation for the upcoming tests is often held in groups with colleagues by going through specific questions and answers on the subject. The theory that self-directed learning is important is approved, but there is also a possible threat that the learning process may lack the glossary and understanding that can be through the support of an actual teacher. For further personnel development in order to motivate the employees to go on with self-motivated lifelong learning, perhaps a new framework that provides satisfaction should replace the motivation forced upon the people to develop their skills and knowledge. Maybe certain credit granted for a specific result in the annual proficiency test. Given the need to maintain the qualifications of personnel, EMS should consider different kinds of training programs for staff of different generations, thus involving inner motivation. Given that ICTs are increasingly entering the EMS, there is a need to develop new programs that encourage the generation of Baby Boomers in the use of ICT, as well as to motivate learning among Generation Y.

## ACKNOWLEDGMENT

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# Foreign Language Curriculum Development: A case study analysis of program goals and objectives

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**Abstract—** Goals and Objectives, are the ‘flexible’, ‘viable’, ‘dynamic’ yet essential components of the curriculum development process for any specific program or course. For the purpose of educational instruction, goals and objectives are likely to be comprised by the instructor taking into consideration the overall needs assessment of the students for a particular course or program. In order to narrow the gap between assumed purpose and actual practical implication of the goals and objectives, the course book *Masterclass Proficiency* was reviewed as it is being used as primary instruction for the course *Contemporary English* at university level. Three questionnaires have been prepared and a set of additional questions which were distributed to participants who were actively enrolled in the course with an aim to express their experiences and opinions in the realm of goals and objectives. This study examines the existing goals and objectives as prescribed by the course and offering possible alternatives for program re-evaluation purposes for future instruction of the course *Contemporary English*.

**Keywords:** curriculum development, language teaching, goals and objectives

## I. INTRODUCTION

The curriculum development process of any course or program is an extensive and demanding procedure. Curriculum development is viewed as a viable entity, a ‘process’ susceptible to alteration as opposed to being a fixed ‘product’ as in [1]. After all, a curriculum should be in essence an ‘amoeba’, able to take different shapes and variants, able to adapt to new working conditions, able to address the needs of new types of students, receptive enough to respond to changes in new language theory or inclined to facilitate the emergence of new political demands and/or constraints within the institution of instruction. The curriculum activities, as in [1], provide a framework which would aid teachers in accomplishing their envisioned teaching activities and in effect, will assist students to learn as efficiently and effectively as possible. Furthermore, it has been argued that such framework can “...help teachers and administrators make choices and implement those choices in a viable and flexible curriculum that will assist teachers in doing what they do best: teaching” [1]. The undertaking of curriculum development is an extensive, multi-layered and time consuming task and should be conducted as a group effort, where teachers are supported by program staff and fellow colleagues.

## II. THE ELEMENTS OF LANGUAGE CURRICULUM

### A. The effective techniques for developing goals and objectives

Six curriculum activities (needs analysis, goals and objectives, language testing, materials development, language teaching, program evaluation/on-going needs assessment, a systematic collection and analysis of information), comprise the notion of curriculum [1].

One of the six curriculum activities which will be the focus of this paper are the *goals and objectives*, which are applied to a particular course/program. The goals and objectives are especially closely tied to the ‘needs analysis/needs assessment’ phase; nevertheless, they are the basis for developing tests, materials, teaching activities, evaluation and re-evaluation. During the process of needs analysis, large amount of both objective and subjective information is obtained which must be sorted and utilized in some way within the curriculum. One approach is to take what has been learned in the needs analysis and use that information in order to formulate the program goals and objectives. Goals, or also stated as tasks, are in fact created from the perceived needs. Goals have been defined as general statements of the program’s purposes [1], as something which a program aims to accomplish, especially from the prism of students’ performance prior to leaving the program, as things which can serve as a framework for creating more precise objectives and the assumption that goals should never be viewed as permanent. Objectives, referred to as ability/skill, are also known as the ‘building blocks’ from which the curriculum is crafted and focus exclusively on ‘end performance’. Instructional objectives are “...specific statements that describe the particular knowledge, behaviors, and/or skills that the learner will be expected to know or perform at the end of the course of program” [1]. They are specific to a particular program as it gives the program clear direction and purpose and are in essence designed to help the instructors. There are three suggested components necessary for the formulation of good objectives on the basis of “...do they communicate” [4], which include *performance* (what a learner is expected to do), *conditions* (under which performance is to occur) and *criteria* (how well the learner must perform in order to be viewed as acceptable). Brown adds two more that of *subject* (the participants) and *measure* (how the desired performance will be observed and or tested).

### B. Transferring goals into objectives

A simplified yet visual representation [1] of the steps involved in the process of transferring goals into objectives could be outlined in the following manner:

*Examine the needs* → *state the needs of the students in terms of realizable goals for the program* → *narrow the scope of the resulting goal statements (by analyzing, classifying, thinking through)* → *state smaller more specific goals as objectives with as much precision as makes sense in the context.*

One can argue that the most apparent difference between goals and objectives is the *level of specificity* among the two.

The creation of both goals and objectives fall in the domain of the instructor and tend to follow the level of flexibility and creativity of the teacher/staff involved in the curriculum development process and the type of syllabus used should not be of hindrance. It is prudent to note that there are contrasting views in the literature concerning the level of importance and appropriateness when taking into consideration language learning being expressed in terms of objectives and the type of syllabus used for such purpose. In the view of critics, objectives should refrain from being linked to structural syllabuses as this type of syllabus is often based on characteristics that objectives do not always possess. Based on the statement "Language learning...is not the sum of myriad parts: it is not by learning 100 grammar rules, 1000 verb forms, and 3000 items of vocabulary, for instance, that one can suddenly read, speak, or understand the language" [8]. Another study argues that the nature of foreign language learning is creative and unpredictable and such characteristics are not in line with the nature of objectives which are seen as inappropriate in such scenario [7]. We on the other hand, agree with the view that 'Objectives do not bite' [1], are valuable aspects to address and are most effective when used in a variety of different types with certain flexibility for divergence. As such, the motivation behind this paper is centered around the view that goals and objectives should be an integral part of a particular course/program. The study presented here, explores this area and observes if goals and objectives are clearly identified, stated and applied for the purpose of the course, through the prism of students' input in relation to their attitudes and behavior.

### III. OVERVIEW OF THE COURSE

The *Contemporary English* Course (SAJ401) first semester, 4 credits/ SAJ411 second semester, 4 credits) is a compulsory 8-credit course for students in the final year of studies at the Faculty of Foreign Languages at FON University. The course is offered in the first and second semester of an academic year. The students are all in their final year of studies at the Faculty of Foreign Languages, enrolled in the 'teaching stream'. As a main source of learning, the course utilizes the textbook *Masterclass Proficiency*, which is the official preparatory book for the Cambridge ESOL Exam - Certificate of Proficiency in English (CPE) examination. The level of examination is Level 5 in the ALTE Framework, corresponding to *Mastery C2* in the Council of Europe Framework. The syllabus – way of organizing a course and materials, in the case of the *Masterclass Proficiency* course-book is mixed/layered in nature. It is topical as it is organized in twelve units and

themes, which the author feels are of importance to the lives of the students for whom the text is designed. It is also functional and skill-based as it organizes materials around the language or academic skills (the different modules) one believes students will most need in order to use and continue to learn the language.

For the purpose of this study, a short overview of the goals and objectives for the two modules ('speaking' and 'writing'), is provided. In the beginning of the semester, in the introductory session, the structure and expectations of the course were presented, and also elaborated on the perceived goals and objectives for the writing and speaking modules.

## IV. RESEARCH METHODOLOGY

### A. Research design

The data were collected from students enrolled in a required English Course, SAJ401 / SAJ411 Contemporary English, a course of 8 credits, in the duration of two semesters, at the FON University in Skopje, Macedonia. It is prudent to note that the study was conducted during the first semester of the 2012/2013 academic year, through class sampling with students enrolled in the class. One dependent variable was used in the study. The dependent variable was tested through the students' knowledge, suggestions and attitudes towards the 'goals and objectives' for the course *Contemporary English* and their overall views of the course and instruction.

The *Contemporary English* course is in essence taught by a resident professor however, a 'native speaker' of the English language was asked to cover two sections, the writing and speaking modules. The conditions under which these two particular sections ('speaking' and 'writing') were selected were by no means random in nature and were in coordination with the main instructor of the course. It was agreed that it would be most practical if each instructor conceptualizes their lesson plans and classes (in accordance to the material/course-book) individually but maintains the same pace of the course. As such each instructor was responsible to fabricate and execute the goals and instructional objectives for their modules yet taking into consideration the overall, overarching goals and objectives for the course *Contemporary English*. It is important to note that it was agreed that objectives should coincide with the needs of the students and that the two instructors could monitor such progression through means of testing and evaluation

### B. Participants

The study employed one group of six students. The data were collected from three questionnaires and a set of discussion questions completed by the students. All participants were female. The participants were all 21-22 years of age, having continual experience of 13-16 years of English language study and learning additional languages such as Albanian, Greek, Italian, Spanish, French and German. The students took the compulsory 8-credit course SAJ401/ SAJ411, *Contemporary English* in the first semester of the academic year 2012/2013. The students are all in their fourth and final year of studies at

the Faculty of Foreign Languages, enrolled in the 'teaching stream'.

### C. Measures

Two instruments were used in this study. The first was an open discussion/interview with four questions, which lasted half-an-hour. The purpose of it was to explore in more detail, through discussion the level of clarity and usefulness of the goals and objectives for the course *Contemporary English* and what the goals and objectives should be for future instruction.

The second instrument included a new, three-part questionnaire which was specifically developed for the purpose of this study and contained a total of 30 questions among the three parts. The first part of the questionnaire – *General Knowledge* was general in nature as the main purpose was to see the level of knowledge and awareness students have in regards to 'goals and objectives'. The second part of the questionnaire – *Course Material* was specific in nature as its intension was to see the students' knowledge of the goals and objectives outlined in the course *Contemporary English* as presented in the main course-book *Masterclass Proficiency*. The third part of the questionnaire – *Student Perspective and Satisfaction Level* focused around students' perceptions and level of satisfaction in relation to the overall course, instruction, and again goals and objectives were addressed. The first seven questions in the third questionnaire were taken from a summary report on the Online Course Questionnaire [6].

A questionnaire was selected as an instrument as it allows for data to be collected on a large scale. The questionnaires had traces of addressing different aspects such as those found in opinion surveys and judgmental ratings. Nevertheless, the main approach was a *Q sort* questionnaire which combines several of the procedures defined above where it asks individuals to provide their own attitudes, views and opinions, by completing questions which need to be ranked in terms of importance. The reliability, validity and usability of the questionnaire will be discussed in the 'Discussion' and 'Concluding Remarks' sections (see below). In the initial stages of preparing the questionnaires other sources were consulted. A sample questionnaire was consulted for its format and example of questions taken from McGill University, and two samples of studies were also analyzed: one was a sample of a study from Indiana University and the other one was from James Madison University. They were consulted from the prism of format and style of writing. Details on the authors and titles of the studies are listed in the references section at the end of the paper.

### D. Procedure

This section outlines the data-collection procedures. Initially, the participants were verbally informed of the undertaking study. Next, the students were requested for their participation by sending them a detailed e-mail message outlining the title of the study, the purpose of it, the nature of the three questionnaires, the additional open-discussion section, the time it would take them to complete the three questionnaires (maximum 45 minutes, depending on the level of involvement and elaboration) and the fact that there is an

incentive for their participation. The potential participants were also told that participation is optional; however, it was emphasized that their contribution is of great importance for this study in order for the data to be applicable and made reference that their input may have direct impact on possible future, re-evaluation of the course. It was also stated that it would be greatly appreciated and desirable if there is as large of a number of participants as possible.

## V. RESULTS AND DISCUSSION

### A. Results

The questionnaires used were with the purpose to test the participants' attitudes and behavior in regards to their general knowledge of goals and objectives, the goals and objectives for the specific course of *Contemporary English* and their experiences with the course in the first semester of studies as well as their input for future re-evaluation purposes.

The number of participants is limited (six in total), however the data collected is extensive as many aspects were taken into consideration when administering the different questionnaires. The results will be reported in a narrative manner as most of them outline a level of satisfaction, their attitudes and behavior as well as their suggestions. At few instances, statistical calculations will be presented in order to add a quantitative and visual dimension to the numbers obtained in the research.

In relation to the main aim of the research (to observe if goals and objectives are clearly identified, stated and applied for the purpose of the course, through the prism of students' input in relation to their attitudes and behavior), it can be stated that the results outline a rather positive outlook in regards to students' perceptions in the manner in which goals and objectives are identified and used for the purpose of the course.

### B. Discussion

The first aspect which will be discussed are the results from the first questionnaire - *General knowledge of goals and objectives*, which participants were asked to complete first, and without any aid from additional sources (dictionaries, internet articles, books, etc). They were instructed not to consult outside sources but to rely only on their innate, acquired, knowledge, experience and competence in the subject matter. In general, all participants were able to define what a goal and objective is (where goal was described as the 'starting point' and the objective as the 'end result'), and were able to provide examples for each. Participants experienced slightly more difficulty when providing an example of an objective however, were aware that it is more specific in nature. An interesting aspect was where one participant had awareness of the fact that in order to see if a goal is attained, testing proves to be the means ("...the level at which the students should **approximately** be after attending and finishing a course, including **taking a test** as to establish whether the goal is reached.") It should be noted that there is a quantity determiner, that of **approximately** which is not characteristic of goals outlined for a program, where the language used is "By the end of the course, the students **will be able to**..." which in turn, is quite definite in nature. Participants were able to clearly differentiate between what a goal and objective is by demonstrating knowledge that goals are more general in nature

and that they are susceptible to change. One participant explained the difference by stating that *"The main difference between goals and objectives is that goals are the final desired result, while objectives are the smaller tasks which have to be accomplished in order to achieve a goal. The objectives are the steps that lead to the ultimate goal."* All participants when asked whether it is important to have clearly outlined goals and objectives for a course provided answers in the affirmative. All participants also demonstrated knowledge that goals and objectives are not universal, but are specific for a particular program/course and cannot be applied to all programs equally. When asked who should be responsible for devising the goals and objectives of a course, the answers among the participants were divided. Answers included that the forward of a book used for a course should outline the goals and objectives and that the institution or individual which/who has introduced the course (such as the Ministry of Education, the Principal of a school, Dean of university, but not the teacher of the course) is responsible for the goals and objectives. Half of the participants answered that it is in fact the instructor of the course who is responsible for comprising the goals and objectives of a course, with one answer being quite extensive and multi-dimensional *"the goals and objectives of a course/program should primarily be devised by the instructor... should consult different student's books to see what they suggest students should work on...could also consult students to see what they believe is important and would like to work on."* When asked if the goals and objectives are part of the curriculum development process of a course, all participants answered in the affirmative. In regards to the question what goals and objectives are based on, all participants answered that they are mainly based on the needs of the students and purpose of studying the subject. A participant answered that they are based on ambition and the need of improvement and another stated that goals and objectives should always be manageable and suitable. Participants struggled when they were posed a question whether goals and objectives are permanent or flexible in nature, and the answers provided varied. One participant differentiated between the needs of a class or that of an individual (flexible), and that of the overall goal of a course (permanent). One participant answered that goals are permanent and objectives are flexible and another participant wrote that the notion of a goal and objective is permanent, but their content is quite flexible. The rest of the participants answered that they are flexible. Participants were also asked to identify if there are any benefits arising from the process of specifying goals and objectives for a course. Their answers were all in the affirmative.

When posed the question whether they feel there are any 'pitfalls' which may arise in specifying goals and objectives, the participants provided various answers. One participant answered that *"...everything can and must be constantly worked upon and be on track with all changes and new needs that might arise."* Others demonstrated that opposing beliefs might be an issue, or that students might be overwhelmed and probably 'scared' of everything that they will need to achieve. In this first questionnaire – *General knowledge of goals and objectives*, it was a pleasant surprise to see that the students' knowledge level of goals and objectives is at a high threshold

and they tend to demonstrate sound acceptance of the importance of having clearly defined goals and objectives for a course, particularly, showing understanding that the benefits are far greater than the effort or the pitfalls which may arise from formulating defined goals and objectives. It was also good to see that all participants viewed the process of comprising and having goals and objectives as a valuable aspect rather than a 'nuisance'.

The second questionnaire – *Course material*, focused primarily on the particular goals and objectives as prescribed in the course-book *Masterclass Proficiency*, the required material for the course *Contemporary English*. All participants wrote that the goals and objectives for the course were 'clearly' or 'very clearly' defined. When asked what the participants expected to learn from the course, the focus was placed on acquisition of new lexis. Accent was placed on learning new vocabulary, using that vocabulary in suitable situations, having exposure to a native speaker especially for the purpose of broadening the colloquial language (such as idioms, collocations, expressions), as well as the academic language used for speaking and writing, and improving communication skills. In one of the questions, participants were asked to rank the goals (of little benefit, somewhat beneficial, extremely beneficial) which the course *Contemporary English* aims to accomplish in order to expand the knowledge and satisfy the expectations of the students. It was expected to see a lower percentage in regards to the level of 'importance' being placed on the grammar / 'language in use' as well as the 'writing' modules. However, the opposite was true. The majority of the participants (83%) felt that exposure and practice in the 'language in use' as well as 'writing' modules, are extremely beneficial goals for the course. On the contrary, the 'reading' module received the lowest rank (50%) where the participants felt that it is of little benefit as a goal for the course. From experience, students usually tend to avoid 'grammar' and 'writing'; however, in this case it proved that they see these modules as highly important. It is perhaps the case since 'grammar' is the foundation of any language and the level of competence is usually measured through the prism of one's knowledge with grammatical functions. The 'writing' module also demonstrates a higher level of literacy and is an important facet especially when applying for international scholarships and study/exchange programs in English speaking countries. Furthermore, participants were asked to rank the objectives (of little benefit, somewhat beneficial, extremely beneficial) which the course *Contemporary English* aims to accomplish in order to expand the knowledge and satisfy the expectations of the students. It is prudent to note that when the objectives were presented (in more detail and depth than the goals), the participants ranked them differently except for one. The 'writing' module remained constant, where 83% of the participants felt that it is an 'extremely beneficial' objective for the course. This time, 'language in use' did not rank as an 'extremely beneficial' objective but instead, the 'speaking module' (83%) took its place. The objective which scored the lowest ranking as being 'of little benefit' was not the 'reading' but was instead, the 'listening' module. Students might feel that when a module is broken down into segments and asked to rank it, have a better visual idea of the finest 'ingredients' which comprise that particular module. Participants were also

asked to voice their opinion in regards to which module, if any (*reading, language in use, listening, speaking, and writing*) they find to be most applicable and useful outside of the classroom. There is a consistency, since majority of the students felt that the productive language skills (writing and speaking) are 'most applicable' and useful outside of the classroom. Two participants expressed that all skills are of equal importance. In addition, participants were asked to voice their opinion in regards to which module, if any (*reading, language in use, listening, speaking, and writing*) they find to be least applicable and useful outside of the classroom. Majority of the participants answered that the 'reading' module is 'least applicable' and useful outside of the classroom because the way people use their reading skills is different than the objectives and exercises prescribed in the course materials. Two participants expressed that all skills are of equal importance. The participants were also asked to express their opinion whether the tests used for examination purposes of the content taught in class reflected appropriately the goals and objectives outlined by the *Proficiency Masterclass* course-book. All participants expressed that the tests clearly reflected the goals and objectives and all participants were satisfied with the goals and objectives prescribed for the course *Contemporary English*.

In the third questionnaire - *Student perspective and satisfaction level*, participants were asked to comment and express their opinion on questions regarding the overall course encompassing the materials used and the means of instruction. When asked from a diagnostic perspective how useful was the instructor feedback (i.e. written comments, grades, verbal communication, etc) in helping students understand what they were doing well and where they needed to improve, all participants except one answered that it was 'very important'. When asked how much (not at all, somewhat, quite a bit, very much) was the course challenging students to do their best work, majority of the participants answered that it challenged them 'very much' but at the same time found it very useful and motivating since it was for their own benefit. Participants were also asked to share any other thoughts or comments they might have regarding the course, the instructors, the evaluation procedure or any other aspects. This is certainly one aspect which could be susceptible to re-evaluation and possible alteration for future instruction of the course. In general, when students were asked to express what they liked the most about the course, almost all of them mentioned the element of outside/additional teaching materials which were not part of the course-book but were introduced ad-hoc by the instructors. The thing which they found enticing is the fact that through the authentic materials, students were able to acquire new vocabulary as well as ideas and had the opportunity to use the new lexis in discussions on various topics. When asked what they liked least about the course, there was no unilateral consensus instead opinions were divided among all different modules covered in the course. There are certainly limitations to these questions as they are very subjective in nature and heavily rely on personal opinion. Nevertheless, in the first instance, being asked what they liked the most, there was a consensus in the answer, whereas in the second instance, opinion was heavily divided. Finally, students were asked to list any suggestions they might have for improving the course.

Some of the more predominant answers included suggestions of having one major speaking/writing assignment at the end of the semester instead of having many smaller ones on weekly basis. Another remark was focused around the topics prescribed for the 'speaking module'. Some participants felt that the topics were uninteresting and 'distant' hence students' level of enthusiasm and engagement was at times low. A possible solution which may be offered in such case would be to introduce the students in advance with the topic which would be covered in the next class (i.e. solar energy, recycling) so that they may prepare in advance by researching the topic and preparing for a general discussion on the subject matter.

The open-discussion/interview section - *Additional questions*, was envisaged for students to take part in a general discussion. However, it could not be conducted with all participants, and as a result, only two participants were actively engaged in a discussion, which lasted for half an hour. When the participants were asked how useful (not very important, important, very important) would it be to see the goals and objectives in written form/print-out at the beginning of the semester, both participants answered that it would be 'important' but not crucial. It is good to see that no one felt it was 'unimportant' but it was desirable to see some state that it is 'very important' as it provides both the students and instructors with clear direction for instruction and expectations for the course. Participants were asked to express what according to them should be the goals and objectives for the 'writing' and 'speaking' modules of the course. For the 'writing' module they expressed notions such as:

- being able to construct arguments
- discussing different topics
- gaining experience and having higher knowledge of discourse
- expressing thoughts cohesively
- being able to write different forms of academic style
- mastering the art of time management when writing a piece of work

For the 'speaking' module, participants expressed that they should be able to do the following:

- using appropriate language and vocabulary for a given topic
- conversing without grammatical errors
- engaging in debates
- elaborating and expressing their opinion on a given topic
- improving their pronunciation
- developing critical thinking and dealing with difference of opinion in a professional manner

Participants were presented, as in [4], components necessary for the formulation of objectives, as in [1] along with additional two components (*subject and measure*) and were

asked to comment if there is a missing component they wish to add. All participants answered that the components were appropriate and satisfactory and that there was no need to add any new ones. We suggest that a subcomponent should be added to the list, that of 'time-frame'. Goals and objectives are expected to be completed within a particular time-frame depending on the nature and expectations of each. Even though one may argue that such notion is envisioned in the broader 'performance' domain, and an emphasis should be placed on the time dimension more vividly.

## V. CONCLUDING REMARKS

The research conducted on the goals and objectives for the course *Contemporary English* as defined by the course-book *Masterclass Proficiency* and through the prism of students' as well as the instructor's input, has allowed to summarize few key points which may be used for future consideration in the course evaluation process. It is indisputable that all modules discussed are of significance to developing sound English metalinguistic skills. However, students' perspectives, knowledge, background experience, competence and interest level, to name a few, should be taken into not only consideration but detailed analysis as they are an affective filter for study. It is advisable for an evaluation to be done at the beginning of the course, partly with students' course expectation opinions as well as some language testing procedures. Since the main aim of the course is not to prepare students for the ESOL Proficiency Examination, (which needs to follow strict standards of instruction, outlined in specific guidelines for each module), the instructor may utilize flexibility in the manner in which the material is presented. The instructor can make a decision based on the students' needs where and how much emphasis should be placed on each module. From the analysis gathered on the goals and objectives prescribed in the course, students' opinions are unified on the matter of which goals and objectives are more fundamental in relation to the different modules. In addition, it is prudent to have the goals and objectives clearly stated at the beginning of the semester along with the testing procedures and the manner in which they will accompany the goals and objectives for the course.

This research paper has its limitations which should be taken into consideration. This study has a limited number of students. A broader picture could be painted with greater level of credibility in the 'results section' if a larger number of

participants were involved in the process. Even though, it was successfully managed to gather highly valuable and dense sample of information from the six participants, it would have been beneficial to have much more participants from the other campuses (located in three different cities) who were enrolled in the same course.

Another aspect which should be addressed in future research should be the gender discrepancy. One may consider the approach taken as being biased towards the sample; as such, it is highly recommended to have female/male gender representation as it may yield opinions and suggestions fostering different perspectives on the topic of goals and objectives for the course. Yet another aspect is that of ethnic background and representation. Nevertheless, an attempt was made to cover different aspects and perspectives when analyzing the situation of the 'goals and objectives' for the course and most of the questions were thorough and required adequate input. As such, in general terms, we would argue that the reliability, validity and usability of the questionnaires are sound and could be replicated with ease for future research study endeavors.

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# Traditions and innovations in Latvian Design education

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**Abstract-**Competitiveness of every country depends on the ability of its educational system to train people for professional activities in changeable environment lifelong by promoting an individual's skills of lifelong learning and its culture, by forecasting and offering such study content and format that would promote the competitiveness of individuals and organizations. These tasks have to be considered in Design education as well. Nowadays design has become an important factor not only to raise the competitiveness of individuals and organizations for the future economy, but also the strategy to ensure the competitiveness and development of regions and countries. The content of design education programmes, meeting the long-term needs of the society, innovative study methods and creative thinking are necessary not only in the work with future designers, but also in the professional development of design pedagogues. The results of the research shows that the postgraduates of the pedagogical study programme for vocational secondary Art and Design Schools teachers offered by Art Academy of Latvia, apply the methods acquired both in their work with students and in establishing professional contacts and partnership. Thus they are not only conveying knowledge, but also improving the appreciation of the society about design as the factor of well-being and sustainability.

**Keywords:** design, education, lifelong learning, innovations, creativity, society, development

## I. INTRODUCTION

The principles of human capital in the program *Sustainable Development Strategy of Latvia 2030* are defined as Latvia's most important resources, and innovation is the primary impulse for not only culture and science, but for every sphere of social and economic life (Saeima of the Republic of Latvia, 2010). However, "the quality, accessibility and content of all levels of education and for all age groups can predetermine Latvian growth and human capital development" (Saeima of Republic of Latvia, 2010). An important factor in this process is state support because "creative economics can develop only in close synergy with state support for a creative environment – cultural education, infrastructure and the creative process (Demakova; Lielpeters; Millersone; Rozite; Cire, 2008). Lifelong learning and education quality in all levels of education are important questions that need to be addressed in Latvian design education.

The Latvian Cultural and Creative Industry Education Centre (KRIIC) project *Professional cultural education teacher continuing education* initiated a study program *Design Teacher* from 2009 to 2011 with the support of the European Structural

Fund (85%) and state funds (15%) (KRIIC, 2012). The program offered professional branch specialists and professional secondary school art and design teachers continuing education opportunities. It has received general public interest as a new addition to the development of art and design teacher professional development.

The purpose of this research project was to determine whether the content and educational quality of the program *Design Teacher* adhered to the competencies required to work in the design field and design pedagogy, with the pedagogical assumption that the most important and long-lasting factor could be knowledge transfer to and exchange of knowledge within a network of graduates, teachers in other schools, pupils and society as follows: teacher – teacher; teacher – pupil; teacher – society; pupils – society; graduate – society.

Today, the field of design is connected to elements in other branches of economics. As a result, creativity, empathy, knowledge sharing and experience are essential in the education process for future designers and design teachers, as well as in designer interaction with colleagues and others branch specialists. Education and informing the general public about the ways in which design can improve the quality of life can be considered the mission of the designer and design teacher. An informed public creates a demand for design – not just unique creations, but also for easily accessible information, positive experiences and functional services.

Brednikovs (Brednikovs, 2011) stresses that inclusive knowledge in society will serve to expand the concept of knowledge transfer, and this transfer of knowledge will be understood, not only as an economic transfer, but also to civil society. "Just as the concept of an inclusive knowledge society stresses that creation of necessary knowledge requires the participation of all strata and groups, new concepts of knowledge transfer anticipate collaboration between researchers and wider societal groups" (Brednikovs, 2011).

Siemens (2006) accents that people create knowledge differently – through senses, observation and experience, thinking and logic, authority and connections (our personal learning network). "We own who we are by the contributions we make" (Siemens, 2006). "In creating knowledge, we experience life, identity, hope. To contribute to the public space, to be recognized, to be a part of something bigger—these motivations drive us." (Siemens, 2006).

## II. RESEARCH METHODOLOGY

In order to determine the role of design in economic knowledge and innovation and developments in design that determine necessary skills, I analyzed theoretical and practical literature in the first part of the study and determined the following analysis criteria:

1. The nature of design
2. Current design trends
3. The future of design development

In order to determine whether the KRIIC project *Professional cultural education teacher continuing education* actually corresponds to current trends in design, the second part of the research project addresses the following:

1. The current situation in education design in Latvia, analysis of design school traditions;
2. Analysis of content, participant results and education outcomes for the program *Professional education in the design of basic teacher education*.
3. In order to ascertain how the graduates of the program *Design Teacher* use their acquired knowledge, the third part of the study consists of design and art school teacher surveys and interviews. The sample consists of professional education teachers from Latvia's largest cities and regions, who are between the ages of 27 and 69.

The research took place in four segments:

1. Content analysis was used to analyze available information in Internet sites and social network sites and telephone interview with program coordinators Ilze Kupče from the Latvian Culture and Creative Industry Education Centre and Aija Freimane from the Latvian Academy of Art. Data were analyzed using the triangulation method.
2. Survey of graduates, teachers and administrators from 22 programs. The survey included ten questions, both structured and unstructured, about teacher professional development and knowledge transfer systems, as noted in Table 1. During the analysis process, 14 respondents were chosen for the third segment and nine respondents for the fourth segment of the research.
3. Semi-structured surveys with 14 respondents determined how the respondents utilized their acquired competencies, as well as their opinion on the transfer of knowledge system described in Table 1.
4. Unstructured interviews with 9 respondents determined how the respondents utilized their acquired competencies, as well as their opinion on the transfer of knowledge system described in Table 1.

Teachers who worked in both art and design schools and professionals in various fields and with differing information and education were surveyed in order to ascertain both common and individual opinions.

Quantitative data was analyzed using frequency analysis; qualitative data analysis included coding and analytical induction methods.

TABLE I. SURVEY AND INTERVIEW TERMINOLOGY AND METHODS

Teacher		Student	
<i>Content</i>	<i>Terms</i>	<i>Content</i>	<i>Terms</i>
Professional development	knowledge; skills; competencies	knowledge; skills; competencies	Learning outcomes
Knowledge Transfer	<i>Terms</i>	<i>Content</i>	<i>Terms</i>
teacher – pupil teacher – teacher teacher – society	competencies, methodology knowledge, skills, Knowledge-sharing	pupil – society graduate - society	Knowledge-sharing

## Results

### Design and design education

In order to define the nature of work in the design field, I have analyzed literature about design theory and documents regarding the design field.

Modern design as a link in the value chain is connected in large part to challenges that can only be solved innovatively through multidisciplinary teamwork.

European design schools have identified entrepreneurship and management skills as those most required in the future (European Design Leadership Board, 2012). Management is an integral factor in making projects viable. "The ability to ensure that the project is tested, delivered to the public or launched on the market is now crucial. Thus, design institutions become innovation centres, bringing together the scientific expertise, researchers, companies and institutions working on development and progress. They become mediators of a "research – training – business" (Guellerin; Salmi, 2012).

Natural resources are coming to an end and quickly; climate change and polarisation in all levels of life are factors that clearly show the incompatibility of consumerism with sustainable development. Good design is environmentally friendly design.

In addition, the document created by the European Design Leadership Board *Design for Growth and Prosperity* stressed: "Further effort is needed to ensure a more widespread uptake of design as a strategic, cross-disciplinary tool for business, where design's strategic role in business is emphasised and where a cross-disciplinary approach to design, business, and technology is encouraged" (European Design Leadership Board, 2012).

Design is a creative process, and despite restrictions and conditions, visual expressiveness and emotional effectiveness of the end product play an important role. The basis of professional design activity is not only overall knowledge and skills, but also developed creativity in both the planning process and cooperation. At the beginning of the 21<sup>st</sup> century, the American researcher Florida (Florida, 2003, 2006) wrote about a new "creative class" and future economic forces:

technologies, talent and tolerance. Florida stressed that it is precisely creativity that is a resource for the development of all other branches and the nation itself; it has overtaken the importance of natural resources and physical capital as the primary force for economic growth (Florida, 2006, 2012). The creative class are not only representatives of the creative professions, but also researchers, engineers, all levels of management and others, who are involved in the development of economic growth and societal well-being, not with monetary investments, but with ideas (Florida, 2006, 2012; Friedenberg, 2004; Lutz, 2012; Hoyman, Faricy, 2008).

Key factors that determined the importance for inclusion of creative thinking in all levels of education programs are the approach to collaborative partnerships in problem solving and creativity.

#### *Conclusions:*

1. Modern designers and design teacher must be able to integrate various competencies in their work: technological competence, personnel and risk management skills, strategic thinking, creativity, communication skills and the ability to cooperate with other specialists, branches and organizations, as well as openness to international and intercultural cooperation.
2. Entrepreneurship and management skills are considered to be a necessity for work in the design field and for successful cooperation in the future.
3. The needs of society are varied and changeable, and require long-term design programs that reflect the current needs of the field, but are able to adapt to changes in the future. Longevity is important, regardless of the type of service, including development and implementation of educational programs. Therefore, when planning adaptations in design education, the unique feature of each nation and its culture must be taken into account (LR Saeima, 2010) as part of design tradition.

In order to determine the needs for improvement in design education in Latvia, I have analyzed several design education situations and schools.

#### *Art and design education in Latvia*

*The education continuum.* Latvia has 96 art-orientated schools for children (Latvian National Centre for Culture, 2013) throughout the country. Some of the graduates of these schools continue their art education in a professional art education program, or enroll in art-focused higher education after graduation from secondary school. Those students, who wish to learn a different profession have developed their creativity skills, individuality and critical thinking, which are basic requirements in any specialty.

Design education is offered by 12 state secondary schools, 12 private professional secondary schools and 11 institutes of higher education (Augstākās izglītības kvalitātes novērtēšanas centrs, 2013) in Riga and other regions of Latvia. An important factor in guaranteeing the quality of education in any design program is the education continuum: pupil readiness, design as a process and understanding the specifics of the chosen field.

As a result, pupils who attend art schools are potential clients for professional secondary and higher education.

*Art as the foundation of design.* Design education programs globally and in Latvia are initially created in art schools, resulting in the continued perception that design is a branch of art, as verified by European and Latvian education classifications (UNESCO, 2013; LR Ministru kabinets, 2008) and curriculum content.

As elsewhere, elements of art considered developmentally important for creativity, imagination and critical thinking are basic to design education in Latvia.

*Teaching methods.* An individual, child-centred approach is central in both art and professional design programs. These traditions are continued today by design education teachers who, for the most part, are graduates of the Latvian Academy of the Arts or graduates of professional secondary schools. This approach guarantees the development of each student's individual abilities.

*Inclusivity.* Although design education is based on acquisition of specific professional skills, Latvian education traditions embrace inclusivity. However, this approach deals with the whole person and general skills that are required for work in other fields.

#### *Conclusions:*

1. Creativity is valued highly in Latvian society, as indicated by the number of professional education programs and the number of design programs in professional education, including professional secondary and higher education.
2. Latvia has strong art and artisan traditions that are the foundation for design schools. Education programs are inclusive, but the connection between design and various branches of the economy create the need for incorporation of subjects that are required for future designers and design teachers, as well for cooperation and networking development.
3. More focus should be placed on student group work, idea exchange and discussion as part of the education in Latvian art and design education.

#### *Continuing education program Design Teacher*

In an interview with Ilze Kupča, KRIIC project coordinator *Professional culture education teacher continuing education*, she stressed that in accordance with results of surveys completed before the onset of the project, a clear sense of necessity for modern professional development emerged that would give both teachers and graduates the opportunity to successfully adapt to today's changing society, environment and job market. KRIIC organized public discussion about continuing education planning, including design development in Latvia, with representatives from the Economics Ministry, professional associations and branch professionals.

The goal of this program is to raise the level of competence among professional secondary design education teachers and school administration (KRIIC, 2012). In order to achieve this, the following tasks have been set out: improve the level of

pedagogical competence and use of teaching methods, increase knowledge of various types of communication, improve planning of the educational process and various associated legal aspects, as well as increase teacher knowledge about incorporation of the entire design process into the learning process (KRIIC, 2012). The Academy of Art administered programs of 328 hours to 100 teachers of professional courses and professional secondary school teachers. An important part of the program modules in design research, the latest creative thinking methods, as well as business, economics, marketing and design management basics (LMA, Dizaina nodaļa, 2010). Thus, the program fulfills the needs of modern design trends. LMA project coordinator Freimane stated: "When developing course content, context analysis was taken into consideration, as well as conclusions reached in cooperation with teachers from other nations and through long-term observations. "

The learning process included 36 teachers from Latvia – Latvian Academy of Art, University of Latvia and Higher Institute of Banking – and abroad – Great Britain, the Netherlands, Sweden, Ireland, Belgium and India (LMA, 2010).

Analysis of available information on the Internet and social networks indicates that both those who teach the programs and graduates of the program are pleased with the results. "The chancellor of the Latvian Academy of Arts, prof. Aleksejs Naumovs stresses that this project has been a great challenge for the Academy and believes that Latvia has achieved European-level social innovation in design" (Kalve, 2011). The availability of access to free education is accentuated by Academy vice-chancellor A. Teikmanis (Kusina, 2011) in that the program has become very popular because teachers were no required to pay.

Project coordinators Kupča (KRIIC) and Freimane (LMA), shared their observations stressing that teachers have indicated satisfaction with the learning process (KRIIC, 2011) that was reviewed and assessed. Graduates of the program also highlighted individual achievements, but are unified in the belief that professional development was qualitative. (KRIIC, 2011).

Although all parties involved in the project are satisfied with the results, I believe that certain aspects should be emphasized, one year after the completion of the project:

1. Program content and associated instructor teaching methods are appropriate for the target group's needs;
2. Research and analysis of how knowledge and skills acquired by the teachers are used in their professional work and teaching – transfer of knowledge and sharing – results that best characterize teaching quality.

*Knowledge transfer results: teacher – teacher; teacher – pupil*

In the first part of my research I recorded the attitudes of teachers and administrators regarding knowledge gained in the teaching and learning process, as well as ways in which these could be used by teachers in their work. I analyzed participant responses to surveys and categorized questions and answers

based on the most significant factors for professional development.

The greatest amount of new knowledge, conclusions and competencies in creative branches was acquired in the subject *Creative Thinking* as noted in Figure 1. This indicates the necessity for acquisition of creative thinking techniques in all levels of art and design program content.

Respondents noted that as they acquired new subjects, they gained knowledge and competencies in design strategy, communication and cooperation, creative thinking and understanding the creative process. Of the respondents, 83.3% reported observing new teaching methods to use in teaching and supplementing presentation skills, 67% mentioned communication skills, 56% group work skills, 44% supplemented layout design skills, and 22% noted improvement in computer skills in Maya, Autocad and Adobe Indesign.

Respondents noted the following methodological developments:

- creation of education blogs;
- pupil study group development and collaborative practice;
- new methods in means to encourage creative thinking;
- new idea process organization and result analysis development;
- analysis, evaluation and supplementation of achieved results.

All the respondents noted that they use their skills when working with pupils.

Respondents noted the following new elements in developing teaching content:

- accenting longevity principles
- incorporation of creative thinking skills
- deeper research into possible new product development, necessity, costs, idea presentation and product consumer research
- teaching process organization outside the classroom

Teachers stressed new elements in creation of final diploma works:

- interviews and surveys in order to ascertain new product design and use and research into analogous products;
- idea trends and topicality
- diploma student blog creation
- practical application in real life

Other responses:

- every subject contained information that I can use in my work;
- basics of design visualization;
- perspective of society.

Respondent replies indicated that the skills they acquired could be used by teachers in both pedagogical work and creative endeavors as indicated in Figure 2.

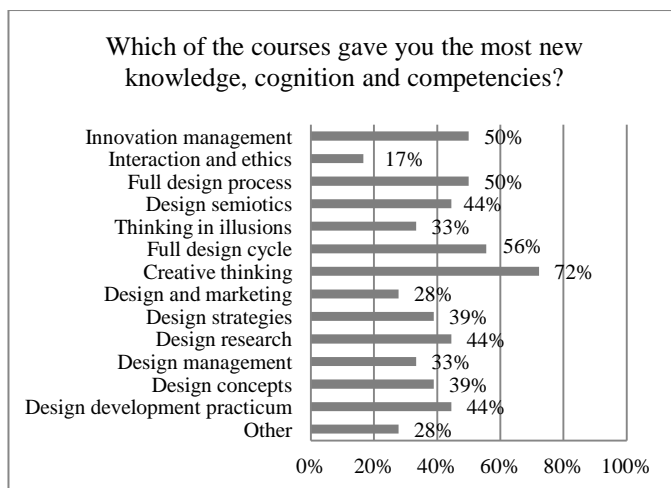


Figure 1. Teaching subject acquisition evaluation

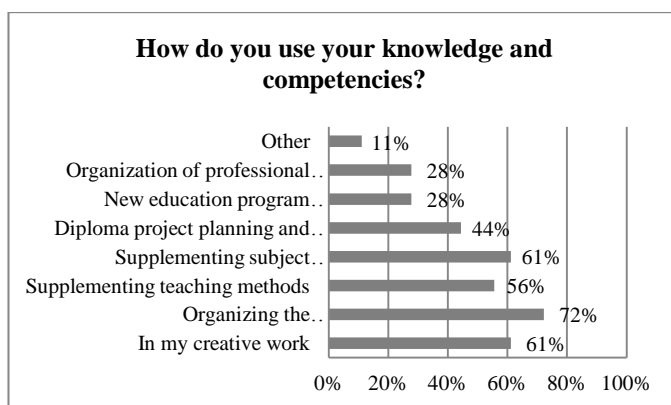


Figure 2. Uses of acquired competencies

#### *Knowledge transfer results teacher-teacher; teacher-society*

The third part of my research analyzed whether teachers used acquired competencies to facilitate cooperation and transfer knowledge. Most of the respondents noted that acquired competencies were used to facilitate cooperation (43%), develop professional contacts (29%) and develop projects in order to receive financing (14 %). Answers indicate that the most successful cooperation was created with other schools and their teachers (50%), as well as other specialists from other branches (36%), municipalities (14%) and organizations (14%). Only administrators from Riga Design and Art Secondary School indicated that cooperation took place with businesses.

The following forms of cooperation were noted: joint participation in projects (57%), joint activities (29%), professional practicums (21%) and involvement in financial resource acquisition (7%).

Respondents noted analogous program organization in other schools (29%) and knowledge sharing with colleagues (7%), as well sharing of experience and personal contacts as indications of knowledge transfer skills.

#### *Knowledge transfer and sharing knowledge system teacher-pupil; pupil-society; graduate-society results and predictions*

The fourth section of the research focuses on the opinion of graduates of the program, specifically about pupil professional development and knowledge transfer in the long-run.

Respondents note the following positive changes in pupil work:

- greater understanding about the relevance of causes of problems and solution;
- potential for deeper, more analytical research and understanding of the relevance of one's ideas, topicality and need for research;
- change in attitudes of future designers as they take on responsibility;
- development of student creativity, cooperation skills and competencies, as they participate in joint projects in and out of school;
- realization of associated responsibility, needs and significance of one's ideas.

Fifty-five percent of respondents noted that pupil understanding of the long-term role of design in society had developed including acknowledgment of the responsibility of the design process in understanding wishes and needs of society.

As a result of knowledge transfer between branches of design and main societal benefits, respondents note the main benefits as the greater potential for smarter thinking and action development through interdisciplinary transfer and sharing of acquired facts. Of the respondents, 54% answered positively the question: "Will those graduates, who will not continue their education in art or design continue to develop the field of design by informing and educating society about the significance influence that design has on improvement of the quality of life?".

Other teachers noted:

- So far only positive responses have been heard from graduates about acquired knowledge, skills and understanding about what is beautiful – things that will assist them in daily life, as well as help them work with other people as they do their job.
- I'm not sure. And is design an important factor in improving people's lives? It's definitely primary.
- Knowledge cannot be taken away and this baggage given to these pupils gives them a stable base upon which they can build their future.

## Discussion

My research indicates:

1. the subjects included in the education program have been revealed to be invaluable for teacher professional development;
2. during the learning process new methods have been discovered that program graduates use in their work with pupils;
3. teachers use acquired competencies in their professional work and teaching.

These results indicate that knowledge transfer in both systems has been successful.

Participant responses to the survey questions indicate that the teachers use their acquired competencies in creation of cooperation and information exchange. Therefore, knowledge transfer occurs successfully.

However, teacher and school administrators indicate a significant shift in pupil perception about the long-term role of the designer in society. As a result, one can surmise that knowledge transfer has taken place, and very well at that. Teacher predictions indicate that knowledge transfer in the systems pupil-society and graduate-society could take place quite successfully. The respondents' opinions are quite subjective, but not contradictory indicating that the professionalism of the program *Design Teacher* was rated quite highly by its graduates.

Professional secondary schoolteachers note these main benefits:

- new teaching methods and new contacts with teachers from other schools;
- view on things from a different perspective
- possibilities for communication with various interesting people in various aspects of design
- new knowledge and methods for developing creative thinking, collaboration and making connections
- exchange of rich, dense, multi-faceted, international pedagogic and professional experience and self-fulfillment
- Professional program teachers noted:
- new modern knowledge
- understanding of design from a modern perspective
- use of modern pedagogic methods
- ability to understand the causal relationship of problems and acknowledge the importance of research (market, design, people, etc.); the most important thing is now I know what to do!
- gained a better understanding of ways that I can sell my art/design on the market

- shared project materials with those teachers who did not participate and commented on specific parts.

## Conclusions

1. Integration of various competencies in professional work, as well as in design education is an essential condition for success today and in the future.
2. Inclusion of current trends in professional work, professional education and professional development is essential for future designers and for complete education of art and design teacher specialists.
3. The creation of the Latvian Cultural and Creative Industry Education Centre (KRIIC) project *Professional Culture Education Teacher Continuing Education* program *Design Teacher* is based on research on economic factors, design economics and design development and education.
4. The goal and content of the program completely reflects the current situation in the field of design.
5. The subject matter included in the program have been recognized as important to the professional development of the teachers associated with design – in the creation of a wider point of view; recognizing different societal perspectives and comprehension of the concept of longevity, as well as understanding the presented material.
6. Skills obtained by graduates of the program can be used in both professional work and teaching as well facilitating cooperation and exchange of information.
7. The program has resulted in cooperation and information networking, as well as knowledge transfer from other fields; the entire system has benefited resulting in more effective and better program results.
8. In order to determine that these conclusions can result in long-term positive results, future research plans to repeat this project, but supplementing it with professional study program and professional secondary school graduates.

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# The nation state and the system of global governance

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**Abstract**— It is vital to attempt a response on the role and place of the nation state at the present time. That question is connected with one on sovereignty of modern state. An idea central to contemporary politics is a conception of the autonomous nation state understood as a post-nation state with an appropriate method of political organization. As nation state, in order that today it is able to perform its fundamental task of satisfying the basic needs of its inhabitants, has had to undergo a number of transformations, metamorphoses, in order to become part of the complex system of global governance.

**Keywords**—democracy, nation state, global governance, sovereignty.

## I. INTRODUCTION

For almost four centuries the global order has been founded on the principles established by the Treaty of Westphalia of 1648. This closed a 30-year period of religious conflict, its provisions becoming permanently inscribed in the history of international relations. It introduced new principles to the international order, specifically:

- the notion of sovereignty;
- the right of each monarchy to select a religion (*cuius regio, eius religio*);
- the legitimisation of the authority on a given territory;
- non-interference in the laws of other states;
- an expansion in the role of national armed forces subordinated to a central authority.

Since the end of the Second World War it has been possible to observe significant changes to the international order. The idea behind the international, intergovernmental organizations which came into being from this point on did not in premise question the provisions of the Westphalian constitution. Initially, the fundamental challenge for Europe was its delivery from post-war economic collapse. Moreover, the memory of many nations was burdened still with visions of the great crisis of the 1930s. The most important task seemed therefore to be the creation of a system capable of acting as guarantor of stable economic circumstances for both Europe and the wider world. The organizations of international reach which then came into being, and which form in essence the contemporary international order, were appointed to strengthen the global economy and act as a guarantor of world peace.

As such, since the end of the Second World War, links which were initially chiefly economic, and later also political, have begun gradually to increase. The road to contemporary

global interdependence was marked by the Cold War, which was fought at five distinct levels: “(1) the strategic confrontation between the USSR and the United States; (2) the ideological struggle between communism and capitalism; (3) a geopolitical rivalry combined with clashing areas of military influence, for almost 40 years maintaining the division of Europe and Germany; (4) a struggle to gain control over the Third World; (5) and finally, from afar, the contradictions of two civilizations, each of which saw a future for the world in itself alone” [1: 159]. The bipolarization of the world was not conducive to the political processes of pan-European integration.

The symbolic fall of the Berlin Wall was to become the beginning of the contemporary international order. That was a great surprise for theorists of international relations, since it had seemed that the bipolar system, which generated certain rules of conduct stabilizing mutual relations, was so “internally stable or – as is sometimes expressed – so peaceable in its nature, that it will go on without impediment into the foreseeable future” [1: 159]. The end of the Cold War and the beginning of the post-Cold War world – as the newly established international order was initially named – has brought significant changes in the positions of nation states in the global political arena.

## II. THE SYSTEM OF GLOBAL GOVERNANCE

Contemporary states are no longer the only players in the global political arena, nor even the most important. Mentioned alongside the state in contemporary debate on global politics are international institutions as well as supranational networks and agencies, both public and private. Together with the states these constitute the system of global governance.

“Global governance consists in more or less effectively managing problems common to the whole of mankind, underlining their significance, introducing norms and undertaking direct interventions. In the course of the past half century the influence and functional scope of global governance has expanded immensely, contributing to a strong politicisations of this sphere of activity” [2: 32].

As C. Reus-Smit writes, “despite the fact of states remaining at the very heart of the international legal system, individuals, groups and organizations are gaining recognition ever more often as subjects of international law. The appearance of a fairly extensive set of international human rights, supported by metamorphosing mechanisms for their enforcement, has granted individuals, as well as some communities, such as minority groups and indigenous peoples, clearly defined rights arising from international law” [3: 429].

This means that new actors are appearing on the political stage, and on the contemporary political stage playing a substantial role.

The Commission on Global Governance [4] defines the system of global governance as the sum of the many individual activities conducted by public and private sector institutions in the management of joint affairs. This is a continuous process in which interests often mutually opposed find expression in activities undertaken together. The document *Our Global Neighbourhood* came into being at the instigation of this commission and proposed the creation of an efficient system the purpose of which would be the management of the political and economic system. The idea behind the operation of the system of global governance presented in this document makes reference to the theory of a world federation proposed by I. Kant.

The World Bank and International Monetary Fund make use of the notion of global governance to refer to a specific type of political and economic order. In their understanding global governance is no different than an expansion of democracy and transparency in management and free trade.

G. Brock defines global governance as “a system concerned with the management of the interests of the inhabitants of more than one state, in the absence of a world government (or a central authority, or a state with a legal monopoly on the use of force, or a state with the ability to enforce rights and principles with use of legal authority). Global governance is not a synonym for a world government. Nonetheless, the very mention of global governance can arouse fear and suspicion among those eager to defend nationalism” [6: 84].

L.S. Finkelstein in turn defines global governance as “management without sovereign authority, relations which go beyond the borders of the state” [7: 369], while according to I. Clark global governance is “a loose system for global regulation of the behaviours of actors in international politics. Of an institutional or prescriptive nature, comprising elements of various types: international organizations and international law, supranational organizations and frameworks for action, elements of a global civic community, widely accepted norms of conduct” [8: 903].

Global governance may also be defined as “a system formed on many levels – from local levels to the global – for political (formal and informal) coordination of the activities of public authorities (states and international, intergovernmental organizations) and private entities (international non-governmental organizations and supranational corporations) for the achievement of common goals or resolution of collective problems through the formation and introduction of global or international norms, regulations, programmes and policies” [2: 24]. In addition to states, the current order is also formed of “an extremely dense and complex network of contemporary forms of international management, encompassing regimes, international organizations and international non-governmental organizations. These shape almost every aspect of public life: the development of a legal regime (in the field of human rights protection, war crimes and the activity of the International Criminal Court), ecological regime and economic regime, as

well as peacekeeping activities entrusted to universal organizations such as the UN” [8: 907].

According to A. M. Kjaer, various views exist as regards the essence of the system of global governance, and three means of perceiving it may be identified: “a narrow approach involving practically all activities as part of transnational networks; a broader understanding of global governance as a 'meta' question, that is, a process for the coordination of the sum of international and intergovernmental activities; and the minimal definition of neoliberalism, equating global governance with a world government” [9: 96].

### III. THE NATION STATE

It is vital to attempt a response on the role and place of the nation state at the present time. Opinions often appear in the international debate stating that with globalization processes nation states have lost the self-sufficiency and sovereignty conferred on them by the Treaty of Westphalia. Ever more often is the decline of the nation state announced (U. Beck, A. Ohmae, J. Scholte). And the cry that states are ever more often disposing of sovereignty to international organizations, that the comprehensiveness and complexity of the contemporary world demands a search for new paths, on which it transpires that the nation state is a relic and the idea of sovereignty is growing archaic, seems to be a cry ever more clearly audible.

According to P. Willetts, a condition for the existence of a nation state is the organization of almost all of the representatives of the given nation in a single state system in which no other national community exists, while in the field of international relations this term is used in reference to a political entity the legitimization of which is derived from the nation, and thus in reference to a state in which the nation is sovereign [10].

F. Gołemski points to the following aspects of the nation state:

- the recognition of the sovereignty of the nation as the body of citizens inhabiting a given territory recognized as integral, in the sense of the ability of the state to exercise full control over it;
- the introduction of its own jurisdiction;
- the separation of the sovereign state by a political border from other similar entities also endowed with sovereignty [11: 34].

The nation state is “a definite and limited territory, inhabited by a permanent population and under the authority of a given government [...] Two fundamental components of sovereign power are the supreme authority of the state over its own territory, and independence. Sovereignty is the right of the highest bodies of state authority, those defined by constitutional bodies: kings, presidents, parliaments, supreme courts etc. It also consists in state independence, independence from foreign governments, recognized by international law. When a given government is described as sovereign this means that it possesses simultaneously supreme authority internally and independence internationally” [12: 18].

Posing the question of the sovereignty of contemporary states in the global system, R. Jackson claims that the system of sovereign states was actually a European invention. However, in the course of the past four centuries it has spread throughout the world, becoming a global system. "Since the time of its appearance in Western Europe in the 16th century the sovereign state system has enjoyed an uninterrupted existence, although it has undergone numerous transformations. It has never disintegrated or been destroyed, never been allowed to begin dying from natural causes, and there has been no return to a pre-modern reality of mutually uncomprehending civilizations, contemptuous of each other and not in communication. Nor has it metamorphosed into a world empire or a world federation. [...] The global scope of the sovereign state system, the absence of competing systems of territorial authority is considered a trivial fact, if noticed at all" [12: 161]. The author takes the view that in the contemporary world "states are still sovereign in the sense of exclusive jurisdiction on their territory. They possess a constitutional independence, that is, the freedom to pass their own laws, organize and control their own armed forces and police, levy their own taxes, conduct their own domestic and foreign policy, maintain relations with other states, organize and become members of international organizations; in short, govern in accordance with their own ideas, interests and values. [...] There is today no actor capable of managing sovereign states" [12: 166].

According to D. Held, "a variety of mutual connections on a global scale has now been visible for quite some time [...]". There is a great deal to indicate that under the influence of international and supranational relations the nature of the authority of the modern sovereign state has undergone change. As a result of global processes, politics certainly no longer takes place primarily around states and their relations with each other. Appearing in the 'rifts' perceived above is the operation of forces which limit freedom of action of governments and states, wearing away the boundary of the domestic political sphere, transforming the conditions in which political decisions are taken, restructuring the institutional and organizational environment of national communities and changing the legal framework for the practice of government action, and which blur the spaces and mechanisms for responsibility of nation states. These phenomena allow it to be claimed that the functioning of the state in an ever more complex global system affects their autonomy and, to an ever greater degree, also sovereignty" [13:390].

As A. M. Kjaer writes, a neorealist approach to the sovereign state, consisting in its being perceived as that which has its diplomatic forces, conducts wars, negotiates and signs peace accords "has been undermined by academics who have observed that the complex interdependence of the contemporary world affects interaction between states. In international relations an important role is played also by non-state participants. [...] Changes at the global level have led to the role of national constitutions being undermined, and thus to the appearance of many different systems of governing of an international nature and of 'governing without government'" [9: 72-73]. It seems therefore, the author continues, that foreign policy has become a complex process in which are involved networks both domestic and international, comprised of states

as well as non-state participants. Responding to the question of threats to the sovereignty of nation states in the face of globalization, she refers to debate between political scientists and economists. As she writes, "if politics is therefore perceived to be more important than economics, it can be assumed that states retain a dominant position, whereas if the dominance of economics over politics is recognized, this will be equivalent to recognition of the decline of states" [9: 97].

This results from the simple fact of neoliberal economists claiming that the state should form a framework allowing for the development of a free market, which is to say the absence of state intervention with regard to the development of world trade and, as a consequence, the stimulation of economic growth. However, political scientists take the view that development of national economies is possible thanks to state interventionism which will protect developing branches of industry.

TABLE 1 VIEWS ON THE ROLE OF THE STATE IN A GLOBAL ERA

	<b>Emphasis on the economy</b>	<b>Emphasis on politics</b>
<b>Comparative national development</b>	Neoliberal economists (Milton, Friedman, international financial institutions)	A state regulatory in nature (Weiss, Evans)
<b>International relations</b>	Strong liberalism (Falk, Rosenau)	Neoliberalism (Waltz, Krasner)

Source: [9: 96].

#### IV. THE SOVEREIGNTY OF THE NATION STATE

In considering aspects related to contemporary sovereignty, T. Pogge defines it as a relationship between A and B.

"A is sovereign over B if and only if

1. A is a governmental body or office ("agency"), and
2. B are persons, and
3. A has unsupervised and irrevocable authority over B
  - (a) to lay down rules against Bs conduct, or
  - (b) to judge Bs compliance with rules, or
  - (c) to enforce rules against B through preemption, prevention, or punishment, or
  - (d) to act in Bs behalf toward other agencies (ones that do or do not have authority over B) or persons (ones whom A is sovereign over, or not).

A has *absolute sovereignty* over B if and only if

1. A is sovereign over B, and
2. no other agency has authority over A or over B which is not both supervised and revocable by A.

Any A having (absolute) sovereignty over some B can then be said to be an (absolute) sovereign (in one place predicate)" [14: 365].

It seems today that another model of absolute sovereignty, as T. Pogge names it, is not generally possible. The days when states enjoyed total sovereignty and autonomy have now passed. And it is unlikely that a nation state model in which there is above A no other entity with supervisory power could survive in the present world. An idea central to contemporary politics is thus a conception of the autonomous nation state understood as a post-nation state with an appropriate method of political organization.

As such, any states which wished to strive for absolute sovereignty would be forced into a voluntary renunciation of participation in international organizations (the condition is then met: no other entity has authority over A or over B which would not be supervised or revocable by A), a situation for the contemporary state which does not in fact pay, since it thereby condemns itself to a voluntary exclusion from supranational economic, political and cultural cooperation. Such a state thus ceases to perform its basic task, which is the satisfaction of the needs of its citizens.

## V. SUMMARY

Expectations of the international order today are substantially greater than they once were. This arises from the simple fact that while in the past the most vital task of the international order was the elimination of threats, the emphasis today is placed chiefly on the 'positive' functions of this order. Their chief task includes a streamlining of the transfer of information and economic resources, respect for human rights and the opening up of access for global social movements.

It seems therefore that in contemporary thought in political science the manner in which the sovereignty of nation states is understood ought to undergo a change. The time for rigorous application of the Westphalian provisions appears the distant past, and the conduct of world politics within closed nation states does not look to be a serious possibility.

The nation state, in order that today it is able to perform its fundamental task of satisfying the basic needs of its

inhabitants, has had to undergo a number of transformations, metamorphoses, in order to become part of the complex system of global governance. It is, however, most essential that as part of this system post-nation states form a vital link in the conduct of global politics. We thus call for a strengthening of the role of post-nation states in the international order.

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# Mental skills toolkit for performing at your best

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**Abstract—** Sports psychology is a relatively new field, but it is growing very fast. This paper<sup>1</sup> is for athletes, but can be applied by everyday workers too at their jobs, who feel that they are physically prepared for whatever, but that they are still unable to follow through. The needs of young athletes in competitive sports are particularly addressed. Many readers while reading this paper might think that they already know some parts for themselves but it actually reinforces your ideas if you read them over again and helps the ideas really sink in and work better.

**Keywords-** *mental toughness, motivation, visualization, anchoring*

## I. INTRODUCTION

Sports psychology is a relatively new field in sports performance, but it is growing very fast. It is simply applying psychological principles in sports. It is meant to be used in accordance to sports, but it can be also applied for example let's say in the corporate worlds and so on. Athletes are of course very competitive and they want to get every edge they can over their opponent, so professional athletes turn to sports psychology for the last twist. Sports psychology helps athletes overcome thoughts of not being able to do something and help them manage their relationships with the rest of their team and work through e.g. mental blocks, slumps, and in general decreases in their performance. [1]

Sports psychology is not just about recovering from slumps and surviving through tough times. It is also about helping you to be at your best. Your mind can make the difference of giving and being 100% or 101%. Sports psychology helps you find out why you have not been performing well. Other fields like Neuro Linguistic Programming tell you how you can try to improve. [2]. Without sports psychology you could only guess what is wrong and then what might help you. Each skill in this booklet is intended for a certain type of problem someone is having and for a certain time (game, practice, free time etc.).

To improve your performance when anything is wrong, the first thing to get right is what's holding you back. There are many different factors, which could be holding you back. Some are lack of mental toughness, not being able to handle fears and lack of motivation. These are factors, which are more related to sports than the ones I will discuss over with you now. The factors can be categorized to be either internal or external factors like friends and confidence.

One factor is selfishness. You have to be selfish in a good way. Of course, you should not be selfish in the way that you

never help and love other people, but you should still remember yourself. The fact that is you have to be ready to stomp on some toes on your way to wherever it is where you want to go. If you never remember yourself, you end up living a life that is what everyone else except you yourself want. There might be people who want to live in this kind of servitude, but I bet 99% do not.

Here is an exercise, which will open a thought to you, which will make it easier for you to live more for yourself. Think of someone very dear to you, who you see as precious. Say to them, "I'd rather have happiness than have you. If I had a choice, no question about it, I'd choose total happiness." I bet you felt thoroughly selfish after that didn't you? Now next, you will realize how you have been thinking for long. Imagine the dear person saying, "How could you be so selfish that you'd choose happiness over me?" Don't you know feel that you are not the only one being selfish in this situation. The person is blaming you for choosing happiness over them. [3]

Another factor is having general happiness. I think you will agree with me that when you are happy you feel like you have more energy to do things. You have to learn to take more pride and get more happiness from things you have done well and not just rely on your daily dose of happiness from compliments and attention. You may not get as many compliments every day, but of course, you would want to keep the good feeling. Think of the fact that you take pride and get happy from other people complementing the nice palm trees in your country or the nice snowfall. You also get happy from other people complementing your shirt you bought. I'm not saying these good feelings aren't good (they are and hold onto them!), but think about it. You are not in charge of the weather and you did not make the nice shirt! Yet, you feel happy for the complements as if you had achieved something or as if you did something more than just bought the shirt.

You are reliant on when others make you feel better through their complements. The other people may not be always in a good mood, so even if you had a new shirt they might not complement it. If you live in a poorer country and someone says to you, "what a slum," most people feel at least a little ashamed. You are not the cause of the rest of the country (hopefully), so do not be ashamed as if it defined you! If people are in a bad mood, they might criticize you! Remember to understand others when they are in a bad mood no matter how hard it might be, otherwise you will take their comments too personally and make them seem as facts. [3] The same goes for a sports team, even if the team would be bad, it doesn't mean you wouldn't be good or vice versa.

<sup>1</sup> Based on a Personal Project product booklet prepared for the Espoo International School in 2012-2013 and presented in May 2013

Then there is an idea, which I will simply say, because I believe it does not require a further intro: don't sweat the small stuff! By this I mean do not think of the small bumps in the road. You have to learn to not sweat the small stuff or you will keep "tripping" all the time over little things. Think will this matter in a year or how will this show in a year. How will I feel about this in a year? Understand that life is not fair and that not everything is in your hands or your fault. Listen to your real feelings, not the ones you are showing to others to get attention or, because you think you should be feeling something else. (Modified from [4]) There is a Buddhist teaching that tells you to see the glass as already broken. This means that everything has a beginning and an end. We just don't know when the start or the end are.

We must learn to not think that we should not even try, since everything will come to an end, but if we realize that everything will end sometime it is easier to cope with the end when it comes. Another thought that helps you with coping with small problems is learning to be O.K. with not knowing. The truth is that we don't know what is going to happen. [4] The only way to get the wanted results is to learn to live in the moment and look into the future. There is no other way of avoiding future problems (including "small stuffs") than to do this. If you did your best and met small bumps then you know there is no reason to beat yourself up about it. Think of this as you walking with your head down and walking into a tree. You become startled and surprised and might hurt yourself, because you didn't look ahead. If you had looked ahead, you could have avoided it or even if you couldn't have, you would not be as startled and understand you can still continue.

Then there is the fact that in the end you just want to become yourself. Right from the beginning when you began to socialize or interact with people you began to use different "faces" than your own. This is only human, but it is a problem. It creates unhappy people and sometimes really terrible ones too. If you are not true to yourself, you might become frustrated and then for example violent. Do you really want to do what you are doing or is it just a status to show off? Do you really like to tease others or is this just to make you seem tough or get attention? Do you really care about winning or do you just want to do what you do because you love it? The fact is every person through their hobbies and actions are trying to find their true self. This is directly related happiness, because you are at your happiest when you are yourself, since it is most natural for you. You should do what you do, because that is what you really want. Otherwise, you will not be truly satisfied. [5]

Being yourself and at your happiest is really hard for example if you go to a hobby you don't like with your best friends to be able to spend time with them or doing a hobby you don't like, but your tough guy "face" feels it looks good to others. Simply, you just have to find a place in life where you feel most at ease. For example, I bet most of you don't or didn't want to go to school at some point or never, but this enables you to be yourself later on even if at the moment school is not what you want.

## II. MENTAL TOUGHNESS

Sports psychology is a lot about creating mental toughness. Mental toughness is about how well you are able to handle adversity and pressure, how motivated and committed you are to doing what you are doing, regardless of the situation, and your ability to stand your ground and remain focused in the most difficult and pressured situations. Some coaches define mental toughness as the ability "to block out what's not important". In sports, to be mentally tough, you first need to be physically tough and in shape. [6] This of course does not apply to the corporate world.

Mental toughness has nothing to do with talent. You can be born with it, you can acquire it, and you can also become discouraged and loose it! You will not lose mental toughness as long as you keep concentrated on what you want. Otherwise, you will become discouraged and begin to doubt how much you actually want it. I asked one of my interviewees (15 yrs., girl and track and fielder) that if you miss out on a competition how do you feel? She told me if she misses a small competition, she believes she can make up for it with training, but if she misses a big competition she get sad about it and it takes weeks to forget it. In this kind of situation, you have to have the mental toughness to understand that whatever the reason, you missed it! Now the only thing you can do is train, train, train. If you sit around sad, you lose energy to train and you will probably not train with your usual passion. You can also create low self-esteem if you blame yourself, which hurts your future performances.

Mental toughness is always needed throughout sports. Mental toughness is not necessarily the absence of fear and doubt, but it can also be the ability to not let these factors stop you. Think about how tough pre-season conditioning is! What about facing the fact that you just weren't good enough to be a starter? What about making costly mistakes that hurt the whole team and then receiving the criticism for having caused them? What about facing a long injury and then wondering is it worth it to recondition and go back? [6] What about knowing the fact that you are competing with your teammates (friends) for a better spot on the same team? Remembering this at every game, practice and competition.

These are just a few examples of the adversities athletes face. Without mental toughness, you would not make it. I asked a friend of mine that when she loses a game what caused it. She said that some reasons are the game being played early, that she feels it is hard to play in the morning, because then you're tired and your concentration is zero. The fundamental issue she said was that if her team plays badly it is hard for her to play better than the rest of her team (she feels the team drags her with it). This can happen due to many reasons, but one way to overcome this is to be mentally tough enough to separate yourself from the team at this sort of point. The trouble is that if you are playing a team sport, it becomes very hard to win if your team begins to lose focus even if you wouldn't. If you take charge and play at your best, your team might follow, but if you quit then there's no chance.

Even though you have to compete with people who are even in the same club, team, or so, you have to concentrate on yourself, not on what they are doing. Let's say your teammates

name who you are competing with for a spot on a team next year is Bob Diligent. It is easy to start concentrating on what Bob is doing and forget yourself. You might even begin to hope that Bob fails and that then you would seem better than he would. A wise professor and life mentor once told me that going to a game or practice in sports is just like going to a test in school. When going to a test in school you study a lot to get a good grade and do not hope that others fail, because it still would not increase your score! Even if they underperformed and you got a little better grade than they did, it doesn't mean that you didn't perform badly and that no one would have noticed it. In sports, you should concentrate on yourself and have a drive to be at your best always! If you do not feel this is how you want to do it, you can honestly ask yourself do you deserve the spot in the team instead of Bob.

Like in everything in life, it is good to have an idea of how you are going to do anything. Therefore, I am going to give a guideline to increasing your mental toughness.

First, you should become aware of your current mental toughness. A good way of doing this is asking questions like the following from honestly from yourself and other people who know you well. (Modified from [6])

- How mentally tough do you think I am?
- How well do I bounce back from mistakes?
- How well do I handle adversity?
- How well do I accept feedback from coaches and teammates?
- How well do I handle pressure involved in competition?
- How well do I believe in my ability to accomplish my goals?
- How motivated am I?
- How well am I able to stay focused when the game is on the line?

Remember to ask the people to whom you present these questions to be specific in their answers. Also, remember to first tell your respondents what mental toughness is. Your respondents could also give their view on what they think is mental toughness. This could give you a range of new ideas on parts of yourself to work on to increase your mental toughness. If you want to have a better possibility of getting honest answers, you could do these questions via e-mail without a return address. Some people can be completely honest with others face to face, but some may fear answering completely

Now you just have to simply think about the answers to the question and concentrate on improving your weak points. You have to remember to evaluate yourself everyday on your mental toughness. I do not mean you have to write anything, but you should think to yourself about the questions above and how they showed that particular day. In addition, if you set out to improve your mental toughness in other aspects of life like relationships and school, your mental toughness in sports will increase too, and vice versa. [6]

Some other ways you can improve your mental toughness are:

- Looking at athletes who do the same sport as you and see how they behave under pressure, before competition and so on.

- Take time before a practice or a game to concentrate on them, not just go to practices and games right after having done homework or so.
- Concentrate on improving your physical strengths.
- Have a mantra for yourself that you say to yourself when under pressure to keep you focused on your goals.

If you fall short sometimes, do not beat yourself about it, but just acknowledge it and move forward. [6] Handling mistakes well creates character and bouncing back does not just require toughness, but creates toughness too.

#### A. Confidence

Mental toughness and confidence go hand in hand. They are very often almost the same thing. If you increase one or the other, the other follows for example if you become more mentally tough, you gain confidence to do more. If you do not have confidence, you begin to doubt yourself, creating a block into your head, which makes it harder for you to perform under pressure ← hurts mental toughness. Confidence is defined as the belief that you have a skill set related to your sport that helps you be successful in that sport [6]. Some common thoughts are, "I can't do this" and "but they're better." If you think like this, whether it is true or not, you are already closer to failing. This causes your mind to think in a way that you should not even try, because it is no use, because you cannot do it.

Confidence plays a big part in how often you win or succeed. Of course, talent and preparation are important too, but without confidence, you are unable to use all the traits you have. If you lack confidence in your skills and/or physical abilities (as this most often is the case) then you should first start concentrating on improving your physical side. A friend of mine who plays basketball for the Finnish national team said that (I'm paraphrasing) you should first concentrate on the fundamentals and tweak them to their fullest, because this also brings confidence, not just skill. After this you can start playing with more finesse.

I asked one my interviewees (age unknown, adult man and coach) that if a player does badly in a game, what should the player do? He replied, "then I would say that it becomes a team thing. Because everybody has their bad games... right? The coach helps to lift the players up at those times. Other teammates help to support them and just don't freak out!" As the coach said, you have to remain calm. That is what you should do. Of course, if you are for completely messed up during a football game, you should not maybe take such big role during the game if it might hurt the whole team. Later in this booklet, I will tell you how to keep concentrated and thus come back from your slumps.

If this does not help, it would be good for you to see a sports psychologist. It is very important to be confident in sports, because it allows you to show and use all your skills and if you show great confidence, it might lower the confidence of your opponents. [6] You have most likely have heard some of the following myths about confidence:

- You just have to believe in yourself
- If you believe it, you can achieve it

- Positive thinking is the secret to a good life
- If you stay positive and always look on the bright side, you'll become more confident
- It's important to be confident – just don't be too confident, or people won't like you (Adapted from [6])

These previous ideas might help some people, but they mostly cause more harm than they do good. First, I want to tell you that there is no such thing as being overly confident. People who are not liked, because they are seen as overly confident are actually cocky. These are the differences between confidence and cockiness.

THE DIFFERENCE BETWEEN CONFIDENCE AND COCKINESS	
CONFIDENCE	COCKINESS
You feel good about yourself.	You don't feel good, but you pretend to.
You're open to feedback.	You're afraid to get feedback.
You believe in your skills.	You doubt your skills.
You love to compete.	You can't handle true competition.
You don't need to brag.	You feel the need to brag about how good you are.
You're strong.	You're insecure.
You manage rejection.	You fear rejection.

(Modified from "Sports Psychology for Dummies" p. 57)

Figure 1. *The difference between confidence and cockiness*

Unlike athletes who are confident, athletes who are not feel a need to create a barrier between them and others to make themselves feel better, and to seem tougher and superior. This barrier is seen as cockiness. Bragging comes from the other listed traits of cockiness. For example doubting your skills does not mean automatically that you are cocky or not a nice person, but this can partly cause you to become one if you care too much what others think or have a personality for showing off.

First of all, I want to grab everyone's attention who think they don't have problems with *fears*. If you see yourself judging others, you are very likely afraid. You have to be careful about how much you think of what and how others are doing. You also have to distinguish between it being empathy or fear. Being empathetic is caring for how others are doing not comparing them to you. Fear of what and how others are doing causes you to become unconfident if you think they are doing b

In addition, if you are unconfident then you focus on how others are doing. It is a dangerous cycle! You have to learn to balance your fears. You also can use your fears as motivators. Do not just sit around and be bitter and troubled if you feel others are doing better. You should get up off your a\*\* and use your fear as a motivator for working yourself harder! It doesn't matter how good others are if you just focus on being better than they are. If you are afraid of others being good, you will never be able to be at your best during competition. This is, because you will always be partly hoping the certain person to perform badly (so you'd look better) and not concentrating on actually being better. And you will also partly not concentrate on the game and playing as a team or for yourself, but concentrating on proving yourself to be better than your competition, whether they are in your team or in the opposing one. This can cause a loss! This also results in a lot of bad feeling when not succeeding in seeming better, since this was your target, not *being* better. How you seem is mostly dependent on how people see you, not how you really are (so this is really hard to control). Especially when your competition is not very good, you slow your progression down

by not aiming on being the best, but being better than for example a newbie to your sport, which is just stupid.

No Fear → No Surprise → No Hesitation → No Doubt  
(Modified from "The Rules of Life")

A simple and often unthought-of way to boost your confidence is to allow yourself to be confident! For whatever reason you might be, do not be afraid to do this. Allowing yourself to be confident and swagger help improve your confidence. Swagger is having confidence in yourself and abilities as an athlete. It's the air about you that tells others that you are confident and that you expect a lot of yourself and that you expect to always beat you opponents. Having a swagger about you intimidates most opponents giving you a mental edge over your competition.

To gain confidence you should always remember the three P qualities (Modified from [6]):

- Present tense: You have to concentrate on the present! Think, "I can do this" instead of thinking, "I will be able to do this." By thinking in the future, you give yourself a chance to not perform at the moment and to possibly perform better later.
- Positive focus: You have to have a positive focus. Think, "My start is fast" instead of thinking, "I mustn't mess this start up!" By thinking negatively, you put the question into your head that "Can I start fast?" or are you going to start fast. Part of positive thinking is believing that whatever you're going for is worth the effort and pain. Always concentrate on improving yourself, do not yell in your ear and tell yourself off.
- Particular behavior: Last, you have to have a mindset to always go to the fullest and until the end (no matter the situation).

Next, after thinking positively with the three Ps, you have to be ready to take risks. Mental toughness and Confidence allow you to be flexible with changes and adapt. Since you are confident, you won't be afraid to try and be flexible and since you are mentally tough you are able to work yourself to adapt, even if it doesn't work at first. Remember this! If you attempt to be perfect, you are setting yourself up for failure. It is impossible to be perfect, but if you have a perfectionist mindset, you will have low self-esteem and bad confidence since you will never achieve perfection. [8]

These previous ideas might help some people, but they mostly cause more harm than they do good. First, I want to tell you that there is no such thing as being overly confident. People who are not liked, because they are seen as overly confident are actually cocky. These are the differences between confidence and cockiness.

### III. MOTIVATION

If you are to succeed, you of course have to be motivated to reach your goals, maintain a status or so on. If you are motivated enough, you will work until you reach your goals. You will not mind to go through practices that work you until you might throw up or just fall off your feet, or going through occasional setbacks, because you have your eye on your goal.

You cannot create motivation for yourself if you do not want it. However, there are ways to keep up your motivation through tough times. A simple, and probably the easiest and most common way, is to look into the future.

One of my interviewees (15 yrs., boy and all-around athlete) told me as a reason for his prior lack of practice, that nowadays he doesn't have time (referring to swimming) because he's in pain all the time. He said that then he was not motivated to train (swimming) and that he skipped practices, because his coaches allowed it. Nowadays, when he concentrates on gym training by himself, he said that he has more motivation and he does it for looks and performance. I think this is a perfect example of a case where true motivation took over. He just was not motivated to swim, because he didn't want it badly. Instead, he wants to go to the gym and does it by himself. You might think that I would now say that coaches should not tell their players that they have to go to practices, because this would not give them a chance to feel their own motivation. On the contrary, I think that coaches have to do it, so that if a player feels s/he cannot keep up, then they should quit. Sometimes athletes have other issues that reflect on motivation and sometimes energy levels might be low, so they might not want to train at all. Everyone needs a kick now and then, and that's one reason why we have coaches. They train you and speak to motivate you when you are about to throw up.

Imagine it is now the future, a few years before the end of your life. You never took action to create the changes you want in your life. How do you feel? What does this inspire you to do or not do now? (Adapted from [8] Now, imagine you're way off into the future again, near the end of your life. But in this future, you've taken action every single day to make your life the way you want it. How is this future different? How do you feel? What does living in this way inspire you to do or not do now? (Modified from [8]).

If you let yourself freely think and do not cut yourself off and try to ignore whatever you might feel, you will get quite a good idea of what you might feel. Be careful not to think that, "yeah I'll probably think like this and this and I should probably do like this and this..." You can easily be side tracked to think what you think you should feel. In the end, you might not care if you had not tried your hardest. What you decide to do is your own choice. I suggest you do whatever you feel will to be best for you, not what you think you should do. If you decide to not do what you feel you should do, remember that that was your choice then (and be ready to ignore your choice later, if you feel you chose wrong).

Another way to boost your motivation is to think of known, successful athletes who have "made it." In addition, you can listen to motivational speeches or pump-up songs before a game or race. The quote from Ganon Baker I put into the start of this booklet is a sort of motivational speech, but not a common one.

#### A. Preparation

Like you probably know, preparation is important in order to do well in a game, race, or so. I interviewed a coach about what he thinks should be included to be prepared well, "Obviously, the major physical stuff that you're making sure that you have enough rest and that you've eaten well and that you've practiced. Then, mental focus as well that you're feeling that your able to block out, you know the rest of your

worries. And anyway focus on the game." He covered just about all the areas in his answer. As he said, the physical parts are very important, but I am aiming to talk more about the mental side of things. If you don't have your head in the game you will not be able to perform at your best. Like he said you have to block out all problems (and empty your mind) before a game or race and be ready to just concentrate on your sport. If you want to perform at your best, you should never leave straight to a game/race for example from your desk after doing homework.

#### B. Relaxation & Visualization

Some people might feel that what I just said does not apply to them, and if it doesn't then okay, but I doubt you like doing it that way. Some ways of concentrating before a game/race are listening to music, visualizing, taking a cool shower, doing repetitions and warming up already at home. Warming up at home or doing squats and then stretching wakes your body up and relaxes you before the competition (improving e.g. your reaction time and mobility). If you are overly stressed you will most likely be like a mouse. You might get startled very easily and you might react to everything very hastily. One of my interviewees (16 yrs., boy, and swimmer) told me this when I asked him how do you concentrate on races, "well during the competition nothing much just trying to concentrate on important things and before competitions I usually like to visualize the competition and listen to music." Just simply listening to music can get you pumped-up and get the adrenaline flowing. It can put you in a mindset that you will push through the pain and sweat and win.

Taking a cool shower wakes you up and gets most people energized. Just the act of going to a shower and prepping for a competition makes you feel more ready, and the smell of your shower gel will most likely wake you more. Think of the difference: nice cool shower (now you're frh, alert and awake) or leaving in your just woken up state (most likely you might smell a little bad, you feel a bit warm and everything feels a bit slow). If you don't do this at home, you can at least find a bathroom at your competition and rinse your face with cool water. If you have to sit in a car on your way to the competition, your "morning" feeling will amplify.

By doing repetitions I mean for example if you swim, you could do stroke repetitions at home before leaving to wake your muscle memory. Another example is if you lay basketball, you could lie on a mattress and do shot repetitions or dribble inside or outside to wake your muscle memory. Visualization or making a highlight reel is the act of watching your future game (how you would want to do in it, specific parts) or your past great performance in your mind. Think of this as a personal highlight reel like on ESPN. You should lie down or sit in a chair at home (or in a car/bus) and close your eyes. Now think of different situations, which will most likely occur in the upcoming competition or past performances that you are proud of (like acing critical free throws or how you are going to hit a home run). Your highlight reel can also be about something that feels gets you excited and pumped-up.

Here are the steps to doing a successful highlight reel.

1. Choose your camera angle. Do not go back and forward between angles while visualizing a certain event or you will become mixed up. Looking from a spectator's camera angle helps you see the whole picture, but the best angle is from your own eyes. If you visualize as if you were there, your muscles can actually get stronger (be able to give off more (not 90% but 95%)) and muscle memory can develop. Athletes refer to muscle memory as the ability to perform successfully on autopilot. "Research indicates that an athlete's muscles fire in sequence when the athlete visualizes from camera-angle three" (Adapted from [9]). In the end you have to decide which angle is best for you.

2. Try to pay close attention to three senses while visualizing to make it more realistic and beneficial.

- Sight (what you see there and how it looks in detail)
- Sound (what you hear e.g. the crowd, the bouncing of a ball, the splashing of water)
- Feel (what everything feels like e.g. how the ball feels as it leaves your hand, how you feel going through the water or how you feel hitting the ball)

3. Repeat! You will get more effective at it and learn your style and it will also help all the visualizing sink in to your head and increase muscle memory.

4. Visualize comprehensively. If you are for example visualizing yourself warming up stressed, you will most likely be stressed. Concentrate on visualizing yourself calm and in control. This will help you eliminate possible problems and reduce distractions.

5. Visualize with emotions. Feel the way you want to feel. Do you want to be aroused or calm?

6. Visualize until you get it right. Replay the highlight reel as long as it is the way you want. Do not settle for less.

7. Visualize in game speed. Remember to visualize yourself in the speed you will want to perform in the game. Faster if you want to be faster or at the same as you have already performed. Sometimes you might want to visualize slower to look at more complex skills, but then return to game speed, so you will get a feel for the speed and get used to it. An example of a highlight reel could be:

- Looking at good training.
- Feeling calm during the warm-up.
- Performing well in the competition.
- The feeling of winning just to motivate you [9].

One way of concentrating during a game is to have a mantra, identity statement or performance statement that you repeat to yourself to keep you focused. It is a thing that you can concentrate on when everything else is messed up and you feel you cannot concentrate anymore. Always make a mantra that you feel works for you the best. Never let anyone make one for you. This is a really simple way to keep you focused, but an important and effective one. Here is an outline for making a performance statement that helps you focus on the relevant points in the game [9]:

- Imagine that now you going to play the biggest game of your life and your coach looks you in your eyes and names two things that if you do them you will be successful. What are the two things?
- Now do the same as above, but now you are the coach. What two things would you say to yourself?
- Now put these two together and you have a mantra for what to do!

Next, here is a way to make your identity statement, to remember who you are or who you want to act like.

- First, what is the greatest strength about you (or one you would like to hone)?
- Second, what do you want to accomplish?
- Lastly, put these two parts together in the present tense (I am...).

### C. Anchoring

An anchor is a stimulus that leads to a response. For example, if you hear an upbeat song you will most likely feel energized or if you hear an alarming sound, you will become more alert to dangers. Anchoring works during in the way that during a sports event, you perform a certain stimulus, which activates an emotion and/or state you prefer for a short period of time. Some states that you would maybe like to anchor are motivated, confident, strong and powerful. Here are the steps to anchoring:

1. Pick an event in your past when you felt the feeling or you were in the state that you want to anchor.

2. Feel as if you are reliving it and not just thinking about it. (be thorough, think of all of you senses!)

3. Now apply the stimulus (either physically or mentally), which you can decide for yourself, but it should be usable during an active moment e.g. pressing your thumb and index finger together or the roaring of the crowd (for the roaring of the crowd you could listen to a tape of one). The anchor should not be you meditating or holding your right big toe. The stimulus should be unique, not something that can be fired by accident, like clenching your fist, since, then it loses its impact.

4. Now, think about something neutral.

5. Repeat steps 1-4 six times.

6. Test by firing (applying the stimulus) the anchor. Be sure to have thought of states and emotions for example "efficient" is not a state or an emotion. An emotion or state of being efficient is what you want to concentrate on! Also, be sure to connect yourself to a strong emotion or state, not weak one!

During a game or competition, the anchor more powerful if fired 3-6 times, not 1-2 or too many times like 9 and up. [2]

## IV. ENDING WORDS

I wrote this paper as a project to school, but it became to be much more than that. I had had trouble with my head in sports and could not come to peace with things. After starting this project and really reading the literature, I finally felt at ease. My main problems were the three subjects I discussed separately: mental toughness, confidence, and motivation. I hadn't really known what I want and how much, but now I do.

I suggest that anyone who found even a few good ideas in this booklet that you look at the cited books below.

#### ACKNOWLEDGMENT

##### *Interviewees*

Girl, 15-year-old, track and fielder  
Man, age unknown, coach  
Boy, 15-year-old, all-around athlete  
Boy, 16-year-old, swimmer  
Boy, 16-year-old, basketball player  
Girl, 15-year-old, soccer player

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# „Psychological aspects of advertising”

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**Abstract** - Modern marketing in its practical dimension to a large extent based on the knowledge of other areas of research. One of these is certainly psychology, which provides developers of advertising information on consumer behavior. Professionals in marketing and sales are wondering how they can increase customer interest in a product. With the help comes here a psychology and couple of social mechanisms that can be successfully used in contact with the client and in the creation of advertising messages.

This paper presents the basic psychological rules of social influence and the possibility of their use in the field of advertising.

**Keywords** – advertising; social psychology; social influence

## I. INTRODUCTION

Kotler and Armstrong define marketing as „the social process by which individuals and organizations obtain what they need and want through creating and exchanging value with others” [1].

Furthermore, Kotler’s and Armstrong’s definition of advertising is “any paid form of non-personal presentation and promotion of ideas, goods and services through mass media such as newspapers, magazines, television or radio by an identified sponsor” [2].

According to Jacek Kall, advertising is when there is presented a product or service in an impersonal way, and for the money [3]. Anthony Benedikt uses the definition of advertising created by the American Marketing Association, which reads: "Advertising is any paid form of non-personal presentation and promotion of goods, services or ideas by a particular sender" [4].

The main purpose of advertising, both commercial and social, is to persuade the recipient to a behavior or desire to change his attitude. The advertisement can be seen, therefore, as a persuasive message. According to Morreale, Spitzberg and Bagre "persuasion is the use of communication to enhance, alter or modify the attitudes, values, beliefs and actions of the audience" [5]. The authors add that persuasion is a form of influence, and occurs in a variety of contexts.

## II. VERBAL ELEMENTS OF ADVERTISING

With regard to the language spoken in advertising, Doliński [6] focuses on several elements characteristic of this type of communication. The first is the tendency to use complex sentences instead of several individual statements, the substance of which carry the same message. Author explains

this strategy that the human mind treats a single sentence as a closed unit that is easy to refute. However, in the case of complex sentence recipient can argue with the whole message, but not for subordinate sentences in the present.

No customer focus on the content of the advertising also uses another strategy presented by Doliński. It concerns the use of large amounts of adjectives defining your product, even though their meanings are synonymous or even identical. The recipient, however, unconcentrated on the analysis of the content of particular words, pays more attention to the number of positive terms than on their semantic analysis.

Another interesting element represented by Doliński is the issue of softening of advertising through the use of words "probably" or "maybe". These expressions may be used with regard to such product characteristics, which are difficult to measure objectively because they relate to tastes or preferences of the recipient, or, for example, to the taste of the product. Then the use of the word "probably" prompts the recipient to treat the producer as being fair and objective, which does not seem to categorical judgments about the client's taste. [6]

Doliński also draws attention to the use by the creators of advertising terms that are not fully known to the average customer. These terms are often complex, intelligent-sounding terms of the latest technologies and components used in the manufacture of the product. The aim of this strategy is to call the recipient belief that the advertised product is characterized by the highest quality. Here, too, advertisers benefit from the fact that the public viewing ads do not make a rational analysis of media.

Another effective strategy is to use the questions in the advertising messages. In addition to the power of rhetorical questions are also important answers provided by advertising on the seemingly trivial questions. There are also significant certain terms appearing in the questions of advertising, such as provided by Doliński the word "enough". From a logical point of view, this expression does not indicate a large amount of the stuff, but with the right context of the question, the recipient reads the advertisement in that way.

The final element of the advertising to which attention is paid by Doliński is that the use of figures, usually in the form of percentages. It is characteristic that advertisers providing such data do not include information on how they are calculated and if they are a reliable source of knowledge.

Most of elements mentioned by Doliński characteristic of the advertising uses the ambiguity of language and the lack of

specifying certain facts. Also significant is the fact that advertising audiences usually do not analyze media content.

### III. MECHANISMS OF SOCIAL INFLUENCE

When creating the advertising you should consider a few rules of social influence, which is based on the mechanisms of social psychology. They are described in the book by Robert Cialdini "Influence. Science and Practice" [7]. The first rule is the mechanism of reciprocity. This is the most powerful tool of social influence. It assumes that we tend to thank another person for some good behavior or favor. It is a habit that we have learned in our relationships with others. Interestingly, this works even if the favors that have not been asked for. In the case of marketing, this rule is applied, for example, by tasting the products or small gifts. The client then feels obliged to "pay the debt of gratitude" and is more inclined to buy the product.

The second rule is a mechanism of commitment and consistency. It stems from the human desire for coherence between their own words, beliefs, attitudes and actions. It is well known that the coherence and consistency of actions are the characteristics desired in the community. How the mechanism of commitment and consistency works in practice? For example, if a person declares himself as a defender of animal rights, then it will be more willing to indulge requests associated with the direction of this commitment, which is to support the organization for this purpose. It is worth noting that the engagement is more effective if it is an active, public, requires effort and is seen by somebody as unforced.

Another tool is a mechanism of social influence conformity, also known as the principle of social proof equity. Conformity is the "conversion behavior consists in being conformed its actions of others" [8]. According to this principle is often the basis of our own decisions is how other people behave. In other words, we show strong signs of imitation. Applying this principle, we provide evidence to customers that other people also behave similarly in a given situation. Keep in mind that social proof have the greatest impact when it comes from individuals similar to the customer and he is not sure how he should behave. The mechanism of conformity is used very often in advertisements, for example, with the actors portraying "ordinary" people who are convinced to purchase a particular product. Advertisers use this technique by placing the advertising information on a large number of people buying the product, or the rewards of trust granted by other consumers.

Another technique of social influence is a mechanism of sympathy. It is based on the premise that people are more likely to people they know and like. The sympathy for the person shall *inter alia* take her physical attractiveness, similarity to us, frequency of contact with a person and her association with someone or something that somebody already likes. It assumes that customers are more susceptible to advertising while convincing them to buy someone they like. Hence the frequent presence known and popular advertising celebrities.

Another technique is a mechanism that authority. It stems from the fact that people have a strong tendency to succumb to authority, because usually they are characterized by wisdom and power. Interestingly, we tend to indulge not only true in

authority, but also to those who do not give up too. Hence, we believe also often symbols and signs of authority, which may be, for example, academic title, clothes and attributes. In practice, the authority mechanism is used, for example, if the advertised toothpaste plays an actor dressed as a dentist. Last presented to rule the social impact of this mechanism is not available. It consists in the fact that we tend to assign a higher value to these things and occasions, which then become unavailable to us. This mechanism is based on the fact that the non-availability of some options means the loss of choice. This rule works most when unavailability appeared recently, and when we compete with other clients of articles readily available. Interestingly, the most frequently meet in two types of unavailability. The first is related to the limited time of purchase or a limited number, so famous promotional text: "limited number of articles." The second type is related to unavailability of a specific group of persons to which a particular offer is intended. An example of the use of this tool can be only giveaways targeted to existing customers. When making purchasing decisions by customers, it often plays a huge role a person seller. In addition to substantive offers traders often use a certain technique, based on well-known psychological mechanisms.

The first of these techniques is the so-called "foot in the door." It is based on the fact that our right a large request, on which we depend, preceded by a smaller, easier to fulfill. Then if our interlocutor accede to our first wish, there is a greater chance that it will meet the second proper request. Why this assumption? Well, smaller meeting request, our interlocutor creates a positive image of yourself as a human being helpful and obliging. After the second request he will seek to maintain a positive image produced previously, thus increasing the chance of favor even with the second wish. It should be noted that this technique uses a simple mechanism commitment and consistency. This rule stems from the human desire for coherence between their own words, beliefs and actions.

How can we improve the technique of "foot in the door"? The modification is "two foot in the door" which differ only in that we found that proper priming two smaller requests.

Technique "foot in the door" in the sales area is used mostly in the cross-selling, where customers intent on buying a single product, is persuaded to buy another one.

The second technique is called "door slammed in face," and is a kind of reversal of the first. In this case, our request is preceded by the appropriate expected much larger, extreme, which will almost certainly not be met. After receiving a negative answer, mention the other one, our proper request, thereby increasing the chances of fulfillment. How does this mechanism works? Well, the "door slammed in your face" using the rule of reciprocity. When our correspondent met with a concession on our part - reducing the rank of request - also feels obliged to make concessions on their part, which is more likely to meet other requests.

As in the case of the "foot in the door", the technique also can be improved. The modification called "double door slammed by the nose" is to prefix the relevant requests two larger.

How does "the door slammed in face" are used in practice

sales? Now, this technique is known retailers who offer the customer at the beginning of the product more expensive, higher-end, and for refusing to meet with a cheaper version of an alternative offer.

Another technique is called a "low ball". According to this principle, when a client after much deliberation, decided to purchase a particular product, he will be more inclined to stay with that decision, even if we change some details. This technique, like "foot in the door," uses the mechanism of commitment and consistency. According to this principle, people like to be seen as those who are confident in their decisions and opinions, so are less likely to frequently change the sentence. Using the technique of "low-ball" often we meet for the purchase of significant value, such as a car. When a client is practically convinced of the desire to buy, there will be less willing to give up even when learns of minor defects of the product sold. The last of the presented techniques is the "principle of contrast". According to this mechanism, we tend to perceive products from the perspective of the other things with which it is compared. Applying this principle, the seller often present your product by comparing it to a competitive, extremely unfavorable. With such a reference, presented the product appears to us the more in a positive light.

Given the described principles and rules can be concluded that today's marketing is very much based on psychological

mechanisms. Therefore it can be assumed that in the future these two areas will work on the basis of practical activities.

However, regardless of the scale of using the rules of social influence in contemporary marketing, it should be kept in mind that marketing essentially involves creating and delivering value to customers. Thus, the use of the rules of social psychology should only be a support for the real value proposition of the product, which is the main core of marketing.

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# Approaches for selecting the correct research strategy

## Differences between full time and part time students

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**Abstract**—Choosing the correct research design is one of the most important steps when writing any kind of thesis. The following paper describes the results from a quantitative research realised on the topic of how students select research designs. The main goals of this study were to identify whereas the preference for a certain research strategy depends on the form of study, and whereas the research strategies used by students are associated with approaches to various areas of their interests. The main research method used was content analysis and statistical tests were performed using the software IBM SPSS v.17. The research found significant differences between full time and part-time students in most areas.

**Keywords:** *research design; quantitative and qualitative research; full time and part time study*

### I. INTRODUCTION

For master's level students, choosing the correct research strategy is important for three main reasons: First, it not only explains what research was performed, but also justifies all the major choices that were made throughout the writing process. Second, it can be one of the easiest places within the thesis to either gain or lose marks. Third, it is possibly the most challenging chapter of the thesis to get to grips with and write in a clear and consistent way. Broadly speaking, when a student does a thesis, he or she will use one of three research designs: a qualitative, quantitative or mixed methods research design [1]. The choice of research design is guided by the research paradigm the student believes in and the type of research he or she is trying to carry out. A paradigm can be understood as a world view, a general perspective, a way of breaking down the complexity of the real world [2].

Unquestionably, the three approaches are not as discrete as they first appear. Qualitative and quantitative approaches should not be viewed as polar opposites or dichotomies; instead, they represent different ends on a continuum [3]. A study tends to be more qualitative than quantitative or vice versa. Mixed methods research resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches.

Qualitative research describes an event in its natural setting. It is a subjective way to look at life as it is lived and an attempt to explain the studied behaviour [4]. The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final

written report has a flexible structure. Those who engage in this form of inquiry support a way of looking at research that honours an inductive style, a focus on individual meaning, and the importance of rendering the complexity of a situation [3].

Quantitative research is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analysed using statistical procedures. The final written report has a set structure consisting of introduction, literature and theory, methods, results, and discussion [3]. Like qualitative researchers, those who engage in this form of inquiry have assumptions about testing theories deductively, building in protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings. Quantitative research establishes statistically significant conclusions about a population by studying a representative sample of the population. The population consists of the entire group being studied. It does not matter if the population is broad or narrow, only that it includes every individual that fits the description of the group being studied [4].

Mixed methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, the use of qualitative and quantitative approaches, and the mixing of both approaches in a study. Thus, it is more than simply collecting and analysing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative research.

The quality of a research study is dependent upon the nature of the problem undertaken by the researcher, and the research design and supportive methodology selected to explore the problem [5]. Methodological decisions depend on the nature of the research question [6].

### II. METHODOLOGY

A total of 114 master theses that were written in 2011 were analysed, consisting of theses written by students of full time and also part time studies. The students were from the Department of Health and Social Work. These are recent works that are in the University of Trnava's library register (theses written in 2012 were not completely available at the time when the research was undertaken). It should be noted, that this research sample does not include all master theses, because during the research I found out, that some works are not freely

available for inspection from various (mostly ethical) reasons (e.g. a thesis on religious sects).

I focused on the following main factors:

- The form of study – full time / part time
- The type of research conducted - quantitative / qualitative (Note: each analysed work included an empirical part, meaning that no work was theoretical, one thesis contained a mixed research strategy that combined both strategies, this work was not included in the research file)
- Scope of research

Determination of the fields in which the research was conducted, was not always obvious, therefore I created four basic categories for dividing the individual theses on the basis of their content, namely:

1. A Specific Group (works dealing with families, communities, ethnic groups, etc.).
2. Management / Policy (works exploring the area of social management, social policy, greater social phenomena etc.)
3. Pathologies (works examining various forms of pathological social phenomena)
4. Health (works addressing issues of health, various diseases, clinical phenomena, etc.).

I am very well aware of the limits of such categorization, but for purposes of this research I consider this division for accurate.

The goal was to answer the following questions:

- Does the preference for a certain research strategy depend on the form of study?
- Does the student's area of interest depend on the form of study?
- Are the research strategies used by students associated with approaches to various areas of students' interests?

The data were analysed with the appropriate software IBM SPSS v.17 using nonparametric statistical tests, namely Chi-square test for association and Fishers exact test [7].

### III. RESULTS

#### A. Are the choice of research strategy and the form of study associated?

The first research goal was to answer the question whether the choice of research strategy used by students differs depending on the form of study. Thus, is it possible to identify differences in the selection of quantitative and qualitative strategies in the students' master thesis of full time and part time form of study (Fig. 1)?

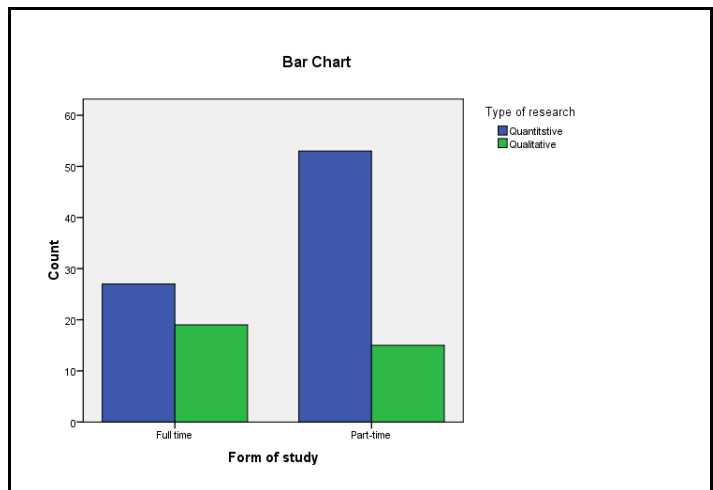


Figure 1. Type of research x Form of study.

The Pearson Chi-square value  $p = 0.028$ , therefore it can be concluded that there are statistically significant differences among the students of full time and part time study and research strategy they chose for their master thesis. I do believe that students of part-time study tend to choose quantitative research methods because they are in a certain way easier for them to understand. Qualitative research strategies require a deeper insight into the problems of empirical research in social sciences, which the full time student is likely to learn more about during contact lessons.

#### B. Does the area of interest of a student vary depending on the form of study?

The next goal was to identify whether the area of interest of a student varies depending on the form of study (Tab. 1). After analysing all works in the research sample significant differences were not observed ( $p = 0.957$ ).

TABLE I. SCOPE OF RESEARCH X FORM OF STUDY

Form of study		Scope of research					
		Specific group			Management / policy	Pathologies	Health
	Full time	16			8	14	8
	Part time	22	13	23	10		

It can therefore be concluded that students' interest in different areas of social life does not differ depending on the form of study.

#### C. Is it possible to observe differences in the approach to different areas of interest of the students in terms of research strategies?

The last goal was to know whether it is possible to observe differences in the approach to different areas of interest of the students in terms of research strategies (Fig. 2).

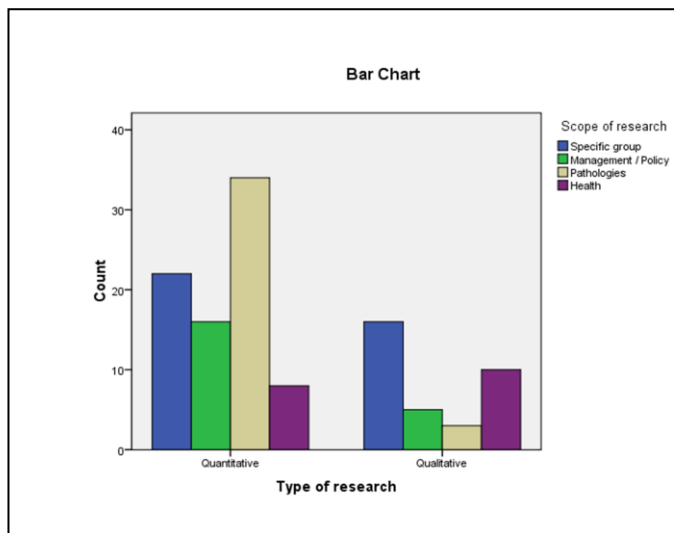


Figure 2. Type of research x Scope of research

Indeed, given the value of the Pearson Chi-square  $p = 0.01$ , we can conclude that the difference in approach to various areas of social life in the master theses can be identified. For problems relating to various pathological phenomena students often opt for quantitative strategy solutions.

It is interesting to watch this assumption even if the file has been split according to the criteria of study. Exact testing procedures were used to determine the results because of fewer students in each category. Let us illustrate the differences in the forms of study in the following bar graphs (Fig. 3, 4).

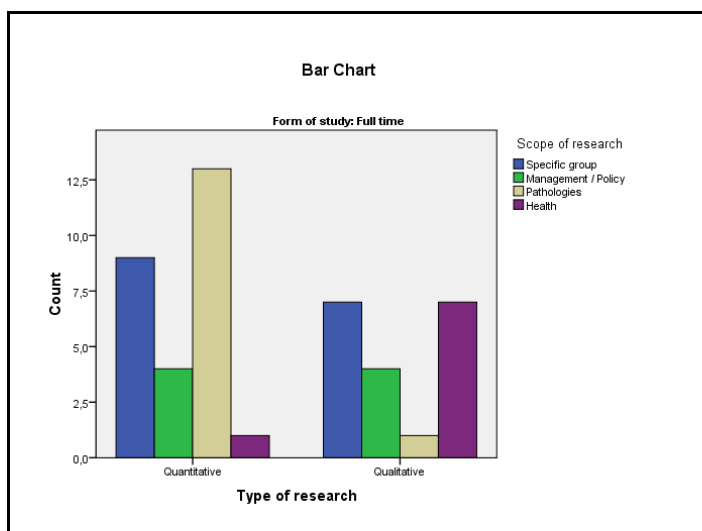


Figure 3. Type of research x Scope of research (full time study)

The value of Fisher's exact test is  $p = 0.002$  for full-time students and  $p = 0.030$  for part-time students. Thus, our assumption is valid for the entire set of students, but also for full time and part time study alone.

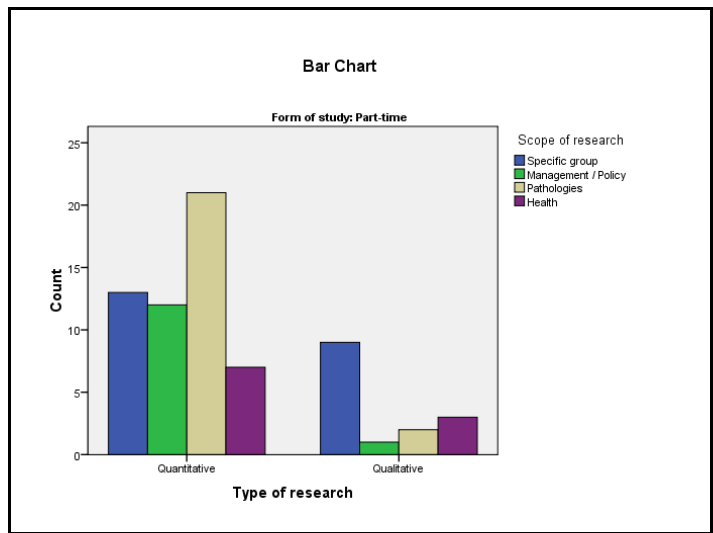


Figure 4. Type of research x Scope of research (part time study)

#### IV. CONCLUSION

The results of the research show that there are significant differences between full time and part time students. As mentioned before, I do believe that students of part-time study tend to choose quantitative research methods because they are in a certain way easier for them to understand. Qualitative research strategies require a deeper insight into the problems of empirical research in social sciences, which the full time student is likely to learn more about during contact lessons. Therefore it is important for the teachers and lecturers in social work and humanities in general to focus more on the qualitative approach and various methods of qualitative research. Students often do not feel comfortable with these methods and they also have problems with the analysis of qualitative data. A good understanding of both research designs is essential for improving the quality of master's (and other) theses.

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# Features of preparation of teachers–bachelors of mathematic in the conditions of distance learning

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**Abstract – The article describes the main features preparation of teachers–bachelors of mathematic in the conditions of distance learning. Outlines the factors enhancing didactic and cognitive activity of teachers–bachelors of mathematic in the process of distance learning, the challenges and problems of preparation of teachers–bachelors of mathematic in higher education institutions.**

**Keywords - distance learning, distance form of learning, preparation of teachers –bachelors of mathematic.**

## I. SCIENTIFIC PROBLEM AND THE REASONS FOR IT.

The modernization of higher pedagogical education needs traditional system of training future teachers of mathematics to be improved. Society of the third millennium needs fundamentally enlightened person capable to change flexibly direction and content of his professional activities. The contemporary training of future teachers–bachelors of mathematic insufficiently focused on the use of information and communication technologies, there is little focus on the individual and requires a creative, exploratory approach to teaching. At the heart of XXI century teachers–bachelors of mathematic should be an opportunity to provide the future specialist an education of the required level and depth to every segment of life. The contemporary stage of development of secondary education has high requirements for the training of teachers, armed with the latest methods and techniques of training, the creator of a creative learning process [5, 10].

Preparation of teachers–bachelors of mathematical disciplines must take into account the specifics of disciplines in natural science. Relations between the idealized objects, not clearly reflect the reality. In this sense, the place of mathematics is special even among the disciplines in natural science. Mathematics is not only contributes to the appearance of new knowledge about nature, society and man, but also finds a kindred sciences real incentives for their development. Thus, the development of the theory of locally convex spaces in functional analysis was stimulated by physical problems of quantum electrodynamics and the problem of finding the generalized solutions of the equations of mathematical physics, the problems of quantum mechanics, tensor analysis - problems of mechanics of elastic media, the theory of functions of several interchangeable - the problems of quantum field theory, etc. On the other hand, in mathematics itself in the last decade appeared sections that are relatively independent subject and specific research methods: artificial intelligence and queuing theory, the theory of stochastic processes and functional

analysis, game theory and mathematical programming, algebraic geometry and set-theoretic topology and others. Therefore, the investigation ever-increasing trend towards fundamental nature preparation of teachers–bachelors of mathematic is associated with intensive use of mathematical methods in other sciences. Organic integration of disciplines in the areas of vocational training, undergraduate mathematics teachers can provide distance form of learning.

## A. Review of the literature on the topic.

Design of distance learning in higher education institutions involved in H.V Burkina. The application of computer technology in the study mathematics devoted work O. Gavrylenko, V. Kushnir, M. Zhaldak. Works of M. Kadem and P. Gurevich are dedicated to problems of the use of telecommunications in education. Opportunities and prospects for distance education, particularly in high school, described in his works V. Domracheev, G. Mihalyn, N. Morse, I. Shuljak, P. Ukhov, A. Lomakin.

## B. The purpose and objectives of the study.

The main objective of the study is to describe the main features of preparation of teachers–bachelors of mathematic in the conditions of distance learning. The main objectives are:

- 1) to outline the factors enhancing didactic and cognitive activity, teachers–bachelors of mathematic in the process of distance learning,
- 2) to describe the challenges and problems preparation of teachers–bachelors of mathematic in higher education institutions.

## C. Methods and phases of the study.

One of the guiding objectives of teacher training of teachers–bachelors of mathematic is the transformation of the individual student in a professional teacher who is able to solve various problems related to the education and training of students. Improving the training teachers–bachelors of mathematic requires not only a new, more effective ways of organizing the educational process in higher education, but also view the structure and content of mathematical training of students, raising it to the level of technology teaching and learning. In modern conditions, the intensive use of mathematical methods in natural history, engineering and adjacent sciences, which will surely find the display in changing programs of school and university mathematics education, there is also an important issue to better incorporate

holistic psychophysiological mechanisms of perception personality student develop his mathematical skills, thinking and culture. The needs of society in mathematics education of citizens are enhanced.

Game theory, artificial intelligence, and information theory become available for study. The logic of mathematical sciences, which are becoming more meaningful in practical application, has not actually represented in the mathematics education of pupil. On the other hand, these new knowledge gives motivational charge of the study of mathematical disciplines and, as a consequence, an increasing interest in the teaching profession of mathematics, as the mathematics education is best of all adapted to the development of the qualities of thinking, the development of theoretical thinking (comparison, heuristics, analogy, insight, analysis, synthesis, etc.). Mathematical thinking of teachers–bachelors of mathematic differs by domination of logical reasons, laconic, clear logic stroke considerations, the ability to identify the main, the ability to synthesize, analyze, synthesis [4, 10].

Training of Mathematics of the first degree is in need of changes in the content of education and teaching methods. Learning mathematics and content of mathematics education in middle and in high school should be revised in the direction of greater visualization, visual modeling and disclosure of the social status of mathematics. Performance of thinking and perception, the development of objective language, logical reasoning usefulness, brain development may be the result of real mathematics education provided its optimal organization. In this regard, improving the training of undergraduate, math teacher needs to look at the structure and content of the training of students specializing in mathematics towards the optimization of its fundamental and human components, raising the theoretical basis of teaching processes at the technological level [6, 7].

Reforming of the current educational system poses in front of pedagogical universities special tasks, which are determined by society's need for teachers who are capable of solving complex problems of training, education and development of students, the formation of their personality. This predetermines the need for a change in the preparation of teachers–bachelors of mathematic. Math teacher with a high level of intelligence, logical thinking, creativity is able to form individual student to meet the requirements of modern times. It should be noted that the main role in this process is the teacher of mathematics [1, 9].

In this regard, teacher–bachelors of mathematic must possess not only a fundamental knowledge of mathematical disciplines, but also a complex of concrete means of professional activity. However, in the training of bachelors–teachers of mathematics questions about the features of the formation of the concept of the use of distance learning technologies are not resolved. According to the modern requirements of subject teachers, in particular mathematical function should be used in the educational process not only a means of communication and information, such as email, thematic forums and chat rooms, but also the elements of distance learning technologies. The future must accompany the traditional teaching self-created distance courses [2, 3].

Despite the considerable amount of research on the characteristics of teachers–bachelors of mathematic, the question of their training is relevant, because the development of society does not stop. Changes that occur in the school education put forward significantly higher training requirements math teacher.

At the contemporary stage of development of education is appropriate to focus on these professionally significant qualities of bachelors–teachers of mathematics, as the focus of the self-learning, self-improvement, as well as deep knowledge of educational material mathematical disciplines. Improvement of the quality level of preparation of students specializing in mathematics is to divert them to distance learning. This approach will contribute to enhancing of the cognitive, research activity of bachelors–teachers of mathematics, the disclosure of their creativity, increasing of the role that independent individual work and is based on a broad introduction to the educational process of teaching and the latest information technology. Targeted work of faculties, departments, faculty of formation and development of the individual in terms of distance learning is the guarantor of improving the quality of learning of their educational material. Let's select the most important factors to enhance the didactic and cognitive activity, bachelors– teachers of mathematics in the process of distance learning:

- development of motivation, strengthening of interest in learning, including methods of acquiring knowledge;
- the development of logical thinking, intellectual abilities;
- individualization and differentiation of teaching;
- providing the benefits of active learning methods;
- increase the visibility of training;
- increasing of arsenal of cognitive activity, the mastery of modern methods of scientific knowledge related to the use of computers;
- simplifying and increasing of the speed of accessing to educational and scientific information through the Internet [2, 6].

During the lesson, math teacher need to pay attention to many aspects, but it is possible to highlight the main aspects that develop in the conditions of training with the use of distance learning:

- the development of memory, vision, and the use of certain properties of mathematical objects;
- develop pupils' computing habits;
- development of a detailed, correct mathematical language;
- revision and consolidation of learned material;
- update support students' knowledge;

- transition of quantitative characteristics of exercise in quality;
- checking the degree of assimilation of new material;
- create a problematic situation to move to studying of new material [3, 7, 9].

Preparation of teachers–bachelors of mathematic should be conducted in close connection with the information and mathematical software that is used in their professional activities. Organization of preparation, optimization of the structure of the content of the professional disciplines of teachers–bachelors of mathematic are designed to improve the quality of training. The introduction in the educational process of schools of information and communication technologies is the requirement of time. Without the use of remote sensing, and information and communication tools cannot provide a quality education. Training of future teachers in the conditions of distance learning will help bring the quality of their education on the appropriate level of information [3, 7, 8].

Mathematics teacher of general educational institutions should be able to navigate in the information space, to obtain information and to operate it according to their own needs and requirements of today's high-tech society. Namely:

Generate:

- Text documents, which include a set of formulas, mathematical symbols and notation,
- Spreadsheets integrals, differentials, derivatives, mathematical formulas etc,
- Drawings, graphics and photo images of geometric figures in the plane and spacious,
- Charts, bar graphs, plots of the mathematical values,
- Presentations that accompany the demonstrational elements of the trainings.
- To use:
- The Internet to search the information, educational topics of the subject;
- Ethernet to exchange methodological developments and practices;
- Data for accumulating and storing educational information.
- To carry out:
- Questioning, diagnosing, testing the level of knowledge of the pupils of secondary schools,
- Find the necessary educational information on the Internet in order to update the curricula, methods and means of teaching mathematics.
- To develop their own electronic products:
- The development of mathematics lessons,

- Demonstration material in the form of presentations, video lectures, photographs etc.,
- Audio Lectures.
- To combine electronical products which are finished:
- Online tutorials, books and encyclopedias,
- E-learning materials in different formats,
- Training and demonstrational programs etc in their professional activities.

Teachers of Mathematics higher education in modern conditions is based on a certain level of mathematical culture and intellectual development, the scientific world, the understanding of the practical orientation of mathematical disciplines, mastering the methods of mathematical modeling. N. Burkina noted in his experiments that the level of this training is to allow students in the future to develop and deploy technology, the foundation of which may be unknown at the time of training [1].

G. Myhalin, the scientist, notes in his work that the organizers of mathematics education at the universities need to think about what and how they should teach students to prepare them for the variety of the following activities and at the same time demonstrate the attractiveness of the state importance of each areas they have chosen for further work. The teachers of Mathematics role and methods of teaching are constantly increasing with the development of civilization. the Integration of mathematics and other sciences acquires the meaning in the development of distance learning technologies. Evidence of this fact is using mathematics in such areas as biology (examining operation and construction of some of the functions of a neuron, the studying the problems of heredity, deciphering the genetic code), sociology (the problems of demography and structural linguistics) economy (from predicting the location of minerals to studying the demand for consumer goods and consumer services, from studying of the needs of the labor force to planning transport networks, passenger transport, the experiments of artificial influence on atmospherical phenomena, etc.) also technology, physics, chemistry, computer science and information technology, where technological processes become important. At the same time there are the specific needs of the theoretical and practical problems which stimulate the creation and the development of new areas of mathematics. So in recent years practical application of non-smooth and non-convex analysis, the theory of fuzzy sets, the theory of fractals, stochastic optimization are formed and found. This in turn pushes the methods of teaching mathematics in higher education to improving, and to the improvement of bachelor of mathematics teachers [7].

The main objectives of bachelor of mathematics teachers in higher education are the following:

- To demonstrate to students the essence of the scientific approach for the examining the processes and phenomena of the world, the role of mathematical disciplines in the development of scientific research and technical progress;

- Form students' ability to construct mathematical models of real processes and phenomena, to explore their mathematical methods to solve formal problems, analyze the obtained results;
  - To form the habit of self-study of mathematical literature and other sources, and use of mathematical knowledge which are obtained for self-education and self-development;
  - To form habits of undergraduates teachers of mathematics to the study of mathematical disciplines in the development of information and communication technologies.
  - In this study, Bachelor of mathematics teachers in higher education institutions must ensure that:
    - The formation of the personality of undergraduated, math teachers, the development of their intellectual abilities, analytical and synthetic thinking, and corresponding culture of mathematical intuition;
    - The acquirement of the mathematical apparatus which is necessary for studying of professional disciplines, the development of mathematical abilities of conscious perception of the mathematical material that are typical to the relevant profession;
    - The acquirement of basic mathematical methods that are necessary for analysis and modeling the processes and phenomena that occur in the social, economic, technical, manufacturing and information systems, the search for optimal solutions to improve the efficiency of these systems, selecting the best way to implement these decisions, processing and analysis of results computational experiments;
    - The formation of an appropriate mathematical level for bachelor-teachers of mathematics in higher education for future careers, self-mathematical, scientific activities in the areas of modern mathematics;
    - Creation of the information culture that are related to future professional work in the informational society [4, 9].
    - The main ways of training bachelor-teachers of mathematics include the following:
      - The purpose and destination of bachelor-math teachers in higher education;
      - Problems of mathematical education of Bachelor-math teachers in higher education;
      - The content of mathematics education and training of undergraduate, math teachers in higher education;
      - Organization of bachelor-math teachers at a university;
      - Pedagogical innovations in mathematical education and training system of Bachelor-math teachers in university;
      - The use of information and communicational technologies in teaching mathematical disciplines and their role and place in mathematical education and training system of Bachelor-math teachers in university [6, 7].
- Mathematical disciplines are the foundation of scientific processes that are developed. Finnish researcher George Malati, describing the state of mathematics education in the Western countries, says in his work that the dynamics of change is expressed with pleasure in international conferences, but in reality the situation is opposite. Everyone complains about the weakness of today's students. Professors who works in universities, are displeased by the education in high schools. In schools, the interest in the study of mathematics is low. To recruit students of high level has become a problem for mathematical departments. Sometimes even the students on math degree are happened to be so few that it is impossible for them to organize the training for the required level. Not all students who come to the mathematics departments finish them: a significant percent of those who entered this department turn to another one or even leave the university. Similar problems exist in universities and similar specialties (eg, physics). All this applies to educational institutions of higher education. These are the main reasons for the low level of teachers of mathematics [1, 9].
- Scientists exploring the main areas of mathematics education pay attention to the following issues:
- 1) reduction of the volume of mathematical disciplines, reducing the number of hours that are allocated to the study of mathematical disciplines in higher education institutions;
  - 2) the gap between the level of mathematical knowledge of high school graduates and the requirement knowledge of students in higher education institutions;
  - 3) the gap between the level of mathematical knowledge of bachelor graduates specializing in mathematics in higher education and the needs of the modern labor market, science and technology;
  - 4) insufficient funding for education from the state [4, 10].
- Analysis of the state of teaching mathematical disciplines in some universities made by the Ukrainian scientists, including pedagogical direction, showed that the results of students' learning, their level of mathematical culture, cognitive activity and independence is quite low. This all has a negative affect to the quality of the knowledge and skills of undergraduate-math teachers, their intellectual development and the level of training. This study has permitted to point several basic problems faced by the students in the study of mathematical disciplines:

- the low level of basic theoretical training in mathematics;
- lack of practical skills and habits regarding the use of this knowledge;
- low motivation to study mathematical disciplines cycle;
- lack of didactic and cognitive activity of students of mathematical sciences;
- inability and unwillingness of students to work independently;
- insufficient number of hours that are set aside for the study of mathematical sciences;
- lack of quality modern textbooks, manuals, educational materials, including electronic;
- inability to apply mathematical knowledge to practical problems and formalize their decision [2, 6].

Reaching the goals and objectives of the quality training of future Bachelor teachers of Mathematics makes it necessary to find ways and means of improving his methodical preparation, which is an important element in the structure of vocational teacher formation and development. The teacher must deeply understand the importance of the approach selected to have the motivation and desire to innovate and to be able to design new technology training. Bachelor's math teacher should have the intrinsic motivation and well managed to learn, strive to achieve personally meaningful results, understand the specifics of future professional activity, to be set up on an active interaction with the instructor and other students.

#### CONCLUSIONS

Preparation of Bachelor of mathematics teachers in higher education should promote the students` who are specialized in mathematics to participate actively in the process of computerization and information. The study of mathematical disciplines in pedagogical universities should give bachelors-

teachers of mathematics necessary knowledge and skills that contribute to shaping the world, provide an opportunity to acquirement a complex professionally-oriented disciplines and can reasonably solve educational problems. Mathematical disciplines have ample opportunities to develop logical thinking and spatial representations of the imagination, algorithmic culture, forming abilities to establish cause-and-effect relationships, to simulate the situation.

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# Phonetic Competence as Part of Students' Linguistic Sociocultural Competence at Linguistic Institutions of Higher Education

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**Abstract**— The phonetic competence is one of the means of forming the more general, linguistic sociocultural, competence, which is necessary for a student who acts as an active participant of educational process as well as of everyday, social and professionally oriented communication within the framework of integrated international relations. (Abstract)

**Keywords**- *linguistic sociocultural competence; phonetic competence; sound; intonation; phonostyles (key words)*

## I. INTRODUCTION

The ongoing process of globalization and focusing upon international education tendencies demand new approaches to the process of foreign language teaching within the framework of higher education institutions in Russia. Such training nowadays implies not only factual and practical mastering all language aspects. First of all, it requires formation of the ability to ensure an individual self-fulfilment in the process of intercultural communication [1].

The main aims of foreign language teaching remain unchanged. But the area closely connected and devoted to linguistic and cultural studies, history and culturology must be substantially expanded [2, 3, 4]. It is the competence-based approach to foreign language teaching that greatly contributes to the realization of these ideas [5]. Its main aim is developing a student's personality with wide world outlook, critical thinking, contextual guess, culture of conversation and appropriate behaviour. All this enables a student to become a full-fledged participant of cross-cultural communication in social, cultural, educational and professional spheres carried out in a foreign language.

Thus, the view on teaching foreign languages has notably changed and the motivation in studying them for the purpose of cross-cultural communication has amplified. More and more people become involved in this process which leads to the heightened needs in mastering foreign languages and a qualitative change of the aims of training. Thereupon teaching phonetics is considered to be rather topical.

Why is it the phonetic aspect of the language that is in the focus of our attention? Although it may seem "an old issue" and "the least culturally loaded", today the perception of this subject is different. The phonetic material of a language can be

viewed as a source of cultural information, especially ethical norms and behaviour patterns. So, the purpose of the paper is to show that studying a foreign language phonetics can be treated as a means of the formation of the linguistic sociocultural competence and also to illustrate the way we embody these principles in teaching Russian students English phonetics.

## II. NOTION OF LINGUISTIC SOCIOCULTURAL COMPETENCE

To better understand the development of what parts of the linguistic sociocultural competence the study of phonetics can contribute to, we should be aware of the range of components this competence comprises.

From the perspective of language education the linguistic sociocultural competence is a key one for a student who acts as an active participant of educational process as well as of everyday, social and professionally oriented communication within the framework of integrated international relations.

In scientific works devoted to interculturally oriented teaching the linguistic social competence is defined as one of the basic divisions of the so-called education of new formation alongside with the study of civil rights, environmental issues, politics and social science. From the point of view of global education the process of linguistic social competence formation is one of the main education aims, as it is absolutely necessary to develop students' empathy to carriers of other cultural values, views, to stimulate flexibility and variation of thinking.

The educational component presupposes the use of a wide range of methods and approaches as tools for effective understanding of foreign culture. It helps to define extra linguistic status of existence for a multicultural personality.

Extra linguistic characteristics of such a personality imply self-sufficiency, empathy, reflection and tolerance. The base of these characteristics is experience in the sphere of emotional and evaluative attitude of an individual to ethnic and cultural interaction.

The cognitive component comprises cross-cultural, cultural and behavioural competence. These competences (on the basis of native and foreign cultures) include the following knowledge: cross-cultural realias and their influence on culture carriers' world outlook, social realias and conventions, values.

In addition to this, the behavioural competence means awareness of dos and don'ts of polite manners, the ability to react adequately to changing cultural context. The psychological component implies a set of individual axiological characteristics [6].

As for the linguistic competence, it can be viewed, on the one hand, as something intermediate between pragmatic and cognitive competence, and thus being an applied sphere. But on the other hand, it does not contradict the idea of inseparability of thinking, culture and language. This idea dates back to the scientific research carried out by V. Humboldt, L. Veybergh and Sahir Wharf hypothesis about linguistic relativity, implying peculiarities of linguistic perception of the world around us, about cognition of the world with the help of linguistic means. So, language does not exist outside culture, outside inherited scope of theoretical ideas and practical skills, which characterize a certain nation's way of life [7].

Culturology and linguistics in their correlation and interconnection give rise to the development of the concept "linguistic personality". This personality is a synthesis of linguistic and psychological phenomena [8, 9].

Thus, we can say that the linguistic competence being an integral and essential part of the linguistic sociocultural competence is viewed not only as a tool of learning another cultural environment, but also as a means of an individual's development.

All this allows us to conclude that the process of teaching in context of intercultural paradigm possesses great potential for the development of an individual. Being an integrated unity of components, the linguistic sociocultural competence directly influences a student's personality, their abilities, personal qualities, traits and characteristics. All this enables a student to carry out different types of verbal and cognitive activities in the process of interaction with representatives of other cultural environments.

The linguistic sociocultural competence can be defined as a student's general understanding of basic culture characteristics, knowledge and empathetic perception of cultural and historic realities of a country, its ethical norms and behaviour patterns, awareness of similarities and differences in foreign environment as compared to a student's native country. It can be stated that the linguistic sociocultural competence is of a complex character. According to the given definition its key components are linguistic, sociocultural and communicative competences [1].

### III. PHONETIC COMPETENCE AS BASE OF LINGUISTIC SOCIOCULTURAL COMPETENCE

Foreign and Russian linguists and methodologists have always paid great attention to the problem of choosing teaching methods in order to form adequate pronunciation skills (H. Brown, V.A. Vinogradov, N.D. Galskova, O. Espersen, I.A. Zimnyaya, U. Littlewood, U. Rivers). In other words, the idea of producing and perception of speech messages is a base for English Teaching Methodology. Nevertheless, a current tendency to give a deeper analysis to the phenomenon of intercultural speech communication demands a more profound

approach to the reconsideration of the mechanisms of speech production and speech perception [10, 11].

From the very start, it is necessary to point out that language proficiency implies high level skills formation in all types of speech activity, their interrelation and interdependence. To understand foreign speech and to be understood is a fundamental aim of foreign language teaching. So students, on the one hand, should have a highly developed speech hearing to carry out interpretation of speech messages. On the other hand, they should possess all the necessary articulatory skills to express appropriate reaction to the information received and to adequately code their own foreign speech.

In order to fulfil the tasks it is absolutely necessary for students to make their speech sound more authentic, develop their pronunciation and intonation skills in monologues and dialogues, which makes the main point of the phonetic competence and is considered the traditional approach to the subject.

This problem is profoundly and deeply dealt with at the initial stage of foreign language teaching and is realized within the framework of the subject "Practical Course of English Phonetics". It is aimed at students' mastering the process of foreign language sound perception, methods of phonetic analysis applied to various types of language material, skills of correct sound and intonation arrangement of the utterance because acquiring correct pronunciation skills is the main condition for all types of speech activity. But we should make it clear that practicing technical articulatory skills is just the beginning of a very long process. And that is where a very important part is assigned to the teacher who should explain to students that speech sounds are just a basic part of a complex system of the phonetic means of a language mastering which helps successful cross-cultural communication.

According to the requirements of the program and the content of the subject this system comprises three main constituent parts:

- Sounds and their modification in connected speech (the peculiar features of the phonetic system of a foreign language under study, differences in the articulation bases of contacting languages, characteristics of the articulatory norms of a foreign language, accurate pronunciation of sounds and sound combinations, analysis of the phonetic phenomena, explanation of the causes of the most typical phonetic mistakes).
- Intonation (the study of basic intonation patterns, observance of the rhythmic and melodic organization of speech and pausing, use of dramatic reading skills in a foreign language).
- Functional phonetic styles (intonation correlation with the semantic content of speech, with the context and situation, skills of correct intonation arrangement of one's own statement, differentiation of phonetic styles of a language under study).

Apparently, the study of these aspects directly leads us to the realization of such components of the linguistic

sociocultural competence as students' empathy, tolerance, awareness of polite manners and so on.

Traditionally it is Received Pronunciation that is the basis of studying English in most Russian institutions of higher education. It is defined as the form of English which is current and literary and acceptable wherever English is spoken. If students come across any deviations from it, additional comments are given. Here we can speak about variants of English existing on the territory of the United Kingdom and outside it (e.g. American English). Taking into account people's pronunciation we can judge about their background, education, occupation and even emotional state.

Students begin studying phonetics with the so-called "introductory course" where the attention is generally focused on studying the phonemic structure of English, and also on obtaining some general information about word stress and intonation, reading and spelling rules. They must learn to perceive a sound (pronounced in isolation, in different positions in the word), reproduce a sound (in isolation, taking into account its characteristics and the existence/absence of its counterpart in the native language, and also in connected speech taking into account its changes), establish sound-alphabetic correspondence. During this stage the "cultural" load is not so great, however indirectly it all the same is present. For instance, students find out what words in the English language are traditionally capitalized while their Russian counterparts are not (e.g. *English, French, June, Monday*).

Some typical tasks for students may be to listen to some sound and pay attention to the way it is pronounced; repeat words after the speaker paying special attention to some of the sounds; pronounce words paying attention to the length of vowels; etc. But what students must be very well aware of is that sounds are seldom pronounced in isolation, they are used in combinations with other sounds in connected speech and are modified by them. Students are brought to understand the mechanisms of assimilation, reduction, positional length of vowels, loss of plosion and so on. While doing phonetic exercise students are asked to avoid glottal stop, pay attention to cases of loss of aspiration, reduced vowels in unstressed positions, etc., thereby they learn to respect the laws of foreign speech.

But even at the initial stage during the lesson it is obviously necessary to touch upon all the three phonetic components described above (in this case students will have an opportunity to see how the phonetic aspect of the language functions, how the choice of nuclear tone, pitch, tempo and timbre provides the relevance of an utterance in one or another communicative situation). Let us consider the example of palatalization. After doing exercises like *"Read the words. Pay attention to the absence of palatalization. Which words contain a palatalized sound?"* students can be asked to listen to a short conversation and find the words containing front vowels. Students will hear a piece of everyday English with the sounds under study. Then the teacher can ask them to role-play the conversation making sure they have no palatalization in those words. If possible, students can be asked to make up their own dialogues with the words given (e.g. *till, eleven, fill, ill, live, meal*). In such a case

the teacher defines priorities and a time proportion for each section depending on the objectives of the lesson.

After mastering the pronunciation of a few sounds and learning how to pronounce a few monosyllables, students begin working at intonation speech patterns. This work is aimed at achieving accurate rhythm of utterances, correct detection of the semantic center and keywords with the help of melodic and temporal means. The task of the teacher consists mainly not in making students imitate a sample they hear, but in bringing home to them the importance of mastering the intonation of a language under study since it is the intonation that often contributes to the successful solution of communicative tasks. Students have to learn to reproduce some intonation patterns of the English language, to compare them with the corresponding models in their native language, to be able to make the right choice depending on a communicative situation and the structure of a sentence. It is possible to illustrate it through the example of the intonation patterns of the direct address. Depending on the structure of an English sentence direct address can/cannot form a separate intonation group. The choice of the nuclear tone is determined by a communicative situation. In official serious speech it is pronounced with the Low Falling Tone, but it can also be pronounced with the Falling-Rising Tone to attract the listener's attention or in a friendly conversation. It is necessary to notice that under conditions of limited lexical and grammatical means the clarity and expressiveness of the utterance is reached only due to phonetic arrangement of speech which is considered an element of compensatory strategies [12].

The influence of rhythm is also very important. To sound English you should observe the rhythmic structure of the English language which differs from the rhythmic structure of Russian. To master it students have to do the tasks like *"Read the dialogue tapping the beat"* or *"Write one word in each sentence below. The word must have the stress pattern shown. Read the sentences"* and the like.

At the stage of studying functional phonetic styles (familiar, scientific, informational, publicistic, declamatory) the sociocultural component becomes quite obvious as phonostylistics examines interconnection between the linguistic and extralinguistic factors caused by the culture of native speakers. Phonetic means serve to transfer socially significant information about the communicative situation, interlocutors and their relationship. Considering different phonostyles we speak not only about their phonetic features, but also about lexical (choice of words and expressions) and grammatical (choice of grammatical structures) ones. It is useful to supply students with various speech patterns along with comments concerning peculiarities of their use because to be able to communicate with the British naturally you need to know the culturally acceptable ways of oral interaction in English. Let us illustrate it through the example of the intonation patterns of the phrases *"Excuse me"* and *"Sorry"* and their distinction in different situations [13].

*"Sorry"* pronounced with the High Falling Tone is not a strong apology, it is used after you have slightly inconvenienced somebody in some way. *"Sorry"* pronounced with the Rising Tone is used to ask a person to repeat what

they said because you didn't hear, understand or believe it. If you really regret something you should say "*I am terribly sorry*" with the Low Falling Tone. "*Sorry*" is always used after you have done something. "*Excuse me*" pronounced with the Falling Tone is the normal expression if you want to pass somebody in a crowd, on a bus, after sneezing, yawning, etc. Being pronounced with the Low Rising Tone it is used to attract somebody's attention, especially if you do not know their names. All these allows us to conclude that learning to pronounce such phrases helps students adopt some behaviour patterns peculiar to native speakers.

#### IV. CONCLUSION

In the course of mastering a foreign language the formation of the phonetic competence is one of the means of forming the more general, linguistic sociocultural, competence. The latter is considered to be of a complex character, incorporating general understanding of basic culture characteristics, realias of a country, its ethical norms, behavior patterns and so on.

We cannot deny the extreme difficulty of the process, which presupposes the development of students' pronunciation skills, empathy to carriers of other culture, tolerance, behavioural competence. It is the teacher who plays a very important role in making students understand the necessity of mastering the phonetic aspect of the language for the purpose of successful cross-cultural communication. The teacher shows how to "extract" some cultural information from phonetic material, how to adequately code one's own foreign speech. The volume and the choice of the material studied are determined by stages of learning a foreign language, though we consider it appropriate and encourage teachers to work with all the three phonetic components (sounds, intonation, phonostyles) even at the initial stage.

Thus, we observe the creation of the cross-disciplinary space in which many academic subjects (methodology,

psychology, study of language, cultural science, various aspects of linguistics) are integrated. All this is aimed at making a student a full-fledged partner of cross-cultural communication in a foreign language.

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# The Multiple Improvement of a Child with the Birth Defects Syndrome – Sensory Integration, Speech Therapy – Study of the Case

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**Abstract—** A case study of a boy with birth defects syndrome (BDS) treated with rehabilitation with the use of sensory integration in order to improve the proprioception, the sense of balance, the proper receipt of other sensory stimuli. Effect of sensory integration therapy to get the proper muscle tone and reduction of scoliosis. In the event of the occurrence of BDS observed various types of speech disorders. They may relate to incorrect pronunciations of the individuals sounds of speech, delay speech development, difficulties in its implementation, or total absence of possibility of transmitting speech. Early support for speech therapy allows you not only to introduce prevention but also to take action on the speech to stimulate speech development. Monitoring its development and evaluations of communication facilities.

**Keywords-** early support, birth defect, rehabilitation, sensory integration, speech disorders, speech therapy, articulators functioning

## I. INTRODUCTION

The object of multiple improvement is changing for the better psychomotor status and correcting irregularities observed in the development of the child through the use of various remedial and therapeutic techniques. It is based on stimulation its psychomotor and social development to begin with the detection of disability pending I starts learning at school. The scope of the impact on the patient's can be very different and depends on the development deficits, which were diagnosed by specialists. It may include: psychomotor, the realm of: communication, including speech and language, functioning of senses of the child and many others. Because early power development is carried out for a number of years, so there are currently, as a result of the experience, rules of conduct and procedures included in the legal documents, which are: The Ordinance of the Minister of National Education and Sports of 4<sup>th</sup> April 2005 on the organizing of early support development of children (Dz. U. Nr 68, poz. 587) issued on the basis of article 71b, section 7, subsection 1 of The Act 7<sup>th</sup> September 1991 on education system (Journal of laws of 2004, Nr 256, item 2572, nr 273, item 2703 and of 2005 Nr 17, item 141).

## A. Presentation of the case

A boy, who names Hubert, was born on October 3, 2004 at the end of the eight month of pregnancy by Cesarean. In the scale of ABGAR he got 8 points, because 2 points were deducted for pigmentation of skin and poor reflexes. five minutes later, as a result of reassessment, he received 10 points. The baby was born with a number of disadvantages including: a congenital obstruction of rectum with recto- and urethrostomy, a heart defect – the tetralogy of Fallot, the disadvantage of thoracic vertebrae, sacrum deficiency and intestinal malrotation. Because of them, the boy went through a lot of complex operations, including: the opening of the rectum and separation of the recto- and urethrostomy (12.05.2005), making the rectum from the surrounding tissue in order to obtain a free descent to a height of crotch integument. Besides the front body of the crotch was opened and then founded seams which anchor rectum and levator ani muscles, it was implanted neorectum into the muscles of muscle complex next. At the end the crotch was stratifiedly sutured. Another surgery was the closure of colostomy, which took place on May 31<sup>st</sup> the same year. At the time Hubert is under the care of the specialist clinics, which are located all over Poland.

The detailed description of defects, which were diagnosed at the boy.

The tetralogy of Fallot – a complex of congenital heart defect consisting of pulmonary stenosis, interventricular septal defects, hypertrophy of right ventricle, and dextroposition of the aorta. ((Dorland's Pocket Medical Dictionary, 28<sup>th</sup> edition, p.923, Wrocław). This complex takes approximately 10% of all congenital heart diseases and is the most common cyanotic heart defect in children (approximately 75%) after the second year of life. ([www.kardiochirurgiadziecieca.cm-uj.krakow.pl/r212.pdf](http://www.kardiochirurgiadziecieca.cm-uj.krakow.pl/r212.pdf))

- cyanosis may be relatively small (pink Fallot) or very severe at the beginning of the neonatal period, in the case of critical pulmonary stenosis or right ventricular outflow tract,
- systolic murmur (ejection murmur), crescendo-decrescendo, loudest over the pulmonary artery,

- hypoxemic seizure (anoxemic), appearing usually between the 6<sup>th</sup> and the 24<sup>th</sup> month of the child's life,
- a symptom of squatting – crouching child reduces the degree of hypoxemia by increasing peripheral resistance and end-diastolic pressure, reducing the same right-left leak,
- clubbed fingers.

Agenesis of sacrum (hypoplasia of sacrum) – “sacral agenesis is defined as the congenital absence of the whole or part of the sacrum. It has a heterogeneous aetiology. In its classical form, often described as the caudal regression syndrome, there are malformations of structures derived from the caudal region of the embryo, that is, the urogenital system, the hindgut, caudal spine and spinal cord, and the lower limbs.” (Lynch S.A., Wang Y., Strachan T., “Autosomal dominant sacral agenesis: Currarino syndrome.)

The defect may have different severity, according to the Renshaw classification, there are four types of it:

I – partial or total unilateral sacral agenesis,

II – partial sacral agenesis with a bilaterally symmetrical defect, a normal or hypoplastic sacral vertebra, and a stable articulation between the ilia and the first sacral vertebra.

III – variable lumbar and total sacral agenesis, with the ilia articulating with the sides of the lowest vertebra present.

IV – Variable lumbar and total sacral agenesis, with the caudal endplate of the lowest vertebra resting above either fused ilia or an iliac amphiarthrosis.” (Dr Arun Pal Singh – “Sacral Agenesis”)

Early diagnosis occurring in boy malformations defined the scope of the necessary surgical operations and following each of these rehabilitation intervention. Until now Hubert has undergone 10 operations. After each of them was necessary rehabilitation in order to improve the physical and mental state of the child. Due to the prevalence the birth defects syndrome in boy, using multifaceted stimulation had to be particularly careful thought-out, taking into account the knowledge of anatomy and physiology of the child. Because of the above-mentioned sickness units, the above-mentioned appeared already in the prenatal period, the proper development of the child's senses, i.e.: touch, vestibular, proprioceptive, taste, smell as well as sight and hearing, could not begin yet. PhD Borowiecka wrote about similar cases in her work “Learning Disabilities and Sensory Integrations Disorders”. And yet, according to J. Ayres, the integration of reflexes and system of senses, which were mentioned above, are the base of the future development of the child (Mass, 1998). Consequently, they began to assume that such problems can have Hubert. In order to verify the hypotheses it has been performed sensory integration diagnosis using the South California Sensory Integration Test and clinical and diagnostic INPP questionnaire.

The diagnosis was preceded by a visit to the Psychology-Pedagogy Clinic, which handed down a judgment, that the boy needs participate in activities of early support of development, because they allow the rehabilitation of the child in the areas

of: speech, pedagogy, cognitive. From the judgment of the psychological clinic No 192 – issued in 2011, appeared that the boy should take part in rehabilitation activities, during which the work will be focused on improving the skills of the small and large motor and the hand-eye coordination. In the general tests of sensory integration has been observed in boy atrial hypersensitivity. This means that each workout in which Hubert will not have feet on the ground, calls him discomfort. As a result he will be irritable, nervous and frustrated. Therefore, in the initial phase of activities Hubert disliked to climb ladders, underslung instruments, used in sensory integration class. His dislike of doing this had to be mitigated because: “The gravitational insecurity and motion intolerance do not have direct impact on schooling, however, significantly affect the emotional functioning and behavior of the child, as well as his contacts with their peers” (Borowiecka, “The child in Balance”, 2010). During the tests, which were carried out on Hubert, it was observed his audible hypersensitivity. It manifested itself as the fact that any high sound cause, that the boy lost his attention and as a result of this he focused attention on unimportant objects and the work he had started, was aborted. It was hard him to return to do the previous action again. The touch hyposensitivity has also been observed, as it was shown by, among other things, a very strong hug of a hand when greetings, as well as very strong holding drawing instruments. Other sensory integration tests confirmed the postural-ocular problems, that are related to the coordination of the visually and fine motor skills and balance. It has been observed the trace elements of the abnormal reaction, which they reason may be, as it was already mentioned above, invalid sensory stimulation during the first year of life.

A very common occurrence in children with birth defects is the existence of minimal brain damage (MBD). According to researchers (Tucholska, 1992; Komender, Wolańczyk, 2004; Hallowell, 2004), they are:

- tendency to distraction,
- impetuosity,
- hyperactivity,
- excitability,
- stunting of development,
- backwardness,
- delay of speech development,
- perceptual deficits,
- problems with the depth perception,
- unformed body image,
- the evil visually-motor coordination,
- motor clumsiness.

Working with Hubert began with the exercises to improve his sense of balance, which aimed to provide proprioceptive, touch, vestibular stimuluses, because according to Sally Godard no sense of balance affects the malfunctioning in the visual, hearing and mobility processing. Consequently of these exercises, Hubert improved awareness of his body schema,

faster pointed to the parts of his body, which were called, decreased difficulties of the item tracking by eyes. There has been a significant improvement in muscle tension, which was related to replace static equilibrium in dynamic and vice versa. The frequency of blinking decreased, as well as he fixes faster his eyes on items. Improved the carrying his head in the midline of his body, as well as his symmetrical and bilateral movement, scoliosis was corrected. So I chose exercises that they provided for biomechanics of Hubert's bony system, because existing fusion of two ribs in thoracic spine and vertebral defect in lumbar spine. Indirectly trainings to get sense of balance affect the functioning of other systems, such as: respiratory, digestive, excretory. I got the feedback information from the parents of a boy, that he controls his excretory needs and that mobility of his chest increased. After the improvement in the sphere of balance I worked on fixing the small motor skills, including performing precision movement, pace of their execution. By the execution of compound exercises by Hubert, his praxia was improved by me. Work with the boy with the within the scope of sensory integration is underway and he becomes more and more independent. He quicker performs tasks associated with the personal toilette and self-service. It improved his social contacts with colleagues and classmates. The widely understood rehabilitation, which was carried through, contributes to the better functioning of the boy in social environment. Also the caring parent care motivates Hubert to work.

#### The speech therapist's description.

Disorders, which are results of the birth defects syndrome occurring in the boy, may also be important in the case of the obtainment of language skills, both in terms of passive speech, and therefore the understanding of speech, as well as active speech, i.e. broadcasting verbal expression. The possibility of the occurrence of disorders as a result of the malfunctioning risks of a central nervous system, associated with the aforementioned common occurrence in people with the congenital MBD, as well as in terms of asymmetry of a craniofacial and expected effect of heterogeneous individual work of right and left segment of the child craniofacial muscles, became the cause of early implementation of speech therapy.

Speech problems, which are results of possible MBD, that could occur and for which the child had to be watched, are related to the acquisition of linguistic competence and these are primarily delayed development of speech and dysarthria. Especially the second kind of disruption of language communication, which could make for disharmony within the scope of breathing – phonation – articulation coordination, as a result of neuromuscular dysfunction (Tłokiński, 2003), had to be excluded, or undergo rehabilitation as soon as possible (Jastrzębowska, 2003). In addition to language broadcasting, the dysarthria may also be accompanied by difficulties concerning the physiology of articulatory (vocal) tract among other things within the scope of mastication and deglutition (Maruszewski, 1970).

Anatomical feature, which is presented in the child, is the asymmetry of the facial skeleton. As a result it can be noted the

disproportion between normal (boosting) work of articulatory muscles on the right side of the face and less reaction of oral praxia on the left one. Craniofacial asymmetry with an invalid, patchy shape of muscles work are a potential cause of a reduction in the efficiency of articulatory tract, which in turn can lead to abnormal respiratory tract, shallow breathing, puerile swallowing and abnormal articulation, including incompatible with lateral phonetic standard execution of consonants. It should also be borne in mind that, in the present case, on the existing asymmetry of anatomical and unbalanced muscle activity overlaps with the fact sensory stimulus unilaterally restrictions during infancy.

Potential risks arising from work of the whole muscle groups of the face, the shoulders and the chest can be circular muscle weakness, individual muscle groups of his cheek, with particular regard to such their party as the zygomatic muscles bigger and smaller, buccinator muscles, depressor anguli oris muscle and risorius muscle. Often occurring in children effect due to a reduction in the tension of the muscle is the presence of abnormal respiratory tract, then when both the inspiratory phase and exhaling one are done through the mouth. This situation belongs to pathology, when it affects the respiration at rest, and therefore, at the time when no sound is produced, both at the time of speech and singing (Binkuńska, 2002, p. 71); Tarasiewicz, 2006p. 42; Zielińska, 2002, p.28; Sobierajska, 1972, p. 43). Effect of resting breathing by mouth is the frequent occurrence of oral infections of the upper respiratory tract, caused by improper swallowing and defects of articulation (Rządka, 2011, p. 25-36) associated with the lack of verticalisation of the tongue and its flat-lying.

Another type of respiratory disorders resulting from malfunctioning chest muscles is shallow breathing, taking into account the breathing his chosen surface – the clavicular breathing, which activate the upper part of the ribs and lungs or ventral using the lower spaces of these organs. The effect of this type of disfunction is weaker oxygenation of the brain.

A disorder of the articulatory tract is caused by abnormal alignment of the tongue and breathing by mouth tract. The effect of it is called puerile swallowing, therefore, during which the tongue in the oral phase does not rise to the upper gums, gingival shaft, the palate with its front parts (apex and praedorsum) alveolar shaft, the palate, but its laying on the bottom of the oral cavity and doing the movement to front and touching teeth or going between them (Mackiewicz, 2001, p. 88; 1998, p. 78-79.; 1983, p. 24; Pluta -Wojciechowska, 2010, p. 110-111).

The effect of the articulators malfunction can be the presence of occlusion defect (Proffit W.R., Fields H.W., 2001; Rokitiańska M., 2004).

The risks of development of speech, which were described, and possible irregularities regarding the physiology of articulators constitute the reference for speech therapy practice in early support of speech development, on which the boy was directed. They provide the basis for observation of the child, but also taking preventative actions.

In the course of speech therapy, it has been observed low efficiency of articulators in the child and unsymmetrical work

of the tongue muscles and orbicular oris muscle characterized by the dominant activity of the right side, anatomic disorders as previously mentioned, as well as craniofacial asymmetry and ankyloglossia as well. As a result of bad work of the muscles, which were mentioned above, among other thing, is guiding the front of the tongue to the left. Among the defects of articulation the parasigmatism was diagnose, which in the case of the boy was replacing sounds [š], [ž], [č], [ž] spoken from the front part of the tongue together with apexem to the gingival shaft, the sounds [s], [z], [c], [z], and pararotacism, which replace the consonant [r] to [l]. The cause of the articulatory abnormalities was weakened articulatory tongue motor and the remaining motor articulatory muscles of the tongue, and their asymmetric activity as well. In addition, the ankyloglossia was the factor perturbative the pronunciation of the sound [r]. Disorder occurring on the boy was also hypernasal speech (rhinolalia aperta). As a result of this articulatory abnormality oral speech sounds are gaining nasal tone (Pluta-Wojciechowska, 2010, p. 79). As the speech overhaul has shown in this case, this is caused by palatal-oropharyngeal insufficiency, associated with the disfunction of the Passavant's ridge (Mitrinowicz-Modrzejewska, p. 236-245; Pruszewicz, 1992, p 153).

The recommendations, which relate to the early support development of the boy speech, in addition to exercise aimed at activating the correct articulation of sound mentioned above, taking into account also the massage session of speech therapy inside the oral cavity, exercises to improve the articulatory engine, including exercises for verticalisation of the tongue, breathing exercises aimed at creating a proper respiratory tract, phonetic exercises, as well as to develop eye-hand coordination and training of receiving stimulus. Among the recommendations were exercise for palatal- oropharyngeal insufficiency – for the soft palate and massage of the Passavant's ridge

By analysis the current state of the boy's speech, it should be pointed out the correct reception of the language and using the correct forms of grammar, both in terms of inflections and morphology and syntax. The child correctly builds sentences, as well as a longer expression. The boy is cute, which translates to a high communication skills. It can turn the listener on to his statements due to their rich lexis.

As a result of the application of exercises to improve the articulatory engine and verticalization of the tongue, we can note the improvement in the phonetic layer of the language. The boy properly pronounce the vowels that require lifting the tip of the tongue to the palate (the previously mentioned sounds: [š], [ž], [č], [ž]. The element, which left after asymmetry within the scope of the oral praxia is directing the tongue in the left side of oral cavity and a slight asymmetry in the work of the orbicularis oris muscle. Speech sound [r] still requires improvement. The boy uses the one pulsation variant form of the speech sound, when the correct pronunciation of Polish sound [r] is to bring the tip of the tongue close to the gums and simultaneous vibrations. "The sides of the tongue slightly adhere to the upper teeth and gums. The body of the tongue is flat, broad and its sides touch the molars, given a fixed position. The middle and especially the front part of the tongue are active and supple" (Skorek, 2003, p. 17). in this

described laid, tongue vibrates its front part. With regard to this description, it should be pointed out that the tongue of the boy, after he lift it to the palate, performs one hit under the influence of the expiration, and the created sound is similar to the gingival implementation of speech sound [d].

The breathing tract of the child is correct. Boy breaths by his nose at the rest. The work of the facial muscles is improved as well. Their asymmetric activity is low.

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# Mental Health practices in Albania and in Europe: literature review

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**Abstract—** In the last 30 years, governments all over the world have developed policies and strategies that aimed the transition from the old institutionalized psychiatric system to the community services in the mental health field.

Studies have been taken to see how these policies and strategies operate around the world, as not all countries have a good quality of services.

Mental health professionals are trying to find why in different countries the mental health reform has show different results.

In Albania research of this kind is limited.

The method used in this article is the investigation of the deinstitutionalized practices and the comparison of the Albanian experience with that of European countries.

The purpose of this article is to analyze through the study of the different practices and the literature review the development of the mental health system in Albania and in other countries.

**Keywords—**mental health, rehabilitation, deinstitutionalization

## I. INTRODUCTION

Mental health is an integral part of general health and welfare. In a broader perspective, it reflects the balance between the individual and the environment in which he lives. So health is seen as "not only the absence of illness or disability" but rather as "a state of complete physical wellbeing, mental and social". The concept of "mental health" should not be defined in a restrictive way as the absence of mental disorders, but under a positive and comprehensive approach

Mental health is ultimately defined as "a state of wellbeing in which the individual is conscious of his / her personal skills, is able to face the concerns of everyday life, is productive and efficient in his work and is able to give contributions in the community where he lives.". Under this positive perspective mental health is the basis for the wellbeing and efficient functioning of the individual and the community as a whole.

Positive mental health cannot be obtained by the treating of mental disorders. In order to ensure a positive mental health, to facilitate economic and social burden of mental disorders, to alleviate poverty and strengthen social inclusion of these persons, it comes out the need for the development and implementation of comprehensive plans. Such plans help in the

not only physical but also the social integration and rehabilitation of the persons in need, this being helped by the establishment of structures such as family homes.

This kind of practice defines the deinstitutionalization as a therapeutic practice and effective way to treat people who have problems with their mental health.

According to the World Health Organization (WHO), deinstitutionalization process consists of the following elements:

- The mobilization of all actors involved in the institutional system;
- The main and primary objective is to transform the relationship between the institution and government entity and primarily between the institution and the patient;
- An alternative way treatment that uses the internal energy of the institution to dismantle it;
- "Free from the need for detention (closing)", by building services to replace the previous services.

So the main goal of deinstitutionalization is the following step to step of mental health patients and the work done with them for rehabilitation and reintegration into the community.

This is a new approach that takes into account the wishes and needs of people, putting them at the center of the services.

The deinstitutionalization practice within mental health facilities leads to the need for not only medical but also psycho - social rehabilitation for patients. The rehabilitation matches the needs of the patient, by so improving the quality of life.

In this way, to provide to the adults a training allowing them to integrate themselves into society, to promote the acquisition of basic competencies in putting into practice activities and social roles, the adaption of individuals with lasting disabilities and providing moral support in the fight to gain confidence in themselves, return to the main objectives of professionals during the rehabilitation of mental health users.

In the basis of rehabilitation should be good communication and relationship between staff, service providers and the patient.

Before, people with psychiatric disorders were obliged to refer only to psychiatric care beds. But now a growing number

of people with mental problems try to rely on structures such as family homes and in the community with the help of professional outpatient services.

Such changes are affected not only by changes in the mental health sector, but also by the growing authority of people with psychiatric disorders and their stories in the improvement process. Care should no longer focus only on symptom relief and management, but above all to support customers in their daily lives, in providing help to integrate into the community and to develop their skills.

Considering the demoralizing conditions in which a part of the people found themselves after their release from a psychiatric hospital (due to delayed hospitalization), becomes a matter of special importance (Bonevik, Wolf, & Niuwenhuizen Schene, 1995a; Malm, May & Dencker, 1981; Oliver, Huxley, Bridges & Mohamad, 1996).

To make easier and less dramatic the transition from hospital to community, in Albania as well has started the process of rehabilitation in the family home.

However, considering the Albanian context and the transition experienced in the mental health services, this article aims to examine the models that have been successful in the implementation in other countries. Given that we are only at the beginning of this process, the reference to other practices is necessary and brings as an initial necessity the examination of literatures in this field.

#### MENTAL HEALTH PRACTICES IN EUROPE AND IN ALBANIA

This paper analysis the Albanian and some of the European experiences in the mental health field. Studies conducted in this field point that different cities in different countries had different paths toward progress. First, this paper discusses mental health reform in some of the main countries. Then, we take an overview to the evolution of the mental health reform in Albania.

#### MENTAL HEALTH PRACTICES IN EUROPE AND IN ALBANIA

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#### MENTAL HEALTH IN ITALY

In Italy, the mental health reform began in 1971, with Franco Basaglia and his group. This experience was crowned with the closure of the Trieste's Psychiatric Hospital in 1980. The hospital services were replaced with an alternative system of services.

Currently, the Department of Mental Health, has in charge four Community Health Centers, opened 24 to 24 hours. These centers have 6-8 beds each, and cover an area of 50 – 65.000 residents. This is a hospital service that offers evaluation, diagnostication and treatment intervention. This service has functioned as a filter for the night's emergencies situations.

People are not hospitalized, but instead are referred to other responsible centres for the mental health care.

The Psychiatric University Clinic was involved in the Department of Mental Health, working in small zones of the city.

Later, there were set Residential Centers for people with residential needs: around 70 living places, apartment type. Their coverage varies from community to community. These centers offer residence for people up to 24 hours. This structure functioned as a social cooperative network. It began with a number of 4 cooperatives and now has reached the number of 12.

In the beginning the Residential Centers were an initiative of Mental Health Centers and were supervised by the latter. Later, the newly opened centers functioned as independent.

Family associations played an important role in the functioning of mental health system in Trieste. They served as as referral points for the self – aid groups.

Meanwhile, in the last years, in order to help people with mental health issues there were organized informative meetings and activities about community culture and about being a citizen in a community (R. Mezzina, 2004).

#### MENTAL HEALTH IN ENGLAND

The mental health experience in England comes as a successful implementation of the regional mental health services.

This service began in Birmingham, and later was spread all over England. The Birmingham experience made possible for the government to adapt a new model of services in the mental health system which was later implemented all over the country.

The innovative system, organized in British cities, not only did improve the quality of the services provided, but, for the first time, it also made possible that the users of the mental health system gave their own opinions about the functioning of the psychiatric system.

Moving teams were built to manage emergency situations and to help in early intervention.

In the last 10 years, in Birmingham, three of the biggest Psychiatric Hospitals were closed down. They were replaced with the so called mental health workshops, and were directed be the National Health Centre in collaboration with regional entities.

Thanks to funding intended for the mental health system the service offered coverage for more than half of the city's population.

Nowadays, allover England, the psychiatric hospitals are closed down, and the users of mental health services receive care at their own home and reality.

Deinstitutionalization programs and adaptation of new methodologies for providing mental health services in community were important factors that brought mental health care out of institutions.

During the last twenty years, the relatives of mental health care users are seen as a very important part of the mental health reform. (S. Sashidharan, 2004).

#### MENTAL HEALTH IN IRELAND

In Ireland, 2-3 weeks after returning home from mental health hospital the patient had to go back to the hospital so that the doctors could decide if he needed changes in medicament treatment and dosage. Then the doctors would wait and see if the patient would go back to the hospital again. Patient's needs were not taken much in consideration. This used to happen before the 90's..

Afterwards there were changes implemented into the Irish psychiatry. Mental health care users and other actors involved in mental health system were asked for things they needed the most from the system. It came out that mental health care users had different needs from those provided by the system.

A group of nurses organized a mobile system, flexible and totally community based which encouraged the government to close down psychiatric hospitals.

The whole system was redesigned based on mental health care users' needs. People didn't go to mental health hospitals anymore, but instead they received the service at home or at the community where they lived. Their needs for additional information and training were addressed too. The mental health ward in the hospital, with a coverage of 27 beds, was not used anymore by mental health patients.

While working with mental health patients it was taken in consideration that they didn't need just medication, but they needed to have a job as well, they needed a place where to live, and they needed to conduct a normal life; all those needs that anybody else takes for granted (Muray.D, 2004).

#### MENTAL HEALTH IN SPAIN

Spain is a federal state, and all the regions are independent from one another. In this case it is the region that has the responsibility for the health care services and not the government.

The first psychiatric reform in Spain was introduced in Asturias in 1965.

The second psychiatric reform was made in 1982 and only in 1989 there were not made new hospitalizations anymore.

During 1984-1985 the health reform began which included mental health too. The health law in general, and in particular the mental health law is in a recommendation form and not as genuine one.

The implementation of the law depends on the area where the person lives. If the person lives in Asturias or Andaluzia, psychiatric hospitalization is made in the regional hospital. For people who live in Barcelona, chances are that mental health care users are hospitalized in a psychiatric hospital. In Catalonia, though being a rich area, hospitalization is made in the psychiatric hospital.

Mental health services are included in the general health services network. Mental health care users receive support in

the community where people live, and hospitalization is made in the general hospitals. Psychiatric disability rehabilitation and support services were developed as well.

Community support services are developed thanks to a wide network of collaboration and coordination of all the actors involved in mental health care services. The benefit from all this is health promotion in the community

#### MENTAL HEALTH IN CROATIA

According to a survey conducted by the International Health Institution on health recording in Croatia from 1999 to 2000, examinations and preventive intervention were reduced by 50%.

Meantime one of the founders of the World Health Organization aimed creating home assistance for mental health services users.

Since the Second World War, a strong network of nurses who provided community services existed in Croatia. Until the beginning of the privatization process of the services, this network successfully sustained people in the community. After the privatization reform the community nurses lost their importance and their reliability in the community.

In 2000 it was concluded that the number of home visit, home care and preventive action experienced a drop under the level affecting the quality of health care.

More or less this was the situation in Croatia when the mental health reform began. This reform helped improving the quality for services provided by the system.

Actually all the efforts are oriented toward the construction of a strong primary health centre which will be able to integrate and provide a good quality of mental health services paying special attention to assistance and active preventive care.

The referral point of the services are the head-nurse, the community nurse, who supervise and coordinate the community nurses. When the mental health patients leave the hospital, all the actors mentioned above cooperate with hospitals and from this moment and on they will be responsible for providing health assistance to these patients.

The primary health centre has the old but still new competences, to monitor the health status of the population in a local level and to identify special needs of the people living in the region they cover.

It is important for the system to coordinate the relationships between general doctors, pediatricians, first aid doctors, ambulatory service and nurses. Also, it is important to strengthen the relationships between hospitals, emergency centers, social services, schools, asylums, police and social services (M. Car, 2003).

#### MENTAL HEALTH IN ALBANIA

Mental health legislation was approved in 1996. In 2003 the document on mental health services was compiled with the support of the WHO office in Tirana. Mental health services are organized on three levels: the primary health care level (the family doctor), the secondary level (regional psychiatric

hospital) and the tertiary level (ambulatory services). Traditionally, the mental health care in Albania was provided by centralized services, biologically oriented and symptom focused. These services were offered to the population according to a scheme where hospitalization predominated, not only in terms of professional approach but in terms of human resources as well.

During the recent years the nature of the existing psychiatric service has changed thanks to the Mental Health Reform. Today, mental health service is part the public service system. Many new services, previously unknown to the public, are built recently, such as community mental health centers, households, daily living centers, etc. Not only did the responsibilities of the existing staff such as doctors and nurses change, but also new professionals such as psychologists, social workers and occupational therapists, were added to the existing staff.

The actual scheme of mental health in Albania made possible that mental health care shifted from psychiatric hospitals to communities. Patients were transferred from hospitals to communities, and so were the necessary human resources. This means that psychiatric hospitals are not the only one to assist mental health patients. Mental health patients can be assisted in the communities where they live by Community Mental Health Centers and households. Households provide a well studied and less dramatic shift of patients from psychiatric hospital to communities.

#### DISCUSSIONS AND CONCLUSIONS

In the past 30 years, in many states has been organized a movement that was directed towards institutionalized treatments in hospitals, to community centers.

The main purpose of these movements has been the creation of a world that respects people that have experienced mental health illness.

These people, as citizens with full rights, through a professional and structured support, but also through utilization of their potentials, were encouraged to live a productive and qualitative life. So they could reach that only with development and perfectionism of community services, which have in center the human, with their necessity and desires.

The function of professional services in mental health is achieved through a good coordination of all actors involved in this scheme.

However, such services have functioned in efficient way only in a limited number of places. So far, for true experiences in mental health services is not spoken much. Is preferred more to generalize the needs and achievements instead of showing experiences and concrete models, to give more numbers rather than to made reflections, to focus more in the number of services than in quality, to show process instead of the correct journey and sometimes by following abstract analysis, based in old theory, instead of referring to urgent needs of beneficiaries and their experiences, what we do is only completing strictly a provided document.

By comparing different European countries and reforms that they have administered, we see that the starting point for these reforms has been long time ago. Franco Basaglia, with his dedication and determination, began the era of closing mental hospitals.

We see that in different countries are in different phase in implantation and development of reforms, but all are at the same mind and are fighting for returning freedom to the person with mental health problems.

Experiences in all the countries, demonstrates for the fact that patients with mental problems, are better to be supported and to be treated in community, by offering them daily care centers, family home etc.

In order to change in the constant way the quality of the patient's life, the actions should be numerous. Also the government's social policies have a special role.

Solutions such as: rent financing, education and professional treatment for mental health patients are the better ones. And above all, the systems should transfer their power on the lives of the patients for the patients.

If patients aren't supported and their partners don't help policymakers to do changes in the way how they see the patient, then the building of the services system will not have success.

According to Lazeri (2003), in Albania, even if we could say that politically we have all opportunities to move forward, in the moment of implantation are found difficulties for the fact that various factors aren't identified, also for the fact that difficulties came out during the implementation process.

Considering a more specific view in the functioning of Albanian psychiatric hospitals, contrasting as well this view with other European countries, it is noticed that in Albania are set the first steps to start the deinstitutionalization era. This is concretized with the opening of community centers and family homes in different areas of the country.

However, it should be mentioned that every beginning encounters difficulties, such as limited environments and staff, especially in hospitals.

A mental health in the community, or more precisely, a community mental health, promotes deinstitutionalization but is not created to have it as starting point. This means that in a new way, in a community mental health it is possible the functioning of the community of free people, different between them, with their stories and individualities.

End of "madhouse" era, will be the one in which, psychiatric hospitals will be totally eliminated, since they are the only places in which it is produced and reproduced the psychiatry and the different ways that deprive people with mental illness from life and its benefits (F.Rotelli, 2003).

Service and healing of the people must be built bearing in the center the beneficiaries of services and also the time they need for rehabilitation.

This composes even today, a problem in Albania because the power is still in psychiatric hospitals to doctors. This factor

prevents the placing of the patient at the center and thus the well functioning of rehabilitation activities in which he/she is included.

A good service would give to the person the opportunity:

- To live in his private space, in accordance with his/her condition and the importance of its problem.
- To reveal his active role in society, through work and its various forms (employment, self-employment, and social enterprises).

The responsibilities of the mental health service needs to restore the social control and the reorganization of all stakeholders of these services, giving more and more attention to the poor actors in service (patients). These services should recognize differences among people, the gender, race, culture and thus ensure lack of prejudices and equality of rights.

However, it's fair to say that whatever type of organization of mental health in the community cannot come from the elimination of any type and size of psychiatric hospitals.

Psychiatric hospitals operate as a closed society. The old model of mental health services, operates as a closed and exclusive space. While the new model of mental health services, the deinstitutionalization one, provides a change of

role of the professional and of the relationship that he holds with the patient, being more open, respecting the time and freedom that this patient needs.

And all this is important because freedom is therapy!

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# SECTION 7.

*Medicine*

# Organization of student research in Kazakh National Medical University

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**Abstract—** The article describes the experience of student research organization in the Kazakh National Medical University named after S.D. Asfendiarov. We have tried to describe how it is formed areas of student research at our university, what measures are being taken.

Research work of students (RWS) is a continuation and deepening of the educational process and included in the process of training. Forms of students research work are divided into two categories: included in the educational process and extracurricular forms. The model was implemented in human morphology department.

**Keywords-** science; research; student

## I. INTRODUCTION

Research work of students (RWS) is an important instrument of improving the quality of training and education of professionals, who are able to apply it creatively in practice, in order to achieve technical, scientific and cultural progress.

Involving students to scientific work makes it possible to use their creative and labour potential for solving urgent problems of the country [1,2].

The main purposes of Organization of scientific and research work for students of Kazakh National Medical University (KazNMU) named after S.D.Asfendiyarov are: improvement of quality of training of young specialists, creation of conditions for the creative activity foundation, independence of university students in their research work; identification of the most talented and gifted young people, supporting the disclosure of their abilities and organization of their further education; development and improvement of quality of the researches and developments of the university; expansion of the scientific cooperation between institutions.

The main purposes of scientific and research work of students are: students' acquaintance with the scientific method of learning, and the deeper and more creative development of

educational material, based on it; foundation of interest and needs for creativity to the young scientists, teaching them basics of information search and scientific documentation preparing; the mastery of a procedure and means for self-solving of scientific and practical problems; clinical thinking foundation; acquisition of skills of work in research teams and acquaintance with methods of scientific work organization; direct participation in solving the scientific and practical problems of the healthcare [3].

## II. OVERVIEW OF THE STUDENT RESEARCH OPPORTUNITIES IN SOME COUNTRIES

First, we take a brief overview of the students' research work in some other countries.

The example of student scientific activity in the **United Kingdom** is The National Student Association of Medical Research (NSAMR). It is a student led initiative aimed at promoting research and academic medicine amongst medical students. The association is a collaborative network composed of research societies throughout the UK which enables the sharing of ideas and resources and provides students with a national voice on issues pertaining to research and academic training [4].

The Association aims to bring together all the student research societies in the UK into a single collaborative network. This means that societies can share ideas and resources, publicize events to a much greater audience, hold national events and have access to society funds.

Each medical school has a different character. Events that established research societies have organized are: Research Talks; Internal Research Symposium (a research competition in medical school); Journal Club - a weekly/monthly journal club to discuss current literature; Workshops; Academic Careers night; Research Database- a database of research projects which students can get involved; School outreach program, where groups of students present a poster that they have made on a research theme/newspaper medical article.

The Stanford University School of Medicine (UK) has a variety of programs for the development of student's scientific potential.

Center of Excellence in Diversity recruits students from under-represented backgrounds; promotes research and training in minority health-care issues.

LGBT Medical Education Research Group strives to improve healthcare by conducting groundbreaking research to affect change in today's medical curricula.

Summer Premedical Student Program a supportive academic opportunity for disadvantaged college students interested in pursuing careers in medicine and biomedical research.

Stanford University Minority Medical Alliance (SUMMA) increases the number of minorities in the health professional fields in order to better serve African American, Latino and Native American communities.

Stanford Medical Youth Science Program a summer residential course that helps high school students from low-income and under-represented backgrounds prepare for future careers in health care.

In May 2008 the National Institutes of Health awarded Stanford a Clinical & Translational Science Award (CTSA). The purpose of the award is to help speed up the time it takes for basic science discoveries to be translated into new and more effective treatments for patients.

The Stanford CTSA is housed under Spectrum: The Stanford Center for Clinical and Translational Education Research. The Stanford CTSA consists of 12 sub-programs, one of which is the Career Development and Diversity Center (CDD). The purpose of the CDD is to implement programs and provide resources and career development to researchers engaged in clinical and translational research. A secondary goal is to increase the demographic diversity of those engaged in CTR at every rank [5].

The Northern Illinois University Graduate Student Research Association (GSRA) in USA is a student organization with the aim of promoting a culture of scholarship and fellowship among students. Specifically, the GSRA strives to provide opportunities for all graduate and undergraduate students who are conducting research or are interested in learning about research within and across their respective disciplines. The GSRA provides a forum for students to share their experiences, discuss their research interests, and learn from and with fellow students and faculty. GSRA sponsors a variety of academic social, and community programs.

The GSRA Conference is an annual campus-wide event. The GSRA plans, organizes, and hosts the conference, which showcases the research and artistic work of graduate students at Northern Illinois University. The conference is held on campus during the Spring semester at the Holmes Student Center. Faculty, students, staff, collaborating partners, and community members are invited to attend the conference to learn more about the work being conducted by graduate students within and across diverse disciplines [6].

University of Chicago Pritzker School of Medicine (USA) encourages students to enhance and enrich their traditional education through research experiences, summer externships, international programs, and various conferences and seminars.

Among these opportunities, the school sponsors some programs for students interested in research activities: Pritzker Summer Research Program, Pritzker Fellowships, Calvin Fentress Fellowships, Senior Scientific (annual symposium in which graduating seniors who have participated in research present their work). This event is designed to offer senior medical students a forum for the presentation of their research.

Approximately, 3-5 students choose to take a year off from the standard curriculum to pursue a year of extended research, either through sponsored research in the Biological Sciences Division, fellowships secured through external funding sources, or the Pritzker Fellowship Program. Generally, students take time off between their third and fourth year of study or second and third year of studies.

The Pritzker School of Medicine offers students the opportunity to take part in a variety of international programs. The school encourages students to apply for programs sponsored by international or national organizations [7].

At the University of Connecticut School of Medicine (USA), many opportunities for students to invest their abilities to advance knowledge through involvement in various student research programs. Students can enroll in research opportunities that may span one month to several years, including: Formal research protocol and design courses in order to gain familiarity with the research process; Individualized research project for elective credit; The design and implementation of an individualized summer fellowship with faculty mentors; A variety of full year enrichment fellowship programs available either through the school, nationally competitive programs, or as a special leave of absence identified by the student with support from the school; Research interests in public and health care management and organization through participation in the combined degree programs, M.D./M.P.H. or M.D./M.B.A V [8].

Indiana University medical school (USA) offers research and internship programs for high school, pre-med, and medical students. The Center for Research and Learning lists a variety of research opportunities categorized as undergraduate research programs, diversity research programs, and summer research programs. The Diversity Scholars Research Program is aimed at attracting academically talented students pursuing an education in the research setting who will contribute to the diversity of university. Open to all Indiana high school graduates in the top 25% of graduating class who have at least a 1070 SAT (math and critical reasoning sections only) or 23 ACT score [9].

Research opportunities for medical students in Georgetown University School of Medicine is a way to conduct clinical research and get started on Independent Scholarly Project. The experience involves "shadowing" a primary care physician in their clinic [10].

Research opportunities for students of faculty of medicine at the University of Toronto are: Wilson Centre for Research In Education (dedicated to advancing healthcare education and practice through research); Centre for Faculty Development (CFD) (a partnership between the University of Toronto (UofT) and St. Michael's Hospital, is committed to enhancing the academic development of faculty through innovation, capacity building and scholarship in the design, implementation and evaluation of faculty development); SIMone (Ontario simulation network); Centre for Interprofessional Education (IPE); Discovery Commons (Academic Technology); Standardized Patient Program; Division of Teaching Laboratories [11].

The study of undergraduate Medical Science at the University of Sydney is undertaken in the Faculty of Science, with major teaching contributions from Sydney Medical School. Medical Science undergraduates are amongst those then eligible to undertake an Honours year within Sydney Medical School as part of their Science degree.

These opportunities constitute an additional year of full-time Honours study in medical research for students from undergraduate courses other than the Medical Program.

During this time the student will conduct a research project and write a thesis under the supervision of a member of the academic staff of Sydney Medical School.

There may be a component of coursework as well.

Summer Research Scholarships offer a unique opportunity for students to obtain experience in medical-related research and provide a fantastic insight into the research process.

The scholarships offer students the experience of working with well-established researchers in high quality medical research facilities [12].

In the countries of the former Soviet Union has preserved many elements of the organization of student scientific work, inherent to the Soviet Union.

After analyzing reported in the literature and electronic media publishing, we can identify the main approaches to the organization of students' science, common to most of them [13 – 19].

In Kazakhstan, as well as in Russia, Ukraine, Belarus and other countries, held an annual state competition for the best research work of students (RWS) in higher institutions. The competition is held by the Ministry of Education and Science.

RWS competition held in several stages: the first stage – at the university level, the second stage - in the basic (national) institutions of higher education, and the third (final) stage - at the state level.

Dates of the university stage of competition are determined by the Rector of the university (in Kazakhstan from October to February), II stage (in basic universities) from February to April, III stage (state) from May to August.

The administration of the university organizes the competition committee for the relevant sections of the contest,

including their constituent representatives from leading scientific organizations and industry.

At the end of Stage I of the competition the committee of the university, approved by order of the rector, the competitively selects and sends the best research work of high school students in basic schools to participate in the II stage of the competition.

First stage is funded by the University. Competition II stage provide the basic universities, the list of which is approved by the Ministry of Education and Science. Phase III costs shall be covered by national funds allocated to the national budget.

### III. KAZNMU CONCEPTS AND DEFINITIONS.

The scientific and research work of students in KazNMU named after S.D. Asfendiyarov is roughly divided into two categories:

1) The training research work of the student included in the educational process,

2) The research work which is performed outside the class hours. We call it - the research work of students (RWS).

The education and research work of the student is included in the curriculum and is performed in the following forms:

- Reports;
- Laboratory work;
- Education and field practices;
- Course and diploma projects.

One of the training research work varieties is the independent work of the student (IWS) as we consider. Minimum 30% of the training time is given to IWS. The list of IWS themes is given to students in the beginning of the semester, as a part of the Syllabus. Students take few topics (depending on the curriculum.). We will explain later how we have organized the RWS in the department. Now we must finally define the concepts and classifications.

Types of RWS:

- work in student clubs;
- work in groups of concern;
- participation in researches conducted by departments of the university;
- participation in the research work of education and healthcare institutions;
- research work carried out upon an individual plan;
- participation in scientific and theoretical conferences, presentations and reports on materials of the unique research.
- participation in work of the electives, special seminars, etc.

#### IV. BASE FOR TRAINING AND SCIENTIFIC RESEARCHES OF STUDENTS

There is an infrastructure, which is created and operates in KazNMU for students scientific and research work.

##### A. *The Science and Education Laboratory - (SEL).*

The science and education laboratory functions:

- demonstration of practical skills and laboratory classes on disciplines;
- training and production practice for the first course students of "Public Health" and "Preventive Medicine" faculties – called "Laboratory assistant".
- scientific and research works of students of second, third, fourth and fifth courses of "General Medicine", "Public Health", "Dentistry" faculties.



Figure 1. Vivarium of KazNMU



Figure 2. KazNMU laboratory of collective using. The students work on the high-tech equipment under the guidance of specially trained staff.

##### B. *Clinical and Experimental laboratory*

Functions:

- to teach students basic practical skills within the experimental work;
- to teach surgeons interns and surgeons subordinators the operative surgical skills using domestic unproductive animals for appliance;

- organization of training and counseling for young scientists and students on the matter of organization of experimental researches in medicine;
- attracting students to scientific researches.

##### C. *Education-and- Scientific-Research Laboratory*

We have created an Education-and- Scientific-Research Laboratory (ESRL) on the basis of divisions of the Department of morphological disciplines.

The main purpose of the scientific and research work of students in ESRL is the implementation of the principle of "Education through research", as well as the identification of talented young people and raising the level of scientific training for specialists.

The tasks of the laboratory:

- to create optimal conditions for organization of various forms of scientific research and methodological work of teachers and students;
- to form the interests of teachers and students in scientific research activities, skills, and investigation abilities.

#### V. APPROACHES TO MANAGEMENT OF STUDENTS' RESEARCH WORKS

The principle of organization of scientific work of students is based on the following structure: at first, the easiest and mandatory element for all students - the IWS (independent work of student). In the beginning of the school year, teachers explain students the nature and prospects of the research work, and consult them in case of having questions. An independent research activity of the student is serving as a guideline. There are only two restrictions which are given - the discipline and the time.

Analysis of the IWS, publishing of all works on the department's website, and exhibition of independent work of students are carried out at the end of the semester.

The most outstanding works which demonstrate a range of IWS formats and students creativity at present year are the following: the Olympiad prepared and conducted by group of students of the first course; the student website dedicated to the anatomy discipline, where the students place personal materials (reports, presentations, videos, etc.); the "3D organs of head and neck" project; the multilingual dictionary of anatomical terms; an interactive manual on musculoskeletal system.

After that - the next level exists for students, who did well, and those students, who are interested and those who initially sets the high bar - research work by levels. During the semester and the academic year students use to carry out their research under the discreet but constant and active guidance of the teacher or the head of the student club. The student selects the supervisor by himself. In the spring, towards the end of the academic year, it is the start of selection tours or competition among students' scientific and research works.

The first round consists of the research works of students performed at the department. Therefore, each department organizes the first round by itself. It is the head of the student

scientific club of department, who is responsible for organization and carrying out the student participation in the first round. There are four departments of the Morphology faculty: Department of Standard Anatomy; Department of Histology, Cytology and Embryology; Department of Pathological Anatomy and Department of Clinical Anatomy and Operative Surgery.

There were four SRW competitions in the department held in the period from February to March of 2013 year. (fig.3)

The second round of the RWS competition was held between departments in April, according to the scientific fields. The Department of Morphology was responsible for the second round organization. The program of the second round of student's competition consists of the scientific and research works of students, who have got the top places in round I.

The second round of the competition on research works of students and young scientists in the field of morphological sciences was held on March 28th 2013. Eleven oral presentations and nine stand (poster) reports were presented.



Figure 3. . The second round of the competition on scientific and research works of students and young scientists in the field of morphological sciences

Eight best reports of the second round were determined after summarizing the results by the amount of points set by members of jury. These reports were subsequently presented in the third round of the competition of scientific and research works of students and young scientists, and also these reports were published in digest data of conference dedicated to the "Day of science" in the form of theses.

The next stage - is the third round, the university one. This year it was held in the period from 22 to 24 April.

Morphological sciences section met on 23 April 2013. The award ceremony of the winners took place on 26 May 2013 in the Rectorate Hall of Fame.



Figure 4. The award ceremony of the winners

The best of the best research works of the University will be sent to the Republican competition and various international competitions in near future. KazNMU department of international cooperation is responsible for that activities.

There is also an opportunity for students to participate in grants: university grant, Ministry of Education grant and Ministry of Health grant. The government policy is aimed to attracting young people to science, that is why participation of students in the research groups is highly welcomed.

In order to form interesting and actual researches, we use the mechanism of combining separate researches (close by the object, topic, etc.) into larger and more significant during the process of students' scientific works reviewing.

As an example it can be said that this year the department of standard anatomy has introduced to the interdepartmental round the report on the topic: "Condition of the mucous membrane of mouth during aging", performed under the guidance of professor Romaniuk by the third year student - Hayrusheva D.

The two researches similar by the topic had been carried out at the department of histology: "Age-related changes of epithelium cytogram of mucous membrane of the lips" (third year student- Hozhamkul F., the scientific supervisor - the senior teacher Tusupova N.M.), and "Cytological markers of biological age" (second year student - Sagymbaeva A., the scientific supervisor - Mulkibaeva Sh.).

According to the results of the second round of the student competition it was recommended by the commission to unite efforts of research groups of students in the larger study of age characteristics of organs and tissues of the mouth.

Scientific groups did as was recommended.

They gathered all obtained data together and made the interpretation once again, and this time the results were more interesting and significant. They presented these results in the third round of the competition (at the university) in the form of the report: "Age characteristics of the mucous membranes of mouth and lips".

Example No. 2. During the time of competition the research groups of different departments:

Department of normal Anatomy

1) The study «Students' stress symptoms identification during the boundary control".

2) "Comparative description of KazNMU students' psycho-physiological adaptation".

3) "Adaptation potential of students"

Department of Cardiology

1) "Cardiovascular system performance of students in the period of psycho-emotional stress".

Department of public health

1) "Psycho-emotional condition of students in Almaty".

The "HealthCare Management" department

1) "Organization of study of psycho emotional condition of children and teenagers in crucial moments"

had gathered together and created the new research area: "Age characteristics of the morpho-functional development and psycho emotional condition of children and teenagers".

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# The use of sculpting models in the study of human anatomy

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**Abstract** — We've used the method of sculptural modeling in polymer materials in order to develop the practical skills in the field of human anatomy to medical students. We've used a polymeric clay as a substrate.

**The content of the study includes planning, execution and evaluation of effectiveness of the abovementioned teaching methodic in the study of the musculoskeletal system anatomy.**

**We evaluated the efficiency of the methodic at the end of the semester. The results of session and level of students' satisfaction according to the survey data had served as a criteria.**

**The second group's students have shown the highest quality indicator of academic progress, and the highest percentage of satisfaction with organizing and content of trainings.**

**Students of the third group - the comparison group, have shown the worst results, but nevertheless, wanted to continue their participation in this study as members of major groups.**

**Keywords:** *innovations, medical education, clay modeling, human anatomy*

## I. INTRODUCTION

The leading place in educational process is given to practice of the research work of students, aimed towards foundation of independence and creative approach in the use of theoretical knowledge, the ability of making better decisions in their professional activity and in case of unusual situations. Teacher's creative approach and ability to guide students to a search plan an important role in this process.

One of the most practice oriented activities, is a sculptural modeling. Above all, it is an effective means of understanding the reality.

The specified activity helps students to develop themselves and to form their own visual perception, imagination, memory, dimensional concepts, feelings and other mental processes. Such personal characteristics as persistency, purposefulness, accuracy and diligence are formed [1].

Usually the student gets acquainted with information about the structure of human's body with the help of the text book, atlas, teachers' explanations, studying the drugs and models on the topic. That is a traditional approach, but the safety of

received information knowledge in this approach is rather low [2].

Immeasurably more productive is the process of studying the material during producing models of the studied organs and body by yourself. During such process the student can willingly pay his attention to the characteristics of the subject and details of its structure, which are usually not noticed when using the ready-made products and models.[3]

We observe the phenomenon described by Confucius in the form of aphorism: "If you tell me, I shall forget. If you show me, I shall remember. If you give me an opportunity to act myself, I will understand".

The involvement of students in the creative activity develops their mental processes and creative skills, necessary to future specialist. Creative work raises the emotional mood, reduces tiredness, as well as the successful outcome increases self-appraisal level, which affects the quality of the student's preparation on a subject [4].

## II. THE MATERIAL AND METHODS OF THE RESEARCH

### A. The aim of introducing the methodic

The aim of introducing the methodic of anatomical models modeling on practical trainings is to activate the learning and cognitive activity of students in the field of studying the human anatomy.

We used the method of sculptural modeling of the studied specimens in polymeric materials, which are used in various branches of industry, for student's independent work together with the teacher, as well as for development of practical skills, under the conditions of morphological chairs. We chose polymeric clay as a substrate.

Polymer clay is freely sold in creativity stores; it is relatively cheap and non-toxic.

Our research contains of development, execution and evaluation of the effectiveness of educational technology of sculptural modeling of anatomical specimens in polymer clay during the study of the musculoskeletal system anatomy.

### B. The material and methods of the research

At the first stage we have developed the methodical support of the method. At the second stage we have executed the

implementation of the methodology in practical classes on anatomy.

Participants of the study - first year students of General Medicine Faculty, groups from 028 to 041; were divided into 3 groups under conditions of informed consent.

Group No.1 - students who use sculptural modeling on each lesson. Group No.2 used a command-oriented approach to modeling models. Group No.3 was studied in the traditional way, using textbooks, atlases, natural specimens and nothing more.

The experiment lasted for one semester and included learning the material of the section "Organs of support and movement". In this section, students had studied bones, joints and ligaments, and then muscles of human body.

Each student of the group No.1 sculpted every bone, which was studied, in clay. And after that, on the syndesiology classes students joined these bones using a wire and drilling holes in models of bones. Then, students had to model the muscle mass and put it on the self-made skeleton frame. It should be noted that the model did not have to be a life-sized. At the first lesson the accurate scale was calculated, in order to prevent the distortion of proportions.

Students of the group No.2 shared out the task by themselves on each lesson. One student had to sculpture the atlas (first cervical vertebra); the second student got the axial cervical vertebra; the third student got the third cervical vertebra, etc.

At "Bones of upper limb" lesson the one got the clavicle, the other - paddle and the third - the humeral bone, etc.

Respectively, by the end of learning the osteology each group had had the one common self-made set of bones of the human body sculptured in clay. Using the same approach, they joined bones and finally got the skeleton, which they also had to cover with muscles together.

### III. RESULTS AND DISCUSSION

At end of the semester, we have evaluated the efficiency of the method. The academic success of students according to results of the session served as a criterion. Also, with help of questionnaires, satisfaction level of students who had studied the discipline was evaluated.

The highest quality index of academic progress was determined to students of Group No. 2, students of Group No.1 (who sculpted everything individually) had learned the discipline section a little worse. We tend to explain this by lack of teamwork and their overloading by sculpturing (fig. 1).

The competition item, obviously, did not play any role. In addition, during the process of working together students of group No.2 were discussing the work, arguing, pointing errors to each other and helping each other to correct them. All of this had improved the quality of learning the teaching material (fig. 2).

Students of Group No.3 had got the worse points on the exam than students from other groups, participated in the study.

According to the results of questioning, the Group No.2 showed the highest percentage of satisfaction with organization and content of the lessons (fig 3).



Figure 1. Students of Group No.1 in operation



Figure 2. Lesson for students of Group No.2

Students of Group No.1 had also evaluated classes positively, but they recommended to reduce the load slightly. Students of Group No.3 - comparison groups wanted to continue their participation in this study as members of major groups.

Thus, the use of sculptural modeling on human anatomy classes can be evaluated positively. This method brings the creative element to the routine and highly complex process of studying the anatomy, it strengthens activities of students,

increases their interest in the subject, and this inevitably reflects on their academic achievements and satisfaction with the quality of education.



A



B



C



D

Figure 3. A-D. Some of the students had the clear ability to sculptural modeling. It was difficult to distinguish their models from natural

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# SECTION 8.

*Veterinary medicine*

# SECTION 9.

*Art, Religion, History, Culturology, Philosophy*

# The Cinema in Aveiro - Between the animation film and film festivals

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**Abstract—** This article aims to determine, through the analyze of institutional data, the impact of animation in the district of Aveiro. Despite not being a central region of Portuguese culture such as Lisbon and Porto, it seems to have a strong and important cinematographic activity with works that assume and represent Portugal abroad. The film producers of this region seem to be able to turn the installed crisis around, which appears to affect the cultural sector. Despite not producing many works, they keep concerning about the quality, they can win international awards and bring prestige to the district. The annual Film Festivals contributes to the dissemination of their film works and also promotes the economy and tourism in the municipalities where they take place. The obvious bond between a professional audience, the one that tries to be professional, and the audience in general, has been attracting a growing number of spectators, which seems to recall the importance of the region of Aveiro in the context of animation films and other genres.

**Keywords-** Cinema, animation, Aveiro, Film Festivals.

## I. INTRODUCTION

In a time that the Portuguese cinema has a very low financial support from the government for its production and dissemination, the region and district of Aveiro seems to rely on its producers and filmmakers who are decided to overcome this fragile situation.

Being essentially produced animation films, the cinema in this district has been bringing merit, culture, awards and international recognition to municipalities and small villages in the area of Aveiro. To achieve this, it seems that many of the prestigious film festivals initiatives have been contributing and also betting on the education in the audiovisual area.

## II. BRIEF HISTORICAL BACKGROUND

### A. The rise of cinema in Aveiro

In the 60's and 70's, when the "new cinema"<sup>1</sup> emerged, some names like Antonio Campos<sup>2</sup>, Vasco Branco, Manuel

<sup>1</sup> This "new cinema" does not refer to the most current forms of filmmaking. It has to do with the fact that in the early 60s, the generation of young filmmakers began to be formed "in criticism, in the activity of film society, the University Film Studio in foreign schools, film amateur or in various sectors of production national (...) "[1].

<sup>2</sup> Antonio Campos was born in Leiria but would live for years in Aveiro. Although it has not belonged to the designated *group of Aveiro*, was one of the drivers of the new film, with the city of Aveiro influenced their films.

Matos Barbosa, Manuel Paula Dias, stand out. These names are attached to films known as being amateurs films. As amateurs filmmakers, their work used to have qualities that often couldn't disguised the natural lack of technical means and methodological, aesthetic and linguistic limitations that characterize the cinema in general.

These masters of cinema, who are remembered as the Group of Aveiro, always dedicated themselves to this art for passion and not for work. Almost all these people pursued careers in other areas, and that is perhaps what makes so fascinating and admirable the effort to make their work recognized.

Aveiro as a region, district and city is very rich in not only natural landscape elements but also architectural that since the mid-twentieth century, began to emerge *Arte Nova* buildings, making it their capital city and named by many the "Venice of Portugal". Perhaps for these reasons, not only the city but also the regions were the main stages of the first film projects.

Concerning *Group of Aveiro*, Matos Barbosa also says that by deciding to get what this region has the best to offer and project that beauty and immensity in the big screen, wasn't easy to raise the group's will power and "often creating risks of public ban, subject to previous censure. [...] Thus it was born a healthy friendly spirit and relationship that would become some sort of group, not closed but very organized, which led to call us group of Aveiro. "[2]

## III. THE ANIMATED FILM IN THE DISTRICT OF AVEIRO

### A. Film Society of Avanca

The Film Society of Avanca, along with other producers, is perhaps the institution that has produced and directed more films in the region of Aveiro. With 28 years of existence but working for 33, it has focused mainly on producing animation films through its animation studio and lab, where these films have been winning numerous awards abroad, bringing merit and recognition for their work.

Through data provided by the institution (Table 1), it appears that it was in 2011 that they produced a greater number of short animation films, making a total of eleven works produced in that year. In 2010, they produced four animation films and a total of five of cinematographic works. In the last year, there were only three short animation films, but had a total of ten films produced.

So it appears that in a time when the government cut almost the entire financial support for the cultural sector, 2011 and 2012 were the years that the film society produced more.

TABLE I. ANIMATION FILMS PRODUCED IN THE LAST THREE YEARS

Period Name	2010	2011	2012
	The estuary, the water, the man ...	Woman shadow	The Miracle
	Tale of the Wind	Witches	15 Billion Slices of God
	The Thomas's Clock	Brincarolas	Tears of a clown
	The lighthouse's eyes	Let's Sing	
		The Circus	
		Schlager	
		A song for a prostitute	
<b>Total</b>	<b>4</b>	<b>7</b>	<b>3</b>

It is important to consider the production cycle of works since it's this factor that explains the disparity of the number of films produced each year, bearing in mind that a work can take between one to four years to be completed.

Quoting a paragraph from an article of the blog of this institution, from the file of September 2011, it stated: "Struggling with consecutive lack of support for the production of their films, the film producers of Avanca have maintained an annual production of ten films and a constant presence in the international film festivals. With a predominance in the production of animation films, the film producers in Avanca were responsible for 51.96% of all awards at film festivals abroad attributed to Portuguese animation films (during the years 2009 and 2010), although having a single animation film since 2008 supported by national public bodies. "[3]

#### B. Cinema The Impact of Film Festivals

Happening at different times of the year, film festivals have enriched through the years, the different municipalities of Aveiro.

Creating cultural and professional experiences, these festivals are an increasingly important demand from all interested persons in this area.

According to information provided by the ICA - Institute of Cinema and Audiovisual [4] (official data), the number of spectators at the festivals of the district of Aveiro, from 2009 to 2011, has had the following changes:

TABLE II. EVOLUTION OF THE NUMBER OF SPECTATORS OF THE FESTIVALS IN THE DISTRICT OF AVEIRO BETWEEN 2009 AND 2011

Festival	County	2009	2010	2011
Avanca - International Meeting of Cinema, Television, Video and Multimedia	Estarreja	13.017	17.833	17.891
Cinanima - International Festival of Animated Film	Espinho	9.625	10.842	10.155
Fest - Festival International Young	Espinho	6.466	4.790	6.252
Luso Brazilian Film Festival	Santa Maria da Feira	2.789	3.179	3.135

Unfortunately only managed data until 2011, since online statistics relating to 2012 are not available yet.

#### C. Estarreja: International Film Festival of Avanca

Since its first edition in 1997, Avanca - International Meeting of Cinema, Television, Video and Multimedia will have its 16th Edition in July 2013.

According to the statistical data of the ICA, the numbers of the audience of Avanca, who come from all over the world, have increased over the years. In parallel, the festival has had a large adherence of films from countries of the five continents.

Comparing with the other three festivals in the district of Aveiro, the Avanca's Festival has had more than a half of the spectators, as can be seen in Table 2.

An aspect that appears to make the festival so interesting is the fact that only national or world premiere works can compete, in other words, the films can't have run to any other type of festival or even been published on the Internet. The festival turns out to be a meeting point for filmmakers, producers, researchers and many other persons from the world of cinema. It is also a space for audiovisual education, achieved through the annual international workshops that take place at the festival.

According to Tables 3 and 3.1, which can determine the last three years there has been a great increase of films contesting and is relatively large the number of countries that follow this event (recalling, again, that these are some national and world premieres). By contrast, the number of selected films is decreasing. The main reason seems to be in the fact that the team's Festival of Avanca, that makes the selection of the applied films, has opted to elect and to prioritize quality over quantity of the films shown during the event.

TABLE III. NUMBERS OF THE LAST THREE YEARS OF THE FESTIVAL OF AVANCA

	No. of films submitted	Total Countries	Selected films	Awards
2010	1200	60	108 films + 21 Trailers (24 countries)	14
2011	2088	67	67	17
2012	2402	69	52	15

TABLE IV. (CONTINUED) NUMBERS OF THE LAST THREE YEARS OF THE FESTIVAL OF AVANCA

	Honorable mentions	Juries	Conferences	Workshops	Avanca's Competition (No. of films selected)
2010	→ 8	7 (const. 23 individualities from 11 countries)	→ 141	→ 6	→ 29
2011	→ 8	8 (const. 34 individualities from 12 countries)	↑ 166	→ 6	↓ 26
2012	↑ 9	8 (const. 34 individualities from 12 countries)	↑ 166	→ 6	↓ 15

The "Avanca's Competition", one of the contests that takes part in the festival only for works produced within the region, was the first regional competition of films happening at film festivals in Portugal. As shown in Table 3.1, the number of films selected has also been reducing for the reason given above.

The "Avanca" was the first festival in Portugal that has integrated an international scientific conference on cinema in its program.

The number of conferences also increased in the last two years because the event shows itself as a stage for discuss experiences, ideas, research, sharing knowledge and culture that has captivated and encouraged more and more those who are attached to the cinematographic world to participate. These conferences involve communications of about 200 researchers and lecturers from universities around the world.

The Festival is organized by the Film Society Avanca and by the City Council of Estarreja with the support of ICA / Secretary of State for Culture, Portuguese Institute of Sport and Youth, Portuguese Academy of Cinema, APEVT, DeCA / University of Aveiro, ESAP, ESAD, "Teatro Aveirense", Parish Council, Parish and School Grouping of Avanca, as well as several local organizations. [5]

This event has allowed to the City of Estarreja a greater invasion of tourists during the event, the local economy has growing and the region, the films and their filmmakers has been promoting.

Basically, these are the main consequences and a natural impact of a well-received Film Festival.

#### D. Santa Maria da Feira: Luso Brazilian Film Festival

This festival, which in 2013 will celebrate its 17th edition, aims to unite and devote what Portugal and Brazil have by sharing knowledge, experiences and cultural experience. Being two countries with strong linguistic connections, the aim is to support the author cinema and make the filmmakers share their productions and discuss their practices and techniques in informal meetings. The festival aims to be a "humanized" event. [6]

The differences between these two countries in terms of cinematographic production are not very different. Both sides of the Atlantic seek to increment an "internationalization of the films, which has enabled to filmmakers contact more with each other" [7].

However, it is clear the highest number of productions found in Brazil, where the investment in the film industry is higher.

In Portugal, film productions are lower and try to compensate with the desire for a higher quality.

Among the four festivals mentioned in this article, the Film Festival Luso-Brazilian is the one with a smaller number of adherences by spectators and participants. As noted in Table 2, in 2011, the festival featured with less forty four assistances than the previous year. In 2012 it had five hundred proposals films resulting in thirty four selected films. Compared with other festivals in the district of Aveiro these numbers are greatly reduced. This doesn't detract the quality of the present work, once this festival has only two participating countries which automatically delimit the number of possible candidates.

#### E. Espinho: Cinanima and Fest – International Youth Film Festival

The Cinanima had its first edition in 1976 and since then it has grown and occupy an important place in the national festivals.

Being considered "a Portuguese innovative project of cultural decentralization, claiming itself as an event of international meaning outside Lisbon and Porto" [8], Cinanima pretends, like any other festival, to approach and promote the contact between professionals in this area and those who are interested for animation, like in this case.

Having fought for nearly 37 years in order to make the public recognize the animation as a cinematographic genre suitable for everyone and not just for children, this festival isn't just a show of animation works but a space that promotes the formation, exhibitions, performances, contests and other activities that are being held during the week.

Being one of the most renowned national and international animation festivals, its participation in Cinanima is a unique opportunity for many, bringing benefits to artists which result as an access to a professional future. According to the presentation of the festival on its site, the following privileges are given to the winners of the event:

- Clearance for the Cartoon D'Or of all the winners of the festival;
- Clearance for the pre-tender appointments to the Academy Awards Hollywood Grand Prize winner of the Cinanima. [9]

Given that only compete animated films, the numbers in relation to works that apply for this festival are high and have been increasing over the past three years. (Table 4)

TABLE V. NUMBERS OF ANIMATED FILMS THAT COMPETED IN THE LAST THREE YEARS

	No. of films submitted	Total Countries
2010	702	51
2011	879	48
2012	952	57

Being animation films the primary issue that entitles this article, this is perhaps the festival to take more into consideration for its approach to this cinematographic genre.

Despite the number of spectators being far from the ones from the Film Festival of Avanca, it remains in 2nd place with the largest number of participants (Table No. 2), bringing to the district of Aveiro and to the county of Espinho a considerable number of visitors from other countries, contributing to the economic growth of the municipality.

The Cinanima is organized by NASCENTE - Cooperativa de Ação Cultural, CRL along with the City of Espinho and has the support of the Ministry of Culture / ICA IP - Institute of Cinema and Audiovisual Secretariat of State for Youth / Portuguese Youth Institute, the Institute of Tourism of Portugal, Inspector General Games, Parish of Espinho and sponsorship and partnership of many private entities and media organization.

Regarding the Fest - International Youth Film Festival, also held in Espinho, was created in 2004 and it aims to disseminate, promote and encourage the creation and film production in young people up to 30 years of age.

Through its program of *Training Ground*, participants can watch and enjoy more than twenty courses related to the field of cinema, from screenwriting, photography, picture, sound, editing, light, etc., with professionals and international personalities.

This festival holds since 2012 the *Pitching Forum*, an important event where young filmmakers and screenwriters have the opportunity to present their projects and ideas for four /five minutes, and the producers can get their feedbacks. These pitching sessions are essential to prepare young people who want to launch a career in cinema and have to impress the producers to finance their projects. [10]

Regarding the accession by the public to this festival, the ICA data (in Table 2) and the disseminated by the organization of the festival, are quite different. The organization's data differ for 2009 in 3.534 spectators, for the year 2010 about 10.026 spectators and in 2011, 10.878 spectators.

## IV. CONCLUSIONS

Aveiro, being a peripheral region of areas like Lisbon and Porto, presents a valued cinematographic ancestry, especially in terms of animation.

Having a history of film production frame by frame, which refers to the 60's and 70's, nowadays is the animation studio's from Film Society of Avanca that has produced more. This productions have been mainly distinguished everywhere.

This film genre also has festivals in the region. Organized annually, besides disseminating and promoting what is produced, in parallel with the latest world production, are thus a window for the international dissemination of local cinematography. On the other hand, festivals give dynamism to the region and contribute to its dissemination across the world and to enrich the economic and touristic districts. The visit of several creators, filmmakers, researchers, academics and cinephiles has propitiating meetings and provided ideas, experiences, methodologies and development of joint projects. Between the animation production and the festivals in the region, strong inter-relational bonds have allowed the production of new films and their disclosure in a concerted manner.

The substantial number of prizes and international participations that animation film produced and directed within the district of Aveiro has raised, as well as the prestige that are gaining Film Festivals (especially Cinanima and Avanca's), it is fair to say that the region of Aveiro presents and represents well this film genre. Their constant production interferes positively in the municipalities of the district, promoting them and enriching them at all levels.

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# Seven Significances of the Term “Discourse”

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**Abstract—** The paper aims to present a historical overview of Rhetoric, based on two premises.

The first premise is Aristotle’s “rhetorical fact”, a model with eight components ranging from “Who is speaking?” to “What is one speaking for?”.

The second premise is the comparative analysis of the relation between three types of enunciations: *cognitive* (epistemic), based on the functor It is - It is not; *deontological*, based on the functor Must – Must not; and *rhetorical*, based on the functor Maybe with its alternatives Maybe yes – Maybe not. The organization of cognitive enunciations is based on Demonstration (D) whereas the one of the deontological and the rhetorical enunciation is based on Argumentation (A). Thus we can differentiate between the theoretical approach and the rhetorical discourse.

Changes in the significances of the term “discourse” occur alongside those in the components of the “rhetorical fact” (including a shift in focus) and in the relation between the three types of enunciations. Seven significances of the term “discourse” were extracted from these premises: the oral discourse; the written discourse; the multiplication of Aristotle’s three genres (R. Descartes, J.J. Rousseau); Perelman’s extension; the generalization of the expression form (A. Leroi-Gourhan); the integration of practice as “discursive practice” (M. Foucault); the theological and metaphysical extension (up to the level of Existence).

We believe that 19<sup>th</sup> century Psychology and 20<sup>th</sup> century Philosophy of Culture constituted two failed attempts to *unify* all forms of culture and that the third attempt is currently ongoing and belongs to Rhetoric. The evolution of the significances of the term “discourse” is also significant for this trend.

**Keywords-** *Discourse; Rhetoric; Deontology; Opinion; Argumentation; Demonstration; Communication model*

## I. THEORETICAL BACKGROUND

The theoretical background includes two correlated and complementary sequences:

### A. The rhetorical (oratorical) fact

The concept of “rhetorical fact” gained methodological meaning and became a theoretical model during the classical period of Rhetoric – from Aristotle to Quintilian. The words “deed” and “to do” denote the praxeological meaning of the fact. The “rhetorical fact” – also known as “oratorical fact” – consists of eight components which, according to Aristotle’s *Rhetoric* and *Topics*, can be formulated as the following questions: “1. Who is speaking?”; 2. “Who is one speaking

to?”; 3. “Where is one speaking?”; 4. “When is one speaking?”; 5. “What is one speaking about?”; 6. “How is one speaking?”; 7. “Why is one speaking?”; 8. “What is one speaking for?”. Aristotle’s last two questions “Why is one speaking?” and “What is one speaking for?” are absent from almost all modern models. The first question concerns the *main cause* of speaking, while the second is related to the *final purpose* of the speech.

In the same *Rhetoric*, Aristotle also spoke about and defined the “rhetorical situation” and its three elements: the speaker, the speech and the audience. [1] Roman Jakobson’s model with six elements called “instances” is certainly more complex and constituted the basis of other models that praised or criticized it. Jakobson’s already classic model, was abstract (conceptual), whereas the other models were directed towards mass communication research. [2] The five questions in Richard Watson’s model - known as the *Rule of the five W’s* - replaced speech with facts and pragmatically focused on sociological/journalistic investigation.

Aristotle’s model is sufficiently rich and systematic to be applicable to our topic. The elements of the “rhetorical fact”, similarly to those of the “rhetorical situation” were variable in time, but they are “dialectic constants” (Bazil Munteanu), and their transformations are accompanied by changes in the meanings of the term “discourse”.

### B. Three types of enunciations

There are three types of enunciations with specific *functors*, associated *values* and *subjective* equivalents, which are sub-textual and implicit [3].

The *cognitive enunciation* is based on the existential functors It is – It is not. It is associated with the values True – False and it has Certitude (C1) as its subjective equivalent. Truth and Falseness do not have degrees of comparison and are verified (confirmed) by Demonstration (D). A coherent set of cognitive enunciations forms a Theory and even an Axiomatic System.

The *rhetorical enunciation* is based on the rhetorical functors Maybe yes – Maybe not, [4], it is associated with the values Verisimilar (“eikos” in Ancient Greek) – Not verisimilar and has Conviction (C2) or Faith (F) as its subjective equivalent. The rhetorical enunciation has degrees of comparison and can be more or less verisimilar and/or convincing. The words “more” and “less” were first used by Aristotle, the theoretician of the Measure doctrine. Rhetorical enunciations are supported through Argumentation (A). In Protagoras’ paradigm, the duty of the orator is “to make the

weaker argument stronger” [5]. A more or less coherent set of rhetorical enunciations forms a discourse.

At least three distinctions have to be made here. The first and the most important is the one between (A) and (D). This distinction was made by Greek thinkers (from Parmenide to Aristotle) between “episteme” and “doxa”: “Episteme” refers to (D), whereas “doxa” refers to (A) [6]. In a systematic approach, Olivier Reboul identifies five differences between them: 1. (A)’s auditorium is particular, while (D)’s auditorium is virtually universal; 2. (A)’s language is natural and ambiguous, while (D)’s language is specialized and univocal; 3. (A)’s premises are only verisimilar, while (D)’s premises are certainly true; 4. (A)’s progressing depends on the orator, but (D)’s progressing doesn’t depend on the author’s subjectivity; 5. (A)’s conclusions are always contestable, while (C)’s conclusions are certainly true [7].

The second distinction, between (A) and “discourse”, is important as the latter also includes the stylistic expression, the Style.

It is also important, in the third place, to underline the difference between Certitude (C1) and Conviction (C2) that in some texts are not distinguished or are assimilated.

The *deontological enunciation* is based on the functors Must – Must not, it is associated with the values Correct – Incorrect and has Respect as its subjective equivalent. Kant stated that respect is a mixture of fear and love. A relatively coherent set of deontological enunciations forms a Deontological Code [8]. In our opinion, Correctness is the fundamental Principle of Deontology and “political correctness” is only one of its particular forms.

Deontology defines the area of intersection between the circles of morality and of profession. [9] All deontological Norms have a moral and a professional component. When referring to Discourse, old Rhetoric, (“Paleorhetoric” as it is called by the  $\mu$  Group), defines three functions: the first, called “logos”, has an informative-cognitive nature, the second “ethos” is motivational and the third “pathos” is aesthetic and psychological. Here, Latins, use the terms: “cognoscere”, “movere”, “delectare”. In this case, the Deontology of Discourse tells us that there Must be a balance among the three functions and that it is only through this balance that Conviction (C2) and/or Faith (F) will be achieved. Otherwise, the discourse may be degraded in three ways: if the discourse stresses the first function it becomes a mere “theoretical presentation”; if the discourse stresses the second function it becomes moralizing; if it stresses the third function it becomes a “flat declamation” as D.D. Roşca, the author of *The Tragic Existence*, put it. In all these three situations, the discourse is not a discourse and Conviction (C2) fades away.

The relation among the different types of enunciations can be defined through the relation of their respective functors. In an ideal case, the deontic functor is placed in the middle between the existential functor and the rhetoric one: it opens the existential functor, which is ultimately tautological ( $A=A$ ) and it limits the rhetorical functor, which is ultimately absurd ( $A\neq A$ ): anything is possible but the Impossible. In Aristotle’s language, the deontic functor occupies the “middle position”

(Measure) between “too little” or “absence (Silence)” and “too much” or “excess” (Noise). In Christian terms, the deontic functor is classified between two thieves, the “thief of poverty” on the left and “the thief of waste” on the right. In Constantin Noica’s words, the deontic functor is “The limitation that does not limit”. This happens, because under one and the same imperative (like the categorical Imperative with Kant), a whole series of achievable and correct possibilities opens. For instance, without responsibility and without the deontological functor Must – Must not, freedom may degrade into libertinism and/or into libertinage. With responsibility and with the deontological functor, freedom is and remains possible and is at the same time authentic. [10].

In the absence of the deontic functor, a *negative rule* of discourse – discursivity may be applied: anyone can say anytime and anywhere, anything and anyhow about anyone and anything. The cause of this possible discursive situation is a generalized conflict of interests, having Nontransparency (with its various degrees, if not Noise) as its purpose. Applying Deontology here reveals that even the anti discourse is a discourse and that its optimum form is accompanied by degraded forms: pseudo discourse, failed discourse, equivocal discourse etc.

A discourse is essentially made of rhetorical enunciations. However, the significances of the term “discourse” depend on and are changed by how the other two types of enunciations are integrated into the discourse. For instance, we can refer here to Opinion. Aristotle states that Rhetoric is the “doctrine of opinion”. Opinion is the core of a discourse and it can be expressed in a sentence (the rhetoric enunciation), or in an ensemble of enunciations that forms a discourse. Opinions exist in an undetermined number, and some of them are optimum, while others are degraded. The optimum opinion contains both a cognitive (informational) and an evaluative (attitudinal) component. If opinion contains only the first component, it (may) convert into a cognitive enunciation, and if it only contains the second component, it (certainly) converts into a mere psychological state (the “subjective arbitrary”, in Hegel’s words), a state that can be expressed also through an “interjection” (Ayer). Or, Deontology establishes, through Rules, the relation of the two components (cognitive and evaluative), and gives us the “equation” for their optimum rate and balance. Solely in such a balance, will pathos find its natural place and will not be degraded.

Let us also mention here, that in the history of Rhetoric there are different classifications of discourse, according to different criteria. Any book or treatise of history of Rhetoric underlines this theoretical fact. Contemporary orientations in Rhetoric also present different classifications [11]. In the volume *The Rhetorical Tradition*, the authors select a series of texts from the history of Rhetoric that comprise many classifications. They define Aristotle’s three genres, and state: “Later rhetoricians expanded this list to include sermons, letters and eventually all forms of discourse, even conversation that could be seen as persuasive in intent” [12]. One can make a classification even starting from the eight components of the “rhetorical fact”. But we are interested here not in the typology of the discourse, but, in the history of the significance of the term “discourse”.

## II. THE SEVEN SIGNIFICANCES

The significances of the term “discourse” change alongside the different transformations (in degree or nuance) occurring with the composition of the “rhetorical fact” and with the relations among the various types of enunciations.

1. The first significance concerns the *oral discourse*, which uses *verbal* language in its *audible* form. The oral forms of old and ancient discourses are irreparably lost and linguists still debate the correct pronunciation of the consonant “c” in names such as Cicero and Caesar. This *language* is obviously accompanied by *nonverbal language* based on the “syntax of gestures” [13]. The first significance is the “strongest” and the longest lasting. In common thinking (and not only) even nowadays, “discourse” is understood as mere “oral discourse”.

In the case of this first significance – and of the next one –, the difference is made by the answer to the question “How does one speak?”, which can be converted into “How does one express him/herself?” This question has two meanings: “How does one express oneself?” and “How does one think?”. In this bivalence of the term “how” is implicitly contained the idea of organic unity between expression and content.

2. The second significance concerns the *written discourse*, multiplied through Gutenberg’s printing press up to the level of a “Galaxy” (J. M. Mc. Luhan). Multimedia devices indefinitely record and multiply the two forms of discourse, which can function alternatively, or concomitantly. G. Molinié believes that since both the oral and the written form contain *sentences* (enunciations), there is also a third significance which is *linguistic* [14]. However, this one does not belong to discourse only, but to any form of communication, as it is related to what Roland Barthes called “writing”, which – axiologically speaking – only has the “zero degree”.

3. The third significance of the term “discourse” aims at the theme (“What is one speaking about?”). Within this third significance, the *theme* of the discourse extends (with its respective problem and solution). Therefore, the answer to the question “What is one speaking about?” enters the game. In his *Rhetoric*, Aristotle made the distinction between the three genres of oratory [15]. The *deliberative* genre, which is employed in politics, has Useful and Pernicious as its values or “purposes”, as Aristotle called them. The *judicial* genre is used in Law and its values are Justice and Injustice. The *epideictic* genre is common in ceremonies that celebrate people, institutions or gods and its values are the human Virtues and Vices. But afterwards, the third significance reaches an almost “sans rivages” theme. Bossuet delivered *homiletic* speeches about the Sacred and the Profane as Mircea Eliade put it, Descartes held a *Discourse on the Method*, while J.J. Rousseau wrote a *Discourse on Inequality among Humans*, the only restrictive condition being the importance of the topic (an open problem and a solution meant to “close” it, i.e. to solve it).

4. The fourth significance of the term “discourse” – if we are to keep it open and variable, according to the previous significance – shifts the focus from the *object* of the discourse (theme – problem – solution) to its *form*. The question that must be again considered is “How is one speaking?”. Within the first three significances of the term discourse, the *verbal* form of expression based on spoken or written *words* prevailed.

Traditional Rhetoric also focused on nonverbal language, but in close association with the speaker and the oral expression. Beginning with its fourth significance, *discourse* takes over the *nonverbal* form of expression but it does so in a general way. This form may be any of the already well-established or about to become so *cultural forms: the sign, the image, the metaphor or the symbol*. According to its form of expression, we can refer to the *poetic* or *novelistic* discourse, the *theatrical* or *film* discourse, the *advertising* discourse or even the discourse of *dreams*. The book *Silogistica* written by Ion Didilescu and Petre Botezatu contains a very clear statement: “A syllogism is a logical discourse” [16]. Furthermore, according to Aurel Codoban, if “the Christian Middle Ages were anti-rhetorical”, in modern times even Philosophy tends to become a “literary genre” [17].

In philosophy, the shift in focus towards the rhetorical modality is illustrated by its multiple genres. In this respect, Ilie Pârnu correctly observed that “The multiple genres and styles in Philosophy make it compete with literature” [18]. According to Olivier Reboul, *Non-paraphrasing* is one of the three Principles of Rhetoric (the other two being the principle of “closing” and the one of “transfer”) [19]. But, as discourse cannot be paraphrased, it almost becomes a work of art, which is unique and unrepeatable. In this way the discourse can enter the sphere of arts and as such it converts into discursivity.

Based on the fundamental distinction made by A. Leroi-Gourhan between *word* and *gesture*, we can conclude that the first three significances of discourse are mainly grounded on *words* while the fourth also includes *images* and *gestures*, with their direct or symbolic derivatives.

5. The fifth significance of the term “discourse” encompasses the entire human Culture as an ensemble of spiritual creations and values with “bipolar” character [20]. This fifth significance preserves both the *universality of the object* (the discourse can be on any theme), as well as the *universality of expression* (the discourse can take any form of expression). Chaïm Perelman had a decisive contribution to this *extension* of the significance of the term “discourse”. For the author of the *Treatise on Argumentation*, the object of Rhetoric includes all Culture forms and their specific values, except for Science, whose cognitive values are Truth and Falseness. Perelman explicitly delimited his views from Aristotle’s theory of the three genres of oratory. He finds that the aim of each Argumentation is identical to the classical aim of oral discourse, i.e. Conviction (C2 in our symbol): “One can see that the aim of oratorical art, i.e. the adhesion of the spirits, is the same as in any argumentation”. Then, Perelman goes on and explains: “But we have no reasons (“raisons”) to limit our study to the presentation of an Argumentation based on words and to limit the type of auditors to a crowd gathered in a square” [21]. For Perelman, the audience of an Argumentation (Discourse) is particular and specific (P) while that of a Demonstration (Theory) is virtually universal (U).

One consequence of Perelman’s *extension* is also the distinction between *discourse* and *discursivity*. The discourse, in its classical and perennial form, is *delimited* (in space and time) while *discursivity* is a generic property of all communication forms, if they result in Conviction (C2) and/or

Faith (F). One consequence of *discursivity* is the universal character of the answers to the questions “Where is one speaking?” and “When is one speaking?”. Verbal and nonverbal expressions are possible anywhere and anytime, given the omnipresence of the Mass and Multimedia. Therefore, the clearly delimited reality turns into an unlimited virtual space.

However, Perelman’s *extension* was recently acknowledged and the fifth significance now includes all Culture forms, including Science. The *Rhetoric of Science*, coordinated by Vincent de Coorebyter, summarizes how Rhetoric successively infiltrates all Sciences, including the “exact” ones like Physics, Mathematics etc. Rhetoric is not present here in the form of purely *decorative*, and therefore esthetic or didactic elements (Cicero) but as basic *suppositions* within the scientific constructs of Theories.

Vincent de Coorebyter supposes what the adversaries of Rhetoric’s introduction in the field of science would say: “putting forward the rhetorical dimension of the scientific discourse would represent a regression, a return to the primitive nondifferentiation bringing us back to the times when Science wasn’t differentiated from myth and from metaphysics”. But the author finds that with “facts”, “figures” and “laws”, Sciences only reach asymptotically the ideal of absolute exactness: “It remains that this ideal is asymptotic and had it been achieved, this wouldn’t be sufficient to stop the irruption of the rhetoric”. He concludes: “admitting that all disciplines are haunted by the forms of communication and of persuasion leads neither to relativism nor to methodological anarchy” [22].

On this occasion, (D) is, or tends to be completely assimilated within (A). Vincenzo Lo Cascio stands on a similar position when distinguishing several “argumentative profiles” [23]. Starting from “texts”, the author distinguishes between “profile2” that designates “an argumentative text meant to demonstrate” and “profile3” that designates “an argumentative text meant to convince”. Here, it is obvious that the difference between (A) and (D) is cancelled and by doing so, the latter is assimilated into the first.

Obviously, by using metaphors, one can say that “Argumentation is a diluted Demonstration” and that “Demonstration is a concentrated Argumentation”, but metaphors don’t take us much further. Anyway, the two positions (the first starting from Science/Sciences, the second starting from Grammar) are significant for the attempt to extend the object of the Discourse in the spirit of Perelman’s extension and beyond it.

With this transformation, the status of the Orator (“Who is speaking?”) also changes. Besides the incarnated orator (Peter or Paul, P1 – P2), the “anonymous author”, or the Voice that can have various hypostases, emerges. This is the “Shrewdness of Reason” with Hegel, the “unconsciousness of conscious activity” with Marx, the “Id” in Freud’s Psychoanalyses. In Sociology, this Voice is Public Opinion. For Michel Foucault, the Voice belongs to the Institutions. We get to the statement according to which through the personalized voice of the Orator, there is an anonymous (someone’s or nobody’s) voice expressing itself.

6. The sixth significance of the term “discourse” was developed by Michel Foucault within and beyond the previous significance. Here, the term “discourse” is assimilated in the very sphere of *real practice*. In this sense, the discourse does not approach a practical issue theoretically (verbally or nonverbally) but, inversely, *real practice* is perceived as a discourse *component* or *form*. Michel Foucault named it “discursive practice”, different from the traditional *Actio* that relied on nonverbal language. Therefore, the *enunciative* set – made of theoretical, reflexive sentences – is only one component of a “discursive formation”. In other words, the traditional meaning of discourse – significances 1, 2, 3 – is only one component of the “discursive formation”. When tackling the phenomenon of *madness*, Michel Foucault spoke consecutively, in concentric circles, about *medical discourse*, *clinical discourse*, *psychiatric discourse* and *psychoanalytical discourse*, i.e. *psychoanalytical therapy*.

The author of the *Archeology of knowledge* concluded that “Discourses such as economy, medicine, grammar or the science of living organisms organize concepts, regroup objects and produce certain enunciations that form themes or theories according to how coherent, rigorous and stable they are”. He further added that “Regardless of their formal level, all these themes and theories shall be conventionally called *strategies* [24]. Therefore, according to these two quotations, only the *enunciation* types overlap the traditional significances (1, 2, 3) of the term “discourse”.

Within the same European Culture, at the same time and from the same structuralist point of view, Louis Althusser introduced the concept of “theoretical practice” as another way of eliminating the difference and opposition between *theory* and *practice* and of extending the discourse into the sphere of practice or, inversely, of assimilating *practice* into and as discourse. Marx’s concept of “spiritual practical” activity or the frequently used “language of practice” idiom may also be interpreted along the same lines. The two questions tacitly involved here are “Why is one speaking?”, which asks about the reason or cause – and “What is one speaking for?”, which underlines the purpose. Thus, the ultimate purpose of the Discourse (discursivity) is no longer Conviction (C2) or Faith (F) only, but also the explicit attitude, the *fact-deed*. This is how the transition from the “rhetorical fact” to the real fact occurs in honor of Goethe’s sentence: “In the beginning was the deed”.

7. The seventh and last significance of the term “discourse” is situated outside the circle of Culture and practice, in the very sphere of Existence. Thus, what Vasile Florescu calls “Retorica Rediviva” [25] gets at the highest point, into the most comprehensive sphere. This last meaning refers to the Circle of all circles and has the widest, most encompassing *theological* and/or *metaphysical* significance. We can use here Cusanus’ epistemic metaphor, according to which God is a circle having the centre everywhere and the circumference nowhere. The “circle” with its “centre” and “circumference” are sacred here (Theology), but they can also be profane (Metaphysics), if we take into consideration the correlation between Sacred and Profane in Mircea Eliade’s conception.

The *theological* significance derives from two statements referring to the Dogma of the Holy Trinity, according to which God is One, but three persons: the Father, the Son and the Holy Spirit. Therefore, God is One but also, Many. The first statement is from the *Genesis* and it suggests the creation of nonidentity from unity: "At first God made the heaven and the earth. And the earth was waste and without form and it was dark on the face of the deep: and the Spirit of God was moving on the face of the waters. And God said, *Let there be light*: and there was light". Hence, God's *wish* generated light, i.e. the medium of divinity, which is only partially and temporarily limited by Darkness (and by the doings of the Dark one, which hides under different names). The second statement is from St. Luke's Gospel: "In the beginning was the Word and the word was with God and the word was God." The sentence highlights the idea of unity in diversity. In Theology, unity and diversity, or identity and nonidentity – and their dialectics, respectively – exist between the *Word* and the *Being*, which both belong to God. To put it differently, God's *Discourse* created the real world and all things in it, which Adam later named. Therefore, according to the language of the "rhetorical fact", the Orator, through His Word, ontologically generated the *theme* and suspended the *problem* (of the difference between the *spiritual* and the *material*). This ontological function of the Word is present in all Cultures, especially in their religions (in Oriental *Mantras* for instance).

The same type of relationship exists in Metaphysics. By speculating the triptych meaning of the Greek word "logos" (word, concept, objective reason) and by applying this triptych semantic scheme to the Latin term "rostrum", Constantin Noica came to refer to the Romanian word "rostire", which has three meanings: *verbal* (to speak), *practical* and *ontological* (to put in order) and *metaphysical* (meaning, the ultimate goal, "Entelechia") [26] This trivalence suggests the metaphysical significance of discourse understood as *Rostire*, as through it, people use words to name things (like Adam), to put things in order and to discover or give *purpose* or *meaning* that *order*. This metaphysical discourse with its three functions equals *Becoming into Being*; here, the entity's identity is equal to its own process. This statement doesn't contradict Quine's classical statement: "There is no entity without identity".

In Postmodernism, Existence is also seen as Discourse, as Nobody's discourse. However, given the crisis of axiological landmarks as well as the harsh criticism of any sort of "narrativity", this Discourse is incoherent and semi-obscure (not clearly-obscure, as in Rembrandt's paintings). Here, speech becomes "stuttering". We believe that Postmodernism is the third historical variant of Skepticism, following the ancient one (Sextus Empiricus) and the modern one (David Hume). Postmodernism brings its own reinterpretation of Gorgias' trilemma: a) Nothing exists; b) If anything does exist, it cannot be known; c) If it can be known, it cannot be communicated". Therefore, Silence is the final result. However, the verbal expression of Silence is a paradox, even a Meta-paradox.

### III. COROLARY

This analysis leads to at least six conclusions:

1. Tacitus' observation according to which Oratory and Rhetoric can only "bloom" in democratic (Republic) and not in dictatorial (Empire) societies was confirmed. Modern, democratic societies witness an exponential increase in the number and variety of opinions. The significances of the term "discourse" change both extensively and intensively based on the real phenomenon that is the unlimited multiplication of opinions at planetary scale. It is on this background that Perelman's "Empire of Rhetoric" develops.

2. Unfortunately, "The Rhetorical Empire" is not unitary. Professor John Kotter's penguin says: "There's a crack in our iceberg". In our case, the crack was introduced by the great orator Cicero, who made the distinction between the Content (theme-problem-solution) and the Style of a discourse. But, the Style was seen as an "ornament" and so, detachable from the content. The two great directions in present Rhetoric developed on this crack: *The Theory of Argumentation* (starting from Perelman) and *The Stylistic Rhetoric* (*The  $\mu$  Group*). In present Rhetoric there are several "specialized" directions, some of which tending to analyze the "small infinite." But regardless their nature and number, they all integrate themselves into and feed the process analyzed by us, which is the one of the extension of Discourse and Discursivity much further than Perelman's crucial moment.

3. All transformations in the history of the term "discourse" can be reduced, ultimately, at two components: the *theme* (with its problem and solution), which is extended, and the expression forms, which are multiplied beyond the *verbal expression*. Thus, Style is also modified - if we mean by that, the specific way of correlating contents with its form, the invisible "interior" with the perceptible "exterior". The theory of Style is one thing, and Style as a characteristic of discourse – discursivity is something else. It is Rhetoric's duty to elaborate a General Theory of Style – not only of figures of style - beyond the one inherited from the Ancients which was limited to three (Styles). Only with the analysis of the "figures of style" we can get - as previously mentioned – at the "small infinite", whose limit is zero (Blaise Pascal). O. Reboul distinguishes even the levels existing between the level of form and the one of content. He distinguishes among four types of figures: "the figures of words", "the figures of meaning", "the figures of construction" and "the figures of thinking" [27]. In the same line, Jean Claude Schmitt speaks – alongside with Leroi-Gourhan's – about the "Reason of gestures" [28] and here, content and form are identical.

4. As previously stated, the multiplication of opinions is a „sans rivages" process. But this "sans rivages" variety must also include Deontology, which makes the distinction between Correct and Incorrect. Some opinions are optimum while others are degraded. The same can be applied to discourses, although no bi-univocal connection exists between the quality of opinions and that of discourses. Another criterion must be introduced in the Universe of opinion and discursivity, namely the "deontological tree" (Henrik von Wright). The "tree" must

be “watered” continuously, otherwise we risk returning from Culture to Nature, and not in the sense of J.J Rousseau’s “return”.

5. According to Tudor Vianu, 19<sup>th</sup> century Psychology and 20<sup>th</sup> century Philosophy of Culture constituted two attempts to unify all forms of human Culture and Civilization. In our opinion, these two attempts failed. The third attempt, initiated with Perelman’s extension, is taking place this very century.

6. The solution of *unification* is an open problem involving the relationship between Rhetoric and Metaphysics, which should also be reconsidered. In the volume “Looking for the Rhetorical Reason”, in press at the “Eikon” Printing House from Cluj-Napoca, we undertook this daring task.

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# God, the Creator of the multiverse

## The theory of concomitance

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**Abstract** – It has always started from the premise that the pattern of scientific knowledge is incompatible with the religious one; it was assumed that the models of modern scientific Cosmology – including theories of *Big Bang* and, especially, *M-theory* – cannot be explained into a theistic version. Moreover, it has been argued that these patterns of scientist thinking (under acronym ST inside the paper) may not include even presumptively the concept of God-the Creator. Though, modern science, in her unyieldingness quest to achieve an unifying theory encompassing all human knowledge itself earned till present, can no longer ignore the answer provided by religion in the great problems of mankind, i.e. *What is the universe, since when is there life, what is man?* On the other hand, the religion can no longer remain indifferent and devoid of a documented response to theories of modern Cosmology; we see this in all sorts of attempts of some adventurers' theologians, who have been trying to "placate" the two visions into mixed, but inconsistent formulations (i.e. *Scientific Creationism* or *theological evolutionism*). If there are contradictions in your own thinking, blanks, incoherent ideas or inconsistent stance, we will not be able to set on the coordinates we engage in these discussions. Removing these inconsistencies may be made through *theory of concomitance* that I broadly sketch out here, due to the small size of the paper, while addressing the possibility of acceptance of *M-theory* by theology and by providing undeflective premises for strengthening of this *theory of everything* (TOE), a self-contained mathematical model that describes all fundamental forces and forms of existence. The theory of concomitance complements and offsets the other theories addressing the relationship religion-science, but also applies to the various cosmogony and cosmological theories – i.e. *Creation ex nihilo*, the *big bang* theories and *string theory* – showing how it should be applied or viewed in such a *theory of everything*. The element of novelty brought by the present study consist the possibility of the new scientific cosmological paradigm co-habitation with the one of religious thinking consists.

**Keywords** – *theory, concomitance, paradigms, gestalt, religion, cosmology, universe, God*

### I. INTRODUCTION

The awakening of human consciousness meant the birth of the essential questions – like *what is life, what is its source; what is the origin of the universe; what is man and what is his role in this universe?* – that were given, at the same time, various responses from the three levels of human knowledge,

religion, philosophy and science<sup>1</sup>. The definition of the scientific method and its object – as being exclusively a part of the figurative domain<sup>2</sup>, pursuing only the material (naturalist) aspects – has conferred to science a distinct path from the other two *gestalts*, non-figurative. But now science is opening to *mystery*; it recognizes its origins, its foundations that aimed precisely to this destiny, not to stop from researching the mystery, of ineffable, despite all the evidence and physical discoveries that it finds: *the road to mystery is sprinkled of physical evidence*.

The opening of the new scientific paradigm to the *mystery* (see e.g. music of the worlds in *M-theory*) demonstrates the ability of science to climb into another level of comprehension, along with philosophy and theology, that through correct and consistent knowledge of the creature, to reach glorification of the Creator. Among first proofs – forced by the time stewardship – of crediting this rational possibility of knowledge of ineffable by the scientific thinking – that was received from the Roman Catholic Theology – it is expressed in the words of *Second Vatican Council*, "God, the beginning and end of all things, can be known with certainty from the reality created by the light of human reason (see Rom. 1: 20); but teaches that it is through His revelation that those religious truths which are by their nature accessible to human reason can be known by all men with ease, with certitude and solid with no trace of error, even in this present state of the human race" (1965, *Dei Verbum* 6).

### II. THE CONCOMITANCE OF THE VISIONS OF SCIENCE AND RELIGION. IT EXIST AN ONLY REALITY

#### A. The new theory in the face of those already enshrined

The possibility and necessity of an open dialogue between theology and modern science was established by both sides to be a real benefit, both for a better and more complex understanding of reality, and also because this cohabitation, science-religion, would reunify human personality – at the same time soul and body – giving it a chance not to splinter between two artificially opposed explanations and being

<sup>1</sup> Because of their particular thinking and their development amplitude I'll just name these three level with the name *gestalt* (see the term's meaning in German psychology).

<sup>2</sup> Into the *figurative* domain knowledge is offered by an immediate relation between the mental representation and the real object, involving all known scientific methods: observation, analysis, experiment, practice etc.; while in the *non-figurative* domain the object thought is missing as a direct presence, but not as a real existence.

always forced to choose between them because their exponents do not allowed so far a cohabitation. The theological vision of the world, as well as the current and the future scientific theories, look towards a common reality, and the simultaneous acceptance of several viable exposures are only broadening the perspective, not narrowing it – as the principles of optics demonstrates this. By accepting each other there is no risk that aspects of each vision to be put into a cone of shadow by the other one, if each retains coherent its exposures and try to develop their own doubts. This is an essential condition to cohabitation: as long as each vision is internally coherent, without gaps and discontinuities, there is no danger that one to absorb the other. Each must assume its aim, object and methods and continue this discussion into an own fluency without feeling any threats by the other vision; there is no competition between them in order to dominate the world and to offer a single explanation over *reality*. It can even be foreseen that this need for “other” (vision), as a partner in an ontological dialog, they both felt – which entitles us once again to affirm their complementarity. For this purpose must be understood why theology have tried to give various explanations, specific to sciences, or sought to support its faith into The Boundless God on rational arguments, in order to infer the presence of the divine in this world. At the same time, frame sectors or some scholars of the exact sciences are trying to use their scientific discoveries and new directions of research to substantiate a *new* theology (genre *New Age*). These attempts prove themselves to be mistakes that such a dialogue needs to be aware off and take a firm and fair stand towards them to deter them, emphasizing at the same time the uniqueness and identity of every path of knowledge, scientific or theological.

The combination between science and religion has always been regarded as a very natural human desire to have a unified vision of the world. “Instead of respecting the major differences between science and religion, the *combination* weaves them into a single fabric, in which they lose each other, becoming close to undistinguished”<sup>3</sup>. Jan Graeme Barbour (b. 1923), Professor of science and religion at Carleton College, promote – in his first book, *Issues in Science and Religion* – the term “critical realism”, through which argues that the basic structure of religion is similar to that of science in some ways, but different in crucial points. *They both are parts of the same spectrum and each presents subjective and objective characteristics. The subjective ones include informational theories, the resistance of comprehensive theories to forgery and the absence of some rules of choosing between paradigms. Objective characteristics include the presence of common data, proof (pros and cons) and independent criteria of paradigm.*<sup>4</sup> He proposes four models of interaction between science and religion: *conflict, independence, dialogue, integration*. On the other hand, John F. Haught proposes other four models – *conflict, contrast, contact, confirmation* – with a desire to complete the pattern proposed by J. Barbour.

## B. *Is this the only possible existing world?*

Even if the proposed approach – the *theory of concomitance* – would seem to fall into the pattern of *contrast* or *conflict* between science and religion – the models already proposed by Barbour and Haught – and that it doesn't bring anything out of such patterns, however this approach doesn't follows closely the rigor of both types, being rather a peculiar pattern, emerging more or less of the theories of mentioned authors. The linking of the two gestalts appear to be the correct one as described in phrase “provocative model”, because at present ST – raised in the *nonfigurative* level of representations and expressions of Philosophy and Religion gestalts – challenges them to prove their validity. ST leaves aside its own method – involving hypothesis, experiment, validation – that doesn't allowed her to work far beyond the material and figurative world, and turns today toward this plan of *nonfiguration*<sup>5</sup>, of “the realm of infinite possibilities, implicitly superior, but invisible, that can no longer be approached by our senses, a transcendent domain, source of all visible things”<sup>6</sup>. Climbing at nonfigurative level, ST would like to have with religion and philosophy a figurative dialogue – which demonstrates the gaps that it came in this nonfigurative level with – and where ST is forced to recant its own definition, that its descendant, philosophy, gave it when he formulated, for example, the principle of *parsimony*, as a fundament of the scientific method. Here “there is no longer but an only one sacred truth: (that) there is no sacred truth” (Carl Sagan, +1996).

In the foreground both science and theology start from the reality of the universe which they assert and explain. Empirically, none of them can't speak about the physical universe other than declarative, by affirming its real existence. But after the philosophical intervention of the interrogative sentence *is this world the only reality?*, each of the two paths are distancing from each other, through their own methods of investigation, in order to respond to it in accordance with their own point of view. Therefore, despite the fact that it regards the same world – this one, our material universe – each gestalt explains it through its method –scientific-materialist or spiritual-religious – producing these visions that I've spoken about. In its depth, every vision is incompatible with other, and while being so close one another – through the object shared in their demonstration – they remain untranslatable one through the other.

However, representatives of both gestalts agree that the universe cannot be explained singular, from a unique perspective – materialistic, ignoring the spirit (consciousness, feeling, confidence, compassion, art or morals) or vice versa, only spiritual, ignoring the matter – because it would produce a fragmented vision of reality. That's why the proposal of *concomitances* is looking to eliminate this fragmented unipolar

<sup>3</sup> John Haught, “Science and Religion: From Conflict to Conversation”, Bucharest: XXI: Eonul Dogmatic, 2002, p. 26.

<sup>4</sup> Jan Graeme Barbour, (2011, 07 Sept.) “Philosophy and theology”, in “Critical Realism. 27 Wikipedia Articles”, p. 61. [Online]. Available: <http://www.bahaistudies.net/asma/criticalrealism-wiki.pdf>

<sup>5</sup> The level of *figurative* (thinking) is about understanding the world with knowledge implied by physical objects, while *nonfigurative* level doesn't imply necessarily the physical object we came to understand. First pattern is assimilated with exact sciences, second with abstract ones, i.e. philosophy and religion.

<sup>6</sup> Deepak Chopra, and Leonard Mlodinow, “War of the Worldviews: Where Science and Spirituality Meet”, version in Romanian language, Bucharest: Editura Trei, 2012, p. 28.

world image and to allow both gestalts to reproduce themselves throughout their splendor, without having to dismiss one another, to exist independent or to be included in a mixed formula, one of compromise.

*C. We opt for a solipsistic or holistic vision for understanding the co-habitation of two gestalts? Comparison with medicine.*

The Cosmo-genesis process must be reconstituted into an integrative vision, overall and not partial, explaining the whole through a fragment. The easiest way to understand this is to use the comparison with medicine today: abstracting the anatomical glands we'll arrive to an independent discipline, endocrinology, that studies in detail the functioning, the positioning and the physiognomy of the glands, but only re-entering them into the human body, its specificity can be respected and known accurately and coherently; otherwise, we have to deal with a disparate discipline that studies, analyzes and investigates – with all techno-logical procedures within reach – a biological excerpt, possibly “worshipping” this organ through a solipsist approach. The same thing should be understood by any other scientific endeavor: we cannot have a paradigm resulting exclusively from scientific investigation; it must be a synthetic solution of the scientific questioning – regarding a scientific domain or overall – but, above all, to contain an integrative vision of several factors outside the discipline. Going back to the earlier comparison, the targets of Endocrinology can be applied and understood with real help of: risk factors (for diabetes), ovarian failure (in acne), hypothyroidism (in anemia), etc. I chose this example because it demonstrates perhaps the best the organic complexity that must be understood in, accumulated and applied the scientific knowledge and especially the fact that integrating them into holists systems thinking is not just a real help, but a *must be*.

Moves of this kind have begun to emerge, not only as simple reactions, but even as independent disciplines who seek to find integrative explanation as many external factors – extern to their specific research area – recognizing the interrelations that exist or can be created between man – with all its components – and the universe. This integrated research is done today by *functional medicine* that approaches differently the patient-disease relationship versus conventional medicine, seeing the patient as a unique entity (biochemical, psychological, social, religious etc.) that must be counterbalanced to reach the true state of health. Such a holistic approach is needed today by this gestalt of human knowledge in order to be able to free itself from the materialist-nihilistic ideology and to *deconstruct* (in Derrida's parlance) science of atheist thinking, integrating the man in a universe that is no other than God's creation.

The assumption that we are not alone in the universe – extended from relevant proposal of heliocentrism that there are multiple planets, solar systems and galaxies to the proposal of the existence of other beings, beyond the limits of this universe known to us – has always inspired minds. Only the possibility – offered by an affirmative answer to this supposition – and still arouses a deep chill to anyone that stops from its way through the existence, chill that implicitly urges a contact with this *the other* that “share” existence with! On the other hand,

the negative answer – *no, there is no other living and rational beings into the existing!* – makes man equally responsible for what he knows and “masters” in the universe; to be the only existence is by far the greatest responsibility that a rational being might have: increasing awareness of proximate space, of its the transfiguration and improvement. Or precisely those values must be underlined by religion too: presenting nature as God's creation and the man to be in charge of the transfiguration of this creation it can make this the latter one to respect nature and get out from the ecological crisis in which sinks.

The goal of religious exposures is not to physically found the foundations of the cosmos, nor of the ST to overcome its method of experimental accumulation of data and logical inferences that can afterwards supports the theories of physical laws etc., in a word, logical-scientific constructs in general, without discontinuities and inconsistencies caused precisely by the impossibility of combining physical laws with theological exposures. The concomitance of both gestalts is postulated by the very existence of the universe and by rationality of man that “fills” the universe.

In this way, religion is exempted from the rational specification of all physical phenomena in the universe, and it is incumbent on science to deliver these explanations exclusively physical, material, without ever returning to the mystical exposures where the limits of rational thought can no longer break through; the beginning of concomitance between the two paradigms was made by ancient thinking of the Greek philosophy, and their branching, like any separation, was made with constraint, clumsiness and the risks involved.

### III. THE CONCOMITANCE OF THE MULTIVERSE. INTEGRATIVE VISION

*A. Could it be otherwise*

*Our universe is perfectly tailored for life. That may be the work of God or the result of our universe being one of many.* Being aware of this true many Christian theologians have always invited people to seek and know the world God made, because only thus the most staunch atheist could reach to the worship of the Creator. “The universe is a place that inspires awe, especially for those who know something about it”<sup>7</sup>. We know from hundreds of recent studies carried out in the field of Astrophysics and quantic that the smallest differences introduced into the current state of things of our universe would let it to no longer be able to support any existing order in the universe, and, much less, life itself. Taking few significant examples highlighted in the book by Martin REES, *Just Six Numbers: The Deep Forces That Shape the Universe*, we can notice along with it that the evolution (both physical and biological) of our universe is remarkably sensitive to the values of six numbers. If any of their values was “untuned,” there would be no stars and life as we know it in our current universe. If those protons were just 0.2 percent more massive than they actually are, they would be unstable and would decay into simpler particles. Atoms wouldn't exist; neither would we. If gravity were slightly more powerful, the consequences

<sup>7</sup> D. Chopra, *Op.cit.*, p. 26.

would be nearly as grave. A beefed-up gravitational force would compress stars more tightly, making them smaller, hotter, and denser. Rather than surviving for billions of years, stars would burn through their fuel in a few million years, sputtering out long before life had a chance to evolve. There are many such examples of the universe's life-friendly properties – so many, in fact, that physicists can't dismiss them all as mere accidents.

As a conclusion, if our universe is so fine “granted” to bear not only the perfect order, but also life up to its most *evolved* forms – the man, why would we stop with the assumptions here? Why couldn't we assume – noticing in the same way both the perfection and the omnipotence of the One who made all those things – that it is possible for the same miraculous and perfect opera to have been repeated for *n* times, concomitant with ours?

#### B. *Is there a possibility of acceptance the multiverse in religious thinking?*

One of the earliest attempts to “unify” gravity and electromagnetic forces came in the form of Kaluza-Klein theory, a short-lived theory that attempted to unify the forces of nature by introducing an extra space dimension. In this theory, the extra space dimension was curled up to a “microscopic” size. Though the theory failed, many of the same concepts were eventually applied in the study of string theory. Extra dimensions have changed the way physicists think about the Universe. And because the connections of extra dimensions to the world could tie into many more well-established physics ideas, extra dimensions are a way to approach older, already verified facts about the Universe. The pluridimensional proposal of a single universe has turned recently, much more believable and more widely accepted, into the *theory of supercords*, in which the term “dimension” has received a new conceptualization, “fantastic and scientific, but not science-fiction”, about *another* universe, parallel to ours.

Without a conceptualization so profound, Greek philosophers, however, initiated the same formula of existence with 23 centuries ago. Around the year 400 BC the Greek philosopher Democritus (c. 450 – 370 BC) presented for the first time a theory about the universe based on his previous assumptions, namely that all matter is composed of atoms (*atomistic* theory). Democritus was starting from the pertinent assumption that the complex nature of the world (*cosmos*) could be explained if all things would be made from different kinds of unchangeable atoms, each kind with its own shape and size<sup>8</sup>. He said of the *cosmos* that was formed when a group of atoms *were brought together* in a certain structure<sup>9</sup>.

According to his theory, the Cosmos consists of the Sun, the Moon, five planets and the stars revolve around the Earth. Even if this theory is one of the many other *geocentric* theories, however it is worth noticing here that to Leucippus

<sup>8</sup> Don Hainesworth, “Philosophy of Science and Religion. Concerning the nature of Humanity and of Reality”, 2nd edition, Bloomington: Author House, 2012, p. 266.

<sup>9</sup> Cf. Timothy Kusky, PH.D., “Encyclopedia of Earth and Space science”, New York: Library of Congress Cataloging-in-Publication Data, 2010, p. 817.

appears the idea of parallel worlds, multiple (*kosmoi*, gr.), even in an infinite number, between which there are unequal distances, in varying degrees of progress, development and, hence, and of sizes... “In one direction lies more worlds, in other fewer, some worlds are increasing, others have reached the peak of its development, some are about to disappear”<sup>10</sup>. One of the many features of this “infinite worlds” in his conception of Leucippus is borrowed by Stephen Hawking, a proponent of the theory of supercords, “occasionally (these words, N.N.) are born, in other parts disappear; the extinction of one world can come from a clash with another. Some worlds are devoid of plants, beings and any moisture”<sup>11</sup>. What is certain is that, for atomists, “in our Universe the Earth arose before heavenly stars”. Democritus himself spoke of a *large number* (not infinite) of worlds that have been formed spontaneously from diffuse matter in space, and then turn off<sup>12</sup>. This picture – originally rejected – it was recurring after more than 23 centuries, today being found into what we know as the theory of *supercords* or *theory M*.

The promoters of this theory claim that cannot be supported any acceptance of God, that “there almost certainly is no God”<sup>13</sup> in this variant of existence. However the theory of *concomitances* will allow me to contradict this “almost certainty”, showing which are the issues that M-theory ignores or omits them, also helping it to accept God's existence.

This new understanding of the typology of “M-theory” gives us the opportunity to administer veridical responses at all levels of the humanity (psychological, philosophical, religious, and scientific/rational) of the same unique truth, God-The Creator of the Multiverse. This theory I promote isn't by far a euphemism of the *concordance* attempt to “fit in” science with religious dogmas, to force things in so that it coerce the adjustment and the correspondence of scientific ideas and the assumptions of the ST with religious dogmas and enactments. Therefore, I don't regard nor the exposure levels of human thinking – named here “the alternative cognitive solutions”, i.e. philosophical thinking, the religion or the scholar ones, to which we could add as well, as a valid and unique direction, the psycho-analytical thinking – as steps or stages of evolution of the same understanding, forcing a knowledge of increasingly complexity as we see in the self-declaring inefficiency of the “fathers” of M-theory.

For me all these levels are merely paradigms (complex and complete *gestalts*), without competition, ambivalence or mutual exclusion, but only *concomitance* (like in the theory of the third included – per acad. Basarab Nicolescu)<sup>14</sup> and mutual validation. That's why I don't understand that each paradigm

<sup>10</sup> Ion Banu, “Greek philosophy until Plato”, II vol., I part., Bucharest: Scientific and Encyclopedic Press, 1984, p. 428, fr. 40.

<sup>11</sup> As per Stephen Hawking, “A Brief History of Time. From the Big Bang to Black Holes”, New York: Bantam Books, 1998.

<sup>12</sup> D. Hainesworth, *Op.cit.*, p. 266.

<sup>13</sup> Richard Dawkins, “The God Delusion”, London: Bantam Press, Reprinted by permission of The Random House Group Ltd, 2006, p. 111.

<sup>14</sup> B. Nicolescu, “Methodology of transdisciplinarity – levels of reality, logic of the included middle and complexity”, in „Transdisciplinary Journal of Engineering & Science”, Vol: 1, No:1, (December, 2010), pp.19-38. [Online]. Available: [http://basarab-nicolescu.fr/Docs\\_Notice/TJESNo\\_1\\_12\\_2010.pdf](http://basarab-nicolescu.fr/Docs_Notice/TJESNo_1_12_2010.pdf)

relies on another cognitive solution to express themselves or to validate its assumptions, neither that each one would talk about something else, in a parallel independence; it is simply about a concomitant exposure of the same truth with the specific possibilities of each cognitive solution. None are beneath to none, none more false, or excluding another one.

It will not be possible nor a development of a meta-knowledge which would involve a transdisciplinary approach – or a transdiscipline that involve a meta-knowledge – all (three gestalts) being incompatible, therefore cannot be any longer valid the Freudian possibility of *cognitive evolution*, meaning that religion would represent only a phase, a stage of human knowledge that are moving towards something else, and that the scientific phase would repeal it, being itself turn canceled by the stage of philosophy of science.

Thence we can say that each meaning given – in the history of human thinking – to the world (*kosmoi*) is equally valid and non-contradictory if you look in-itself, in light of the context in which it was stated and not from a different perspective – like in the idea of human *thinking's stadiality*.

In this case we will understand that (1) “*geocentric universe*” hypothesis is a healthy option if you affirm the centrality of the vitality of the Earth inside our dimension (universe); (2) that the assumption of “*heliocentric*” universe is a premium version of the scientific solution about the atomistic organization of matter, followed by the impact of the micro and macrocosm discoveries after the same “*heliocentric*” pattern (e.g. the distribution of the nucleus and the electrons in the atom, the organization of galaxies, the cast away from the Big Bang center of the universe, etc.); we will understand (3) the functionality of the *Big Bang* hypothesis as a coherent and valid alternative to respond to the problem of originating this universe and, in the end, we will understand (4) nonexclusively the *M-theory* as a solution of explaining our existence concomitant with other worlds created by the same God. Each of these nonexclusive theories presents the same reality under other aspects, and therefore there are so different one from another, without ever being under competition. They are the only multiple faces of the same truth. Nor the *Big bang* hypothesis` promoters or *M-theory's* should “see” (operate) themselves in opposition, competing for supremacy or (even) prevailing, because each one regards and specify – from the evidences it has (unique, by the way) – another inference about the origin of the universe, while the *M-theory* will have to confine to references over our concomitance with other worlds only. The disappointment of both theories` promoters that future evidence will no longer be able to validate one or the other of the two theories – because the universe will expand beyond the limits of our technology – and we`ll lose the initial information, must fall with this double, nonexclusive understanding of those two approaches: *Big Bang* – the origin of the universe, *M-theory* – its concomitance with other universes. Even if, compared to others, none of those theories cannot be considered as absolute – because they are incomparable, uncompetitive – does not mean neither that inside itself, each theory is absolute and does not have any mistakes, omissions or the need to complete or correct itself.

The possible mistakes of *M-theory* – in addition to the fundamental error that she wish to explain, in competition with the *Big Bang's*, the origin of the universe – could be the consideration of *multiexistentialism*, i.e. the vision of *The One* (the James Wong`s movie), meaning that each living being has *n* correspondents, one in every dimension. It is wrong to think that the other dimensions are actually other facets of your universe, linking them forcefully with this one and artificially creating a “natural” inter-dimensional correspondence! If other universes would actually be all the same “us”-selves, but in a *multi-alterity* – as the promoters of *M-theory* are wrongly trying to handle their understanding over the multiverse –, then the anthropocentrism arrogance of ST would be far greater than that of religion`s which they have accused to be unjustified. You cannot refute the (religious) theory that *the universe it has its reason for existence in Man* and promote, on a similar nonfigurative basis, the idea that in all other universes exist variations of the same *me*<sup>15</sup>, without being suspected of anthropocentric arrogance. Or, the concomitance of our universe with other universes should have opened – with at least the same hypothetical odds – the possibility of the existence of other beings, without any connection with *us*, those from this universe.

So, how could a theory like the multiverse one – in which its promoters claim the “near” inexistence of God – placate with the theistic view over the existence of the Whole? My answer comes from a correct understanding of the **matter**, which was not created as a *barrier* to the spiritual world (but became so when the original Sin broke the gracious link between the two worlds); it isn't at the edge of the spiritual world (universe). The matter should not be understood as being “beyond”, at the end of the spiritual world, because then we`ll run to the edge of the material universe – with the hopelessness of unfulfillment – to arrive at the beginning of the spiritual dimension. God has not put the bodies to stem the souls (Platonism), but He has made yet another world, another dimension, that will enjoy the shining of His light.

Thus understood, the material world is indeed one of many dimensions of the same reality, one of the many worlds created by God, in each co-existing other beings, but precisely in this lies the deep love and the profound meaning of the Christian understanding of the Whole: each being putted to “rule” every of these worlds (dimensions) – man over the universe material, the devil over hell, the Angels over heavens and so on – is not confined in his dimension, condemned to be and remain trapped in his world. If mankind were able to become aware of other dimensions, this is not a threat of “breaking” the balance of the multiverse, of looking at something taboo, not allowed, but precisely now we`ll understand, at rational level, what we only felt and assumed at the empirical and spiritual level till now: the presence of “the other” or, better said, *the others*, of many “others” that coexist simultaneously with us. Now we`ll understand increasingly better and rationally that the existence of a “someone else” should be accepted and that this someone else (another one for each dimension) could exist, but not in this very universe – no need to talk about “aliens” – because

<sup>15</sup> G. F. R. Ellis, U. Kirchner, and W. R. Stoeger, “Multiverses and physical cosmology”, in *Monthly Notices of the Royal Astronomical Society* (MNRAS), Oxford University Press, (2004), vol. 347 (issue 3), p. 925.

“here” they would only be variations on the same theme, *man: a diversity in the same unity*. This is already demonstrated with the thousands creatures that surround us and that science has found endless similarities with. That’s why neither the discovery of alien life in this universe, in this material world, is no longer striking for a man of science, nor to the Church or to the man that correctly understands God and His revelation about Creation: “glory be to Thee, One who have surrounded ourselves with thousands and thousands of creatures!” (*Acathistus of thanksgiving*). All the creatures created in this material universe prove our dimension unity; they are the evidence that this dimension has the coordinates and characteristics already found in large part. So we understand contextually the similarities and particularities between species; similarities because all creatures that exist in this universe have certain characteristics in accordance with the features of their universe, with the laws that govern it – gravity, space, time, motion etc. We will not be able to discover truly “something else”, no matter how deep we’ll look into this world, because everything here is determined by the same laws that govern this *building* (I Corinthians 3:9; Psalm 104:25). In other dimensions, things are the same: their creatures have features that enframe with the laws of their universe.

#### IV. CONCLUSION

This presentation is only one relative, framed by the “possibilities” of quantum mechanics on the one hand and the “accuracy” of the revealed Christian religion’s statements on the other. If it is possible or not that through this approach of concomitances to “placate” the modern vision of the *theory of supercords* with the paradigm of religious thinking – this depends only on the *translation* of one or more of the aspects of one of these gestalts into the language of the other.

Mutual influence between dimensions – assumed by quantum mechanics, but contested through the theory of general relativity by Einstein in 1935 with two younger colleagues, Boris Podolsky and Nathan Rosen, initiative intended as an attack on quantum theory – is one of the possible explanations from the perspective of the Christian paradigm too, and fits into the words “I say unto you, that likewise joy shall be in heaven over one sinner that repenteth, more than over ninety and nine just persons, which need no repentance” (Luke 15:7).

On the same pattern of quantum thinking the sensitization of some dimensional points for inter-dimensional communication is in accordance with the conception of Holiness or sin, of inspiration and revelation as frequency trimmings and mutual influence between two different dimensions/universes etc. We can also approach with the same caution many other dogmas – not to comply them with the new scientific paradigm, but to test the validity of this theory of concomitance – i.e. the problem of divine grace which pervades the universe imbuing it entirely along with other dimensions at the same time; also the generic problem of the Holy sacraments as a manifestation of inter-dimensional divine grace that “keeps all (universes, n. n.) by hand” (cf. Revelation 2: 1) not leaving them to fall apart or to overlap more than they are allowed” and so forth.

But perhaps the most interesting and important theological issue possibly accepted (not supported!) by the cosmological configuration of M-theory would be the Incarnation of Christ. Would this be still possible if such a theory would officially be proven as valid? The answer is positive, the incarnation it’s very real, for the penetration and manifestation of someone extra-dimensional into another dimension imply its transformation congruent to the matrix of this new dimension. That imply an incarnation for anyone who wants to penetrate and manifests into our dimension (the appearance of angels into this world, i.e. Daniel 4:13; Genesis 19; 22:12; Acts 12: 8, 9 etc.).

The implications of these features of quantum mechanics for our picture of reality are a subject of ongoing research. Normally, spatial separation implies physical independence. If one wants to control what’s happening on the other side of the football field, he have to go there, or, at the very least, he have to send someone or something (air molecules, a flash of light to get someone’s attention, etc.) across the field to convey your influence. Otherwise he will have no impact or influence, since intervening space ensures the absence of a physical connection.

There are many other issues which would be not only interesting, but also useful to approach transdisciplinary – the problems of religious paradigm being interpreted and explained under the incidence of the current cosmological formulations of ST – but the limited space of the published paper do not allows me to expose them here.

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# Art and Technology

## Teaching as transformation, experience and challenge

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**Abstract—** With the impact of new technologies in Art the practice the teaching of Art is undergoing a period of transition that is reflected in the transformation of its curriculum. This transition constitutes a turning point that opens opportunities to deeply explore the historical relationship between art and technology and how it emerges today. This paper will analyze this transition and will contribute with a reflection on the experiences, problems, achievements, opportunities and challenges. Firstly we will outline the main aspects of the historical interplay between art and technology. Secondly we will explain the methodology and scope. Thirdly, we will point out the main achievement. The paper will offer a comprehensive scheme that can support teaching and trigger reflection.

**Keywords-** art; technology, university education

### I. INTRODUCTION

This paper emerges from the need to clarify how the practice the teaching of Art is undergoing a period of transition as result of the impact of new technologies in the Art field. This transition is reflected in the transformation of curriculum in Spanish University what constitutes a turning point that opens opportunities to deeply explore the historical relationship between art and technology and how it emerges today.

This paper will analyze this transition based in the experience of 3 years of teaching the subject of Art and Technology to first level students and will contribute with a reflection on the experiences, problems, achievements, opportunities and challenges.

In section II we will outline the main aspects of the historical interplay between art and technology that support the theoretical aspects of the subject. In section III, the methodological framework and steps will be explained. In section IV, a few reflections about the main problems and achievements will be offered that can serve as a comprehensive scheme to support further teaching and research.

### II. ART AND TECHNOLOGY: THE INTERPLAY

The relationship between art and technology can be considered from a broader and inclusive point of view. This paper will be based on a way of looking at the relationship between both concepts according to this approach. Somehow it is supported by Heidegger's [1] idea that technique is not the same as the essence of technique and that we need to go beyond the technique to be able to grasp the essence of the technique.

Translating these ideas into the relationship between technology and art we need to find out what is essential and universal in this relationship that is present in art. Both art and technology are present in any manifestation of art, in all art processes and through history. There is no case in which art and technology have not being intrinsically linked forming an indivisible whole either if we assume or deny this omnipresent relationship.

Heidegger also says that technique is nothing technical and that we will never experience our relationship with the technical if we limit ourselves uniquely to the technical to impulse it, reject it or accept it.

So how can we understand the essence of the relationship between art and technology? If we expand Heidegger's ideas into this relationship it would be necessary to first of all avoid considering technology as a neutral element. This is also maintained by McLuhan's idea that "the medium is the message".

Technology or medium has a meaning in itself. The idea that technology is neutral and the meaning comes from how we use it is a trap; it is necessary to look at the very meaning of technology and how this

meaning emerges in relation to art in each art piece or process.

It is very useful to review the reflections developed by Rancière [2] regarding the word 'medium' and to extend them to understand the interplay between technology and art because they directly relate to the shaper of meaning. Rancière said:

*"[...] theorizations of medium as the crucial element of artistic modernity bring two apparently opposite senses of the word into play. First, we understand the word 'medium' as 'that which holds between': between an idea and its realization, between a thing and its reproduction. The medium thus appears as an intermediary, as the means to an end or the agent of an operation. Now, modernist theorization makes 'fidelity to the medium' into the very principle of art, inverting the perspective. This medium to whose specificity one must be faithful is no longer simply the instrument of art. It becomes the specific materiality defining its essence. This is certainly the case in the Greenbergian definition of painting as that which is faithful to its own medium—the two-dimensional surface and the coloured pigment—and thereby delivered from the servile tasks of representation. The medium, then, is no longer the means to an end. It is properly speaking that which prescribes this end" (Rancière, 2011).*

Some are instrumental (Frankfurt School), others humanistic. If technique is not only a medium and has content in itself it would be necessary to deeply understand and control this content in any art process so that is not the technology that uses artists but artists use technology.

The definition of the relationship between art and technology should be done according to a wide range of aspects. Starting with the four elements that constitute technology, such as matter (or material), form (shape), aim (use, function) and the efficient action (Aristotle; Heidegger) it is necessary to include other layers like the symbolic, instrumental, phenomenological aspects, or the interdependence between body, society and technology. Being able to transmit such broad way of understanding the interplay between Art and Technology is one of the main aims to be achieved regarding students at the first year.

Students (with exceptions) usually arrive at the university with a conceptual framework that is dominated by one of these aspects. In most cases there is a dominance of the 'aim' factor or the 'technology as object' fact, in the way they look at technology. They barely question the possibility of using technology as a material for art, or the very

content with which technology impregnates any art piece, or the relationship between the body, action and technology, or society, art, technology and social change. For example, they barely know about the perceptive change brought by the introduction of perspective; the impact of the printing press (McLuhan; Innis) in the constitution of the subject and its effects on art or the impact of Internet in the processes of creation, reproduction, distribution and authorship in art (de Kerckhove). They are mainly used to deal with technology as 'technological object' and do not go beyond that concept.

Therefore one of the main objectives of teaching Art and Technology is to offer a broad view on these questions as to trigger a transformation in the way students perceive the interplay, interdependence and feedback between both art and technology.

### III. SOME HINTS ON METHODOLOGY AND SCOPE

#### A. Definition of universe of study

- The universe of study is composed by 6 groups of 40 students (240 students) of first level of Art and Technology I in the Facultad de Bellas Artes, University of the Basque Country, Spain. Classes were given by two teachers (authors), each one with a separate group for 3 years what makes 2 groups per year.
- Two assignments were given to students in different phases right at the beginning of the academic period. The first step (phase 1) was to ask them to work in small groups of 5 to explore in a conceptual map the concepts of art and technology in a separate way (photos nº...) After that phase students are required to present their findings to the whole group and a debate is carried out together with the teacher.
- During these presentations the teachers extract the main ideas from students to develop a conceptual map together with the whole class. The objective is to share ideas among all students and to homogenize the comprehension level about the concepts of art and technology and their interplay.
- Once this phase is finished a second phase (phase 2) takes place, in which each student is

required to individually develop the same conceptual map for the same concepts but to be handed out after nine months, as a final assignment for the whole course so that a transformation on their ways to define and understand these concepts can take place. The most important aim is to compare the change that is produced in the comprehension.

- This paper analysis the results of these exercises according to this aim. Analysis aims at identifying the dominant aspect in the definitions and reflections developed by students by students groups during the classes.
- The analysis will show how from a dominance of one or more of these elements typical at the beginning of the academic course a transformation is produced at the end of the course. This transformation is shown in the way students reflect about the relationship between art and technology in a conceptual way.
- The aspects that are going to be taken into consideration to identify the level of inclusiveness in their definitions about the interplay between art and technology are: material, formal, functional, performative (action), symbolic, instrumental and phenomenological, corporal, social and instrumental aspects.

### B. Examples and preliminary analysis

Although the two phases are developed in each course here we are going to highlight just the last phase that shows the transformation in students' way of dealing with the subject at the end of the course. Now we are going to show a few paradigm examples of this transformation that show how inclusive their definitions about art and technology can be. Three of the most inclusive examples of each concept were selected.

#### b.1. Regarding technology

Student 1's definition:

"Technology as Aristotle said, includes four elements: aim, action, form and matter. Nevertheless, it seems important to me to highlight the different forms in which it can be represented, the different platforms. The creation and

imagination factors are important and, no doubt, it is essential that objectives of communication, improvement and advancement are taken into consideration as much as new social needs that appear."

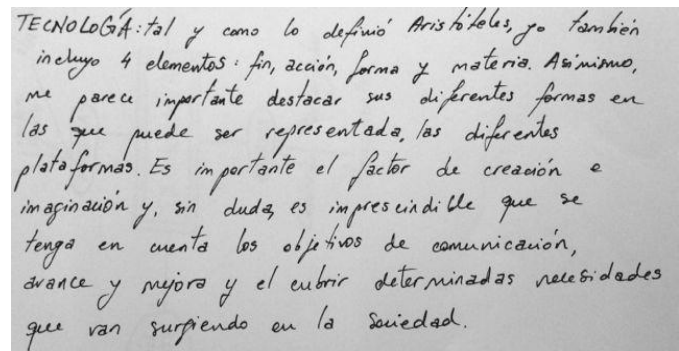


Figure 1. Example of a definition of the concept of technology

Student 2's definition: "Technology is an element that enables any action to take place and to develop its aim, there fore it acts in small and large scales. It is part of evolution and in grand part the later is determined by its variations along human history. In the same way, a technology always forms part of a process, including those in which technological achievement is the aim."

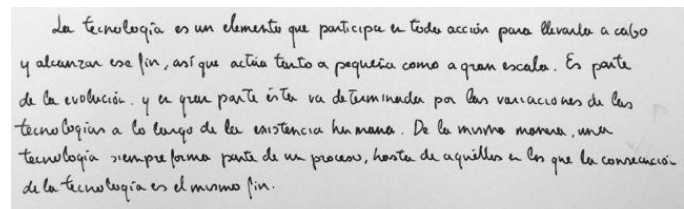


Figure 2. Example of a definition of the concept of technology

Student 3's definition: "Technology is anything created by humans and that serves to the advance and amplification of human capacities. Technologies are bodily extensions of human beings; they are artificial elements that extend their capacities. Technology can be a pencil, a key, a pan, a computer or a cell phone. Technology is not only big advances of this age, there are many technologies that we are not conscious that they are technologies."

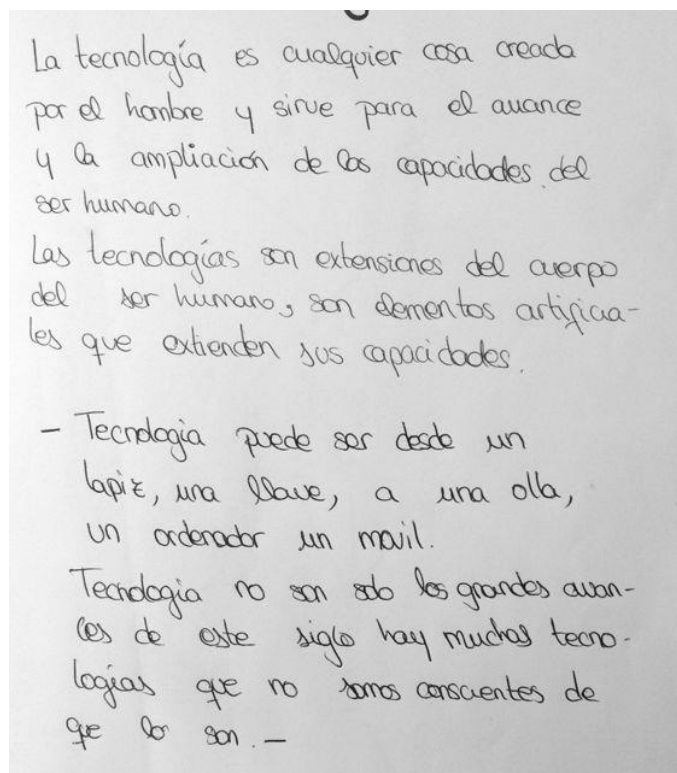


Figure 3. Example of a definition of the concept of technology

### b.2 Regarding art

Student 1's definition: "Art can be material or immaterial, an activity of creation, expression or representation; free, original or conditioned that can even constitute a life style beyond a professional or leisure aim. In occasions it is even classified as a natural element, inherent to human beings; in any case we could say it is uniquely proper of human beings, as it is agreed that intention is a key aspect of the art activity."

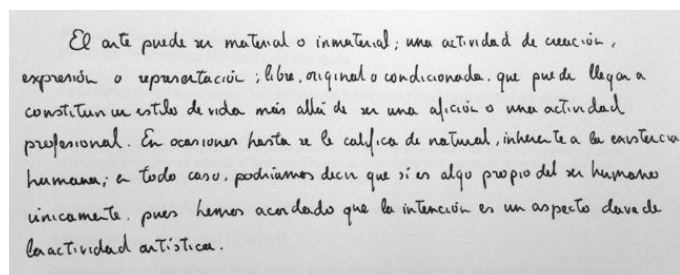


Figure 4. Example of a definition of the concept of art

Student 2's definition: "Art is a form of expression and representation. Many different things can be art; it is difficult to know what art is and what it is not, given the fact that what could be considered art by someone, another person would never accept as art. Art can be simple a technique display,

something that transmits aesthetic pleasure, or something more profound that transmits feelings and sensations. Therefore, art is not a universal language, as also the cultural and historical context in which it develops is important.

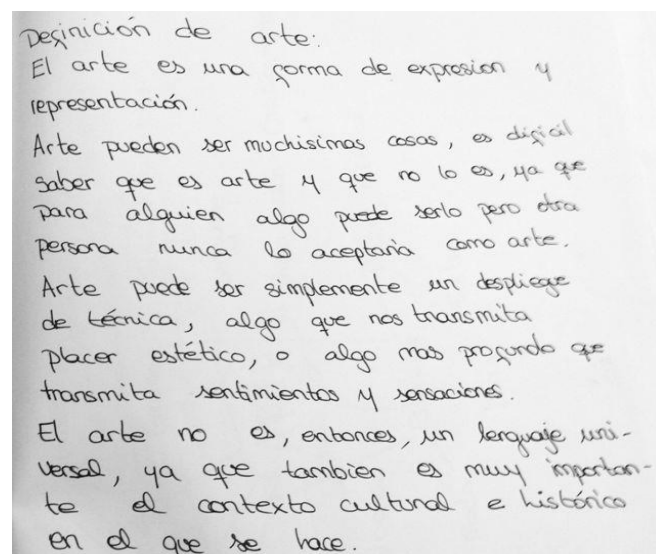


Figure 5. Example of a definition of the concept of art

Student 3's definition: "Art is anything created by human beings with the intention to be art."

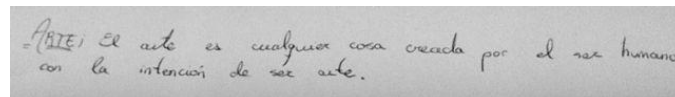


Figure 6. Example of a definition of the concept of art

## IV. ACKNOWLEDGMENTS

The authors thank students from the Art and Technology Group 1 (2010-13) for the possibility to use their materials and works in the preparation of this paper.

## V. REFLECTIONS AND CONCLUSIONS

In the above examples of definitions of art and technology we can observe the results of the transformation in the conceptualization of art and technology. Regarding technology they include: aim, action, form and matter, creativity, imagination, communication, instrumental aims of improvement and advancement and social needs. They also include a wide range of scales, the possibility of technology be consider as a process and the role of technology in human historical evolution and the role of technology being an aim in itself. There are

also references that technology can be anything that amplifies or extends human bodily capacities and sensorial apparatus.

In relation to the concept of art, students also express their vision that art can be material or immaterial, free or determined; with a function of creation, expression or representation and have an essential role in the very constitution and differentiation of what means to be a human being.

Students are aware that art is not universal and depends on culture and History; has not essential definition and can be materialized in different manners.

It is remarkable to notice that students of the first year can consider art from such broad and inclusive approach after a deep transformation is achieved in relation to their vision at the beginning of the course.

Therefore the aspects that were taken into consideration as references to analyze the degree of inclusiveness (material, formal, functional, performance (action), symbolic, instrumental and phenomenological, corporal, social and instrumental aspects) are mostly reflected in their expressions about art and technology. The methodology followed during the course enabled the pursued conceptual transformation to take place. Lastly but not least we would like to highlight that this is process is still in an initial phase and these are only the first reflections of an experience-in-progress.

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# Archaeoacoustics in ancient sites

## A new way to analyzing archaeological locations

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**Abstract**—Using archaeoacoustics we can analyze ancient sites from another point of view to discover the real purpose of their builders to point out natural phenomena connected with a particular location and the mystic state of visitors. We also present the results from two ancient sites we studied over the last two years in Europe.

**Keywords:** *archaeoacoustics, ultrasounds; abbye; San Salvatore, Visočica; Bosnia; pyramid; infrasounds; low frequency sounds*

### I. ARCHAEOACOUSTICS

Archaeoacoustics is not a new science, it is a new perspective to analyze archaeological sites which sometimes have interesting sound characteristics<sup>[2,6]</sup>. It can demonstrate sound occurrences projected by the builders of some structures, and also natural phenomena which can influence the psychological state of a person in a mystic state or during prayers<sup>[2,3,4]</sup>. In a previous article we described the resonance phenomenon we found in some archaeological sites<sup>[1]</sup>. Using modern digital recording techniques it is now possible to record very clearly non audible sound frequency bands such as ultrasound or infrasound. These bands have a direct effect on the human body without a person being aware of the associated mechanical vibrations. The hypothesis of our research group is that in some archaeological sites considered sacred for thousands of years, there are measurable natural audio phenomena that make the place somewhat more mystical than others.

Following this line of research, we started to test various sacred sites in Europe to assess this hypothesis. We found interesting archaeoacoustics effects at some sites, which included the Cistercian Abbey of San Salvatore in Abbadia San Salvatore in the province of Siena (Italy) and among ruins of medieval monastery/fortress on the top of the Visočica Hill near Visoko in Bosnia-Herzegovina.

### II. ULTRASOUNDS, INFRASOUNDS AND AUDIBLE LOW FREQUENCIES

There are a lot of scientific papers that evidence mechanical vibrations have a positive or negative influence on our health and there are several predominant sources of naturally occurring ultrasounds, very low frequency and infrasound found in the environment. Depending on age and gender, humans can perceive sounds in the range of 20hz to 20Khz, in some cases sounds above 14-18Khz are not audible to the

human ear. Careful measurements have shown that hearing does not abruptly stop at 20Hz but the ear is capable of registering infrasound if the sound pressure is sufficient. Frequencies above 20Khz are considered ultrasound whilst frequencies below 20Hz are considered infrasound.

Low frequency sound has a relatively long wavelength and low material absorption rate, hence it has the ability to travel vast distances. These properties make it possible to achieve a profound effect on vast tracts of acoustic space with the production of high sound pressure level acoustic waves. Low frequency sound is non directional sound in it's propagation and therefore has the effect of enveloping the individual without any discernable localized source<sup>[8]</sup>.

Some animals such as elephants, hippopotamuses, rhinoceros and giraffes are known to use infrasound to communicate over distances. Many animals are able to perceive infrasonic waves that pass through the earth before natural disasters, which act as an early warning system for them.

Any severe and artificial extreme imposed on the sonic environment has a profoundly destabilizing effect on the individual, indeed infrasound has been used in the context of wars and nowadays there are currently several organizations conducting research in the area of acoustic weapons. However, natural low vibrations with an absence of high pressure can have a positive influence on human health and some people can perceive very low-frequency sounds as a sensation rather than a sound. Infrasound may also cause feelings of awe or fear in humans. Given it is not consciously perceived, it may make people feel that odd or supernatural events are taking place<sup>[9]</sup>. So it is possible to hypothesis that where there are a lot of natural low vibrations present, ancient populations considered these sites to be "sacred".

The same argument could be applied to natural ultrasounds. The upper frequency limit in humans of approximately 20.000Hz is due to limitations of the middle ear, which acts as a low-pass filter. However, if ultrasound is fed directly into the human skull and reaches the cochlea through bone conduction, without passing through the middle ear, it is then possible to hear also these frequencies<sup>[11]</sup>. Because in humans the upper limit pitch of hearing tends to decrease with age, children are able to hear some high frequencies sounds that older adults cannot<sup>[10]</sup>. Ultrasounds are well known and used in the medical field. Ultrasonography is a diagnostic medical imaging

technique used to visualize many internal organs with real time tomographic images. Ultrasound is used for healing inflamed tissue and for therapeutic applications or in dentistry for cleaning tartar from teeth. Although the long term effects of exposure to ultrasound at strong intensity are still unknown, currently medicine considers the benefits to patients outweigh the risks. In contrast to medical applications ultrasound has been studied as a basis for sonic weapons, due to its direct effect on the human body and nervous system. Applications have been developed that include riot control through the disorientation of attackers and lethal levels of ultrasound that can be used like a gun. In fact high frequencies can readily be absorbed by materials and being highly directional they have incorporated in the design of acoustic weapons. It is probable that natural emissions of ultrasounds were heard by very young people of ancient civilizations as a supernatural sound, but in the rest of the population these were felt only as a good or bad sensation relative to the perceptible frequencies in a particular location along with the mystic aspect of the site.

From this assumption from 2010, we decided to begin researching these frequencies in "sacred" ancient and well known archeological sites. This study gave amazing results for a possible explanation as to why a particular site was considered sacred. We analyzed several ancient sites and we are focusing on other locations in Europe. In this paper we will speak about two such sites we analyzed: the Abbey of San Salvatore in Abbadia San Salvatore (Siena) in Italy for ultrasounds and Visocica Hill in Visoko Valley in Bosnia-Herzegovina for low frequencies and infrasounds.



Figure 1. The Abbey of San Salvatore in Abbadia San Salvatore (Siena)

### III. MATERIALS AND METHODS

We used two types of dynamic high-end microphones extended in the ultrasound field together principally with a digital portable recorder with a maximum sampling rate of 192KHz (Tascam DR-680 of TEAC Group), but we controlled the result with other digital recorders (Tascam DR-100 and Marantz PMD661) with less technical characteristics.

For recording in water we used ultrasensitive omnidirectional microphones also used by sea biologists (Aquarian H2a-XLR Hydrophone, frequency response from

10Hz to 100Hz) with shielded water proof cable from factory, which we used especially for the tank of Abbey of San Salvatore. This type of microphone has a wide bandwidth typically used to hear the song of the whales up to several kilometers away. In this case the sound is transmitted very quickly in water, with the body of water acting as a reflector capable of capturing every vibration many meters away.

At the same time as recording in the air we used professional studio microphones with a wide dynamic range and a flat response at different frequencies (Sennheiser MKH 8020, response Frequency 10Hz - 60.000Hz) along with shielded cables (Mogami Gold Edition XLR) and gold-plated connectors.

Before recording we used a spectrum analyzer (Spectran NF-3010 from the German factory Aaronia AG) for searching electromagnetic phenomena present around us which could have had a negative influence on our results.

For analyzing audio records we used PRO TOOLS ver. 9.05 and Praat version 5.3.02 software for Mac to overlap and mix the various tracks recorded using two different methods of recording and Audacity ver.2.0.2 and Praat ver.5.3.35 for Windows.



Figure 2. The set used for recording in the Abbey of San Salvatore: the recorder Tascam DR-680 and Sennheiser MKH 8020 microphones

### IV. THE ABBEY OF SAN SALVATORE

The first evidence of the existence of this monastic centre in this location dates back to a document from 762 AD, but the existence of this place can be traced back to the sixth century BC during the process of urbanization of Northern Etruria by the Etruscans.

The excavations carried out in the area of the abbey in the '90s however, also gave rise to the discovery of arrowheads and flint, indicating the presence of a population since the Upper Paleolithic period.

The abbey has a large sixteenth-century cloister with a huge tank of water, the depth of which is considerable and that according to oral tradition, sits on a natural source of water. It

also collects rain from the surface above and filters it with an ingenious system of cleansing by carbon tanks located on the sides.



Figure 3. The well at the centre of the cloister of the abbey of San Salvatore offers the only access to the huge tank below

The depth is greater than ten meters from the edge of the pit at the centre of the cloister. Such a tank of water is precious in archaeoacoustics because it works like a huge dish that collects the sound from underground, thereby behaving like a perfect transducer. Thanks to the availability of the monks still present in the abbey we proceeded to reopen the well at the center of the cloister which had been closed for over 15 years and introduced microphones in deep water.



Figure 4. two microphones Hydrophones being placed in the well, despite a cable length of 12 meters, they did not resting on the bottom of the tank



Figure 5. Immediately we observed a strong ultrasonic signal coming from underground

We also placed one other digital recorder in the cloister to verify the presence of spurious sounds from the environment that could affect the main recordings. But in all records we didn't find any anomalous noises from other sources.

We performed an immediate graphic control on the recordings so that optimal adjustments of the recording volume and execution times could be undertaken. We took ten recordings over a period of three hours with a long pause in between, but the same result was found in all recordings. We took these measurements at two different times of the year for three consecutive days.

The results appear extremely interesting: in all recordings made over two hours we found a very intense mechanical ultrasonic vibration present, oscillating between 26kHz and 30kHz with a mean peak around 28.000Hz. with the look of a Gaussian curve.

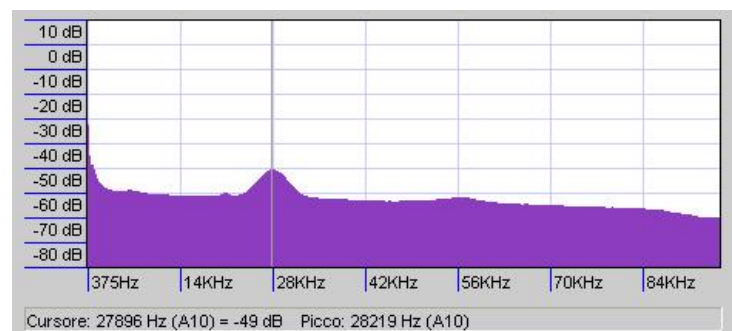


Figure 6. There is a peak of ultrasounds around 28.219Hz with an almost total silence on the other frequencies

Transposing the ultrasonic signal into the audible band was similar to a modulated whistle.

To check whether the signal was present in a larger area of the abbey we placed the microphones in a mining pond located less than 500 meters away, we also examined other bodies of water nearby and in neighbouring locations, but we did not find any ultrasonic frequencies present as those found in the Abbey of San Salvatore.

## V. VIŠOČICA HILL

The hill of Višočica is in Bosnia and Herzegovina and on the top can be found the site of the Old town of Visoki. Visoki was a famous medieval royal castle town and monastery destroyed by the Ottomans during the fourteenth century. The first mention of the town was in 1355 by King Tvrtko I of Bosnia, but from ancient artifacts found in that location we can suppose that a settlement was present from very ancient times.

During 2010 together with archaeological researches by Bosnian Pyramid of the Sun Foundation in Visoko Valley, Dr. Slobodan Mizdrak discovered an interesting natural emission of radio waves on the top of the hill among the ruins of the Old Town. These emissions were confirmed with an experiment in April 2011 (7), so our research group began to study the archaeoacoustics aspects of this site from 2011.

Also in this place we found ultrasounds of a frequency around 28,4KHz, but not constant (12). So we decided to analyze the site using the same methods as those used on the Abbey of San Salvatore.



Figure 7. Višočica Hill also called Bosnian Pyramid of the Sun for its pyramid shaped aspect is over the new town of Visoko (Bosnia-Herzegovina)

We found a very strong emission of low frequencies and infrasounds around the top of the hill. The range in total silence and with an absence of wind was between 10 Hz and 70 Hz with a large peak around 48 Hz. The volume was not elevated. This mechanic vibration is the most likely reason why so many sensitive people have the sensation of energy when they arrive on top of Višočica Hill visiting the ruins of an ancient castle. Below a particular volume we perceive low sounds better by vibration through sensors in human bones than by ear. This volume cannot create damage to human health, but we cannot be sure what happens over a long period of exposure.



Figure 8. The ruins of the ancient Old Town of Visoki. The position of the microphones are pointed out by red circle.

We searched for the same vibration on the hills around in the surrounding valley but we didn't find any similar. We tested these results for two years using different equipment.

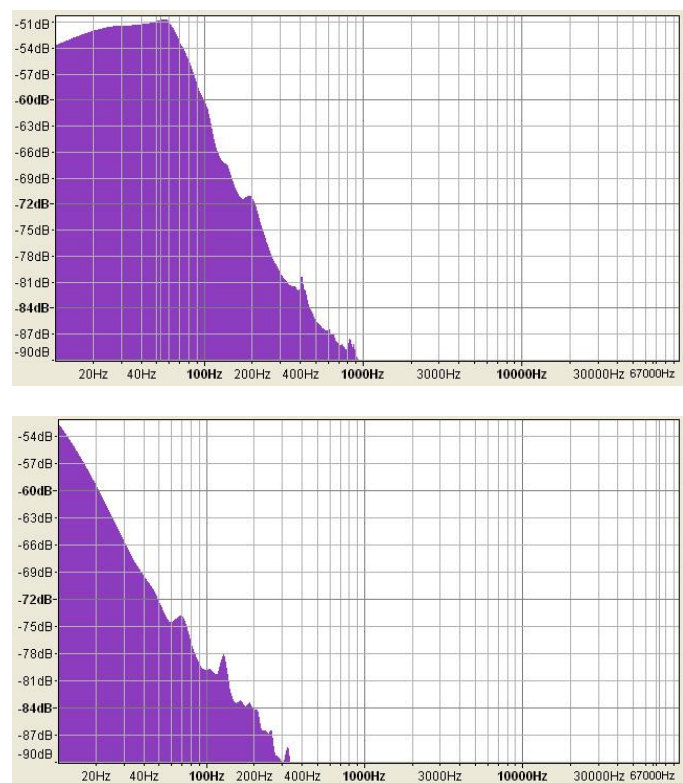


Figure 9. Top: the graphic aspect of sound recorded on Višočica Hill. Below: graphic aspect on a hill in a neighbouring location, the difference in frequencies between 10 and 70 Hz and the peak around 48 Hz is evident.

## VI. CONCLUSIONS

The thesis, that our research group (SBRG\*) has followed for more than three years, is that natural phenomena in the band of audible sound, infrasonic or ultrasonic, and electromagnetic or geodynamic phenomena may have had a

close connection with aspects of spirituality of particular places. These characteristics appear to have ultimately influenced the choice of construction of a particular temple in a certain location. We observed that when we found a natural interesting phenomenon, the archaeological site was very ancient and important and had a church or temple present long before the arrival of medieval churches. We also collected not significant data from chapels and medieval sites which appeared very interesting for their mystical nature and religious importance, but without any physical/mechanical secrets. In our archaeoacoustics research we also found some sites with interesting phenomena in suggestive archaeological locations without finding any significant archaeoacoustics features.

The Abbey of San Salvatore sits at the foot of Mount Amiata in Tuscany built over an ancient sacred Etruscan settlement. Mount Amiata is an extinct volcano, but some activity remains underground. It is likely that these natural sounds, perceptible even to a sensitive ear to the ground, were also present at the time of the Etruscans who were greatly impressed by them as the voice of God and therefore lead them to consider these locations sacred. Because ultrasounds are very directional our protocol proposes to use all possible stagnant bodies of water as a parabola for receiving sounds by Hydrophones and the huge tank of water of the abbey was perfect for this use. But no infrasounds or low frequencies were found here.

On the contrary the low frequencies and infrasounds found on Visočica Hill explain very clearly the sensation of mysticism which some people perceive in this place and how is very easy for those practising meditation can apply this technique at this site. We can suppose that these frequencies are probably coming from a nearby earth fault and are concentrated by the pyramid shape of Visočica Hill. In fact there are no similar frequencies in the surrounding hills. There is an ongoing debate that the Old Town on the top had or was also a monastery, but all historians agree it was the location where many important historic documents of medieval Bosnia were written and signed. So it was a place where wisdom, culture and attention was common, helped by this good natural environment. Because infrasounds and low frequencies are not directional, for our protocol we needed to capture these sounds using professional microphones with a flat response on all frequencies and a deep response in all frequencies. In either case, researching ultrasounds or low frequencies, it is very important to use well shielded cables with gold-plated connectors to avoid picking up radio waves from other sources.

Living our modern lives in urban towns and cities, we are dipped in a lot of bad mechanic vibrations with a high volume which in most cases is very detrimental for health. In contrast, in their absence ancient people would have been more attuned to natural vibrations. They understood the best locations to go to so they could make contact with God through their prayers, leading them to build their temples in these locations.

In conclusion as our experience demonstrates, archaeoacoustics appears to be an interesting new method for reanalyzing ancient sites using different study parameters. This reaffirms the aura of legends that pervades these places, and modern technology is now able to give greater clarity to the origin of many interesting phenomena.

#### ACKNOWLEDGMENT

We are grateful to Department of Medical Sciences of the University of Trieste (Italy) for supporting in our research and in particular to the Director, professor Roberto Di Lenarda.

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\* Note. SB Research Group is an international and interdisciplinary project team of research (Italian, Croatian and Finish members) on archaeo-acoustic of ancient sites and temple in Europe (Official web site: <http://www.sbresearchgroup.eu>).

# The role of ambiguity in enhancing the aesthetic experience – where architecture meets neuropsychology

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**Abstract**—One key concept in the discussion of aesthetic value is the aesthetic experience. The word experience is often mentioned in the architectural discourse but this paper aims to deepen this understanding by investigating the biological aspects of the process of experience. Recent researches in the field of neuropsychology and neurocognition conducted by Antonio Damasio, Gerald Edelman, Semir Zeki take interest in the subjective creation of meaning in the process of experience, making now possible the confrontation between the humanist and the scientific perspectives in the study of human consciousness. Semir Zeki, professor of neuroaesthetics at University College London, launches the concept of ambiguity in his research about the neural concept formation and art. The paper will outline an experiment to confront Semir Zeki's theory about the importance of ambiguity in the aesthetic experience with several concepts that feed the theoretical architectural discourse.

**Keywords**- *aesthetics, ambiguity, architecture, neuropsychology*

## I. INTRODUCTION

The criticism of modernism, the emergence of computer and the scientific progress are pushing the architectural field to investigate new forms of expression, developing new and different trends both on conceptual and formal levels. Trying to find a theoretical basis for reconciling the built environment with human nature, architects turn to philosophy or look for inspiration in other scientific areas.

It is known that the built environment can generate a prompt emotional response; they can be oppressive or uplifting, surprising or predictable, can be welcoming or, conversely, can induce feelings of anxiety, variety of emotions is as high as the refinement of human experiences. Architects intuit which particular features of the designed space can generate a certain state and the quality of their architecture lies precisely in the spiritual wealth they created. What nobody knows is why certain properties of architectural spaces produce a certain kind of subjective experience.

Recent researches in the field of neuropsychology and neurocognition, conducted by Antonio Damasio, Semir Zeki, Gerald Edelman, take interest in the subjective creation of meaning in the process of experience, making now possible the confrontation between the humanist and the scientific perspectives in the study of human consciousness and aesthetic experience.

In recent decades the re-examination of architecture and cultural modernity has fueled a series of theoretical debates about the relationships between architecture, perception and aesthetic experience.

## II. AESTHETIC EXPERIENCE- NEUROPSYCHOLOGICAL FOUNDATIONS

### A. Aesthetic experience

The word *aesthetics* rooted in ancient Greek, meant aesthetic things perceived through the senses as opposed to *noeta* signifying things that are thought or immaterial. Aesthetic is an adjective, while Aesthetics is a field of study concerned with aesthetic experience and aesthetic properties.

We can identify three elements that characterize the search field of philosophical aesthetics: the first is the art practice or the activities related with the creation and the appreciation of art, the second refers to certain properties of objects, called aesthetic properties, such as beauty, grace and dynamism, and the third involves a certain kind of attitude, perception, experience, which in turn may be labeled as aesthetic. The questions that marked aesthetic philosophy has revolved between these three elements considering one or another of them as being crucial for the understanding of art. Philosophers have tried to explain what are the properties which characterizes the aesthetic experience, naming: pleasure, beauty, emotion and knowledge and they identified them as the necessary and sufficient condition for defining an artistic object.<sup>[1]</sup>

By reviewing the theories proposed by philosophical aesthetics we can see that many of them intuitively connected certain phenomena related to artistic appreciation with emotional or mental innate capacity of all human beings.

The neuroscientist V.S. Ramachandran argues that the biological substrate of the aesthetic experience needs “3 levels of investigation: first the “internal logic” of the phenomenon, second the evolutionary argument (the question of why the phenomenon has evolved and came to that particular form) and third the neuropsychological basis. The evolutionary argument is given by evolutionary psychology which investigates art in the context of any adaptive behavior, that aims to favour the individual survival and his reproductive success, what is called fitness.”<sup>[2]</sup>

As human beings, our simple interaction with the surrounding world is under a constant state of aesthetic evaluation. We engage in the dialogue with reality by using our senses, perception of external stimuli and assigning values for each entry (consciously or not) by a mechanism based on reward.<sup>[3]</sup>

The task of the visual apparatus is to collect information about the world in order to ensure individual survival and does this by selecting the essential properties of the objects it encounters, first removing all irrelevant information, and then comparing the information selected with past experiences. To make this task possible it has to generalize the visual event, or as the professor of neuroaesthetics Semir Zeki says, "the brain is only interested in obtaining knowledge about the properties of objects and surfaces that can be considered permanent, essential or characteristic and thus allowing their classification".<sup>[4]</sup> On this basis Zeki defines visual art as "an extension of the major functions of the visual brain".<sup>[5]</sup>

This brain mechanisms that underpin aesthetic judgments and results in a feeling of reward, provides evidence that the visual system is directly related to the limbic system, the site of emotions. Because of this connection "we tend to make associations that involve other groups of neurons because entire neural networks are activated when parts are stimulated".<sup>[6]</sup> These "other groups of neurons" may include brain areas involved in memory, thus introducing subjectivity in aesthetic appreciation. Individual experiences and memories, together with the appropriate emotions, will inform the individual artistic perception. However, although the artistic appreciation is a subjective phenomenon, there are certain common patterns of aesthetic perception. These patterns allow art to become a means of communication.

### B. Concept, Ideal, Ambiguity

Semir Zeki says that we are far from understanding the neurological underpinnings of the laws that dictate artistic creativity, creation and appreciation, but we can find the origins of art in a fundamental property of the brain, namely the ability to form concepts.<sup>[7]</sup>

This capacity is itself a product of the brain's essential characteristics of which abstraction is required by the fundamental function of the brain, that is to acquire knowledge. Semir Zeki is trying to investigate from the neurological point of view the concept of *idea* and its formation in the brain. Ideas have been a subject of philosophical debate that spans more than two millennia, but the investigation was made from the point of view of the *mind* not the *brain*. Zeki discusses exclusively in cerebral terms, arguing that the formation of ideas is the necessary and inevitable product of an efficient system of acquiring knowledge about essential, permanent and constant properties of objects and situations, given the fact that the information reaching the brain are always different. This process is called by Zeki abstraction.<sup>[8]</sup>

How the brain abstracts is only partially known, but it is clear that the neurological processes that support abstraction takes place automatically, and we are not aware of the processes themselves but their outcome.

It is plausible to believe that the outcome of this process of abstraction is to create an *ideal* in which all sensory

experiences were synthetically combined. This construct although is dependent on many features in its construction, is still independent to a particular feature. The idea resonates with the Platonic *Ideal* concept, believing that the ideal is not a thing, but a construct of all things that form a category that the brain has known by experience. In other words the Ideal formed by the brain is dependent on the individual brain and the individual experience that varies between different individuals. In other words ideals formed by different individuals are not identical. Zeki quotes J. G. Frazer saying that "generalization, while the highest power of the human intellect and a mark of its strength, is no less a mark of its weakness. Generalization is but the compendious and imperfect way in which a finite mind grasps the infinity of particulars."<sup>[9]</sup> In other words, the mind must pay a price for this: abstraction leads to an Idea or concept, but our experience remains that of the particular, through perception, and the particular that we experience may not always satisfy the Idea formed in and by our brains. One way of obtaining that satisfaction is to 'download' the Idea formed in the brain, into a work of art.

The translation of concepts in the artist's mind onto canvas, or into music or literature constitutes art. Great art is that which corresponds to as many different concepts in as many different brains over the longest period of time possible.

Everything becomes more complex when, in trying to instill meaning into this world and extract the essentials, the brain is confronted with several possible solutions. Here, it must first evaluate what the possible solutions are and decide which is the most likely. "True ambiguity results when no single solution is more likely than other solutions, leaving the brain with the only option left, of treating them all as equally likely and giving each a place on the conscious stage, one at a time, so that we are only conscious of one of the interpretations at any given time. Thus a neurobiologically based definition of ambiguity is the opposite of the dictionary definition; it is not *uncertainty*, but *certainty*—the certainty of many, equally plausible interpretations, each one of which is sovereign when it occupies the conscious stage."<sup>[10]</sup>

Ambiguity is such a prized characteristic of all great art because it can correspond to many different concepts. Ambiguity, says Zeki is a way the artwork engages the brain more intensely. The relationship of ambiguity to consciousness is critical; "My second aim is to show that the characteristic of ambiguity in art is not special to art. It is rather, a general property of the brain which is often confronted with situations or views that are open to more than one, and sometimes to several, interpretations. The artist, rather than creating ambiguity, thus uses, sometimes to exquisite effect, this potential of the brain."<sup>[11]</sup>

There are different levels of ambiguity dictated by neurological necessity and built into the physiology of the brain. These different levels may involve a single cortical area or set of areas; they may involve different cortical areas, with different perceptual specialization or they may involve, in addition, higher cognitive factors such as learning, judgment, memory, and experience. Whether the result of activity in a single area or in different areas, these different levels are tied together by a metaphoric thread whose purpose is the

acquisition of knowledge about the world and of making sense of the many signals that the brain receives.<sup>[12]</sup>

Zeki's ideas begin to be confirmed by new research in other areas. For example in the article entitled "Complexity Theory of Art: Recent Investigation", Igor Yevin, researcher of the Russian Academy of Sciences in Moscow, shows that "mathematical models applied to the perception of ambiguous patterns can be regarded as basic model of artistic perception."

<sup>[13]</sup> Ambiguous patterns are not exceptional phenomena, any pattern is, somehow, a multistable ambiguous pattern, but in daily life, using additional information, we solve or avoid ambiguity.

### III. AESTHETIC ATTITUDES AND CONCEPTUAL TOOLS

Investigated from the architectural point of view the concept of ambiguity involves an analysis of the phenomenological concept of limit. The limit theme comes from the very purpose of architecture, that of building, of establishing a shelter by cutting a boundary of a space within space.

The deleuzian philosophy was talking about limit as the most ambiguous element, not belonging neither to interior nor to exterior, revealing and concealing, a manifestation of the difference. Limit can be understood as a boundary between inside and outside, as a change of density of matter, as a manifestation of visibility, or as a continuous state of becoming.

The ambiguity theme involves also the term "amphiboly", meaning ambiguous grammatical structure, which involves, in addition to the double meaning of language, the mental involvement of different concepts. The origin of the word indicates the existence of two opposing claims, whose contrast leads to a sense of suspicion due not to the lack of evidence or information, but to the presence of contradictory evidence.

Peter Zumthor quotes Giacomo Leopardi saying that the way we can achieve ambiguity, understood as multivalent, is not using vagueness but precision, "pedantic accuracy and attention to the composition of each image, a thorough definition of details, of light and atmosphere."<sup>[14]</sup>

The publication in 1966 of the book "Complexity and Contradiction in Architecture" written by Robert Venturi, promotes the anti-modern component of pairs of binary oppositions such as hybrid/pure, distorted/straightforward, and ambiguous/articulated. Venturi is influenced by several thought paradigms: semiology, Gestalt psychology and William Empson's literary theory in „Seven Types of Ambiguity”.

#### A. *Le Corbusier – spatial layering*

Rowe and Slutzky refer to the architectural concept of transparency that appeared in the effort to interpret the beginning of the 20<sup>th</sup> century architecture and painting as conceptual parallel path ways. The definition of the term invoke the optic property of seeing through. Rowe and Slutzky in their essay "Transparency: Literal and Phenomenal" refer to a passage of the art theorist Gyorgy Kepes saying: "If one sees two or more figures overlapping one another, and each of them

claims for itself the common overlapped part, then one is confronted with a contradiction of spatial dimensions. To resolve this contradiction one must assume the presence of a new optical quality. The figures are endowed with transparency; that is they are able to interpenetrate without an optical destruction of each other. Transparency however implies more than an optical characteristic, it implies a broader spatial order. Transparency means a simultaneous perception of different spatial locations. Space not only recedes but fluctuates in a continuous activity. The position of the transparent figures has equivocal meaning as one sees each figure as the closer or as the further one."<sup>[15]</sup>

Rowe and Slutzky were saying that, despite the definition of transparency, a necessary analysis must establish a dichotomy. Transparency can be an inherent quality of substance or an inherent quality of organization and accordingly we have to deal with a real transparency-literal or with a simulated one-phenomenal.

In the architectural practice Rowe and Slutzky use the example of Le Corbusier's Villa Stein, proposing an imaginary model of the building, analyzing the garden elevation. In analogy with two-dimensional pictorial space, the impression of depth is generated by fluctuations in the Gestalt figure-background relationship. This continuous interpretative fluctuation reaffirms the notion of simulated transparency-phenomenal. The oscillation between planes or layers produces an ambiguity in spatial depth, the simultaneous perception of multiple overlapping plans and readings.<sup>[16]</sup>

In opposition appears literal transparency, illustrated by the curtain wall of Bauhaus building, the workshops wing. Rowe and Slutzky construct a critical argument of this concept through a rigorous use of Gestalt theory applied to the architectural experience. The generous glazing of the glass boxes, that most often represent modernity, allows the mutual perception of interior and exterior, but the two worlds keep their integrity. Rowe and Slutzky concludes that translating into three dimensions the "cubist" space in architecture and in particular in Le Corbusier's architecture is not only optical but phenomenological, involving a new space order.

The concept of phenomenal transparency, which helped a new generation of architects to understand the formal richness, complexity and sophistication of Le Corbusier's architecture had a major impact on the practice of architecture after 1970. Formal properties as visual ambiguity, layered space, overlapping and interpenetrating figures, etc., became principles of configuration that generate solutions to architectural problems.

#### B. *Porous architecture and landscape architecture*

Poché's theme reintroduced by Louis Kahn, referring to the differentiation of substance, has led in recent decades to a gradual change in the concept of architecture as object, through the progressive complexity of the figure – ground relationship, through the transfer from the building autonomy to the relation with the landscape, from tectonic to topography, from Euclidean to fractal. Architectural tradition has always focused on the positive, the building, but today architectural compositions successfully articulate opposite polarities

(positive /negative, built/unbuilt) favoring new perceptual experiences by introducing the "in-between" class of spaces. The "in-between" is not necessarily a residual space (the inherent gap between two volumes in modern architecture and urbanism), but rather, using complex geometries, it can become an important space that allows architecture to inhale and exhale.<sup>[17]</sup>

Steven Holl showed that the theme of a "porous architecture" is based on weakening the importance of visual sense, by the superposition of several fields of view, as they are illustrated by Alvar Aalto in Villa Mairea, in opposition to the strict geometry of Villa Savoye.<sup>[18]</sup> Steven Holl recalls the image of the sponge, composed of many voids forming breathing spaces through which natural light is introduced. The model is Menger sponge obtained by successive removal of the same form.

In 1966 Venturi quotes Aldo van Eyck: "Architecture should be conceived of as a configuration of intermediary places clearly defined. This does not imply continual transition or endless postponement with respect to place and occasion. On the contrary, it implies a break away from the contemporary concept (call it sickness) of spatial continuity and the tendency to erase every articulation between spaces, i.e., between outside and inside, between one space and another (between one reality and another). Instead the transition must be articulated by means of defined in-between places which induce simultaneous awareness of what is significant on either side. An inbetween space in this sense provides the common ground where conflicting polarities can again become twin phenomena."<sup>[19]</sup>

What takes place is an ambiguity in space perception, an inciting complexity and strangeness. This property of mediation recalls the ambiguity property described by Semir Zeki. It is not there imprecision, but enrichment by adding a new even contrary meaning, that of externalization of the interior and interiority of exterior.

The relationship between figure and ground provides another aspect, different from that of the complex intertwining of interior and exterior, that of blurring the difference, by deleting the boundary between built form and land. The idea of landscape architecture came under the influence of Gilles Deleuze's philosophy and was favored by the new digital techniques for surface generation. Translating in architectural language the deleuzian terms: fold, smooth space, striated space, leads building to actually cut into the ground, uniting architecture and landscape in a new composition that does not rely on figure and ground, but rather produces both simultaneously.

The paradigmatic example of landscape architecture is the "City of Culture" in Santiago de Compostela, Spain designed by the American architect Peter Eisenman. The project reinterprets the palimpsest principle, in the desire to incorporate the past and the future of the site in a single, topological surface.

Using computer modeling Eisenman overlaps three layers of information: the historic streets of the medieval townplan and a Cartesian grid both placed over the topography of the hills that distorts them generating a fluid surface that is either

figure and ground, and in the same time try to recall the old medieval tissue. This process generates a new but somewhat familiar presence, and mediates the conflict between nature and the city.

### C. *Homogeneous envelope and blurring architecture*

Illustrating another way of relating the project to urban form, architecture displays a new appetite to "unitary forms" inspired directly from the conceptual art.<sup>[20]</sup> Unitary and sculptural form is usually associated with a homogeneous envelope, whose perception provides instant understanding of form, stating the unity, but at the same time generating an ambiguity. The play between transparency and opacity, between simplicity and complexity deletes, paradoxically, the simplicity of the building's volume and introduces, as architecture critic Jacques Lucan says, "une perception indécise".<sup>[21]</sup> The envelope offers an ambiguity of the form, therefore calls for the acuity of the view and for the deepening of the viewer in the perception of the architectural object.<sup>[22]</sup>

Lucan, in his book "Composition, non-composition. Architecture et Theories, XIXe-XXe siècles" introduces us to another method to generate an ambiguity of the architectural form that is accomplished by destroying the hegemonic visibility by creating a phenomenological environment. Lucan builds his argument on Matisse's ideas, which demonstrates that the "void" between things, for us the environment in which they "float", is more difficult to deal with than things themselves.<sup>[23]</sup> Lucan uses the design of the Japanese office SANAA to illustrate the phenomenological environments. "In any of the environments that form the inner world or the interior landscapes of Sanaa buildings, there are divisions which are not different from each other, there are fine, ethereal walls, which gather or which irradiate a white light. Constructive elements hide in these always equal walls, whatever the size or function of the pieces they enclose, they become "deep" surfaces. White makes the perception uncertain in an environment of uncertain dimensions."<sup>[24]</sup>

### D. *"Fragile architecture" and "weak thought"*

In his article "Hapticity and Time – Notes on Fragile Architecture" Juhani Pallasmaa says: "Authentic Works of art, however, always remain suspended between certainty and uncertainty, faith and doubt." There can be traced a parallelism between Pallasmaa's concept of "fragile architecture" and the way in which the Portuguese neuroscientist Antonio Damasio describes how consciousness handles the conflicting needs of the organism. In relation to his discussion of "fragility" in architecture, Pallasmaa mentions ideas by the philosopher Gianni Vattimo, which are inscribed in what has been called "the philosophy of difference".<sup>[25]</sup> It argues that the distinction between true and false, essence and appearance, rational and irrational, have to be dissolved. This means that our experience of the world is wholly constituted by interpretation. As we saw the study of human consciousness also argue that we depend on interpretations in our encounters with the surrounding world, and these are always tied to the individual body, individual experiences, and the environment. Pallasmaa emphasises the idea that, in accordance with Vattimo's concepts of weak ontology and fragile thought, we can talk about a fragile

architecture, or, more precisely, a "weak image architecture" as opposed to a strong image architecture. While the latter tries to impose a single, exceptional image and a consistent articulation of form, weak image architecture is contextual and responsive. It is concerned with sensory interaction and not a pure conceptual manifestation. The power of the fragility is given by dialogue and listening.

#### E. Nest / cave

The Japanese architect Sou Fujimoto is talking about his architecture like a permanent search for the spatial relativity of the "primitive". He builds his argument on the distinction between two terms: nest and cave. "A nest is a place for people, which is very well prepared, in which everything is assembled and very functional. A cave is just raw space, which people need to explore and find their own comfort within...a situation where people can use space creatively. I prefer cave-like unintentional space, something between nature and artefact."<sup>[26]</sup>

Human habitation develops in the cave-architecture around the subjective creation of meaning, in the way people are invited to invest space with their own impulse.

### IV. CONCLUSIONS

The neuropsychological approach to the construction of aesthetic experience is demonstrating the genetic programming of the brain through a "deep structure" based on certain rules to generate aesthetic pleasure activated by the experience. This suggests that artistic experience may be only partially identified as conscious experience. While traditional aesthetic theory attempts to explain the artistic phenomena through their unique properties that distinguish each work of art, the neuropsychological approach reveals the universal properties underlying all artistic practices.

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# Spatial Invariables In the Consciousness of Town Dwellers

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**Abstract—** Art, artificial surroundings and artificial forms more and more frequently replace the natural environment. Whereas, in the opinion of ethologists, higher feelings - which constitute the condition behind the development of civilization, may be shaped exclusively when living in natural environment. Only true form of nature gives in to the general understanding and empathy. If we think of a positive scenario of the development of civilization, then artificial forms need to be true, they need to evoke positive emotions - share the language of mankind. To put it in one word, they must contain spatial invariants, which allow man to orientate himself in the group of other people. Paradoxically, ethological research shows that globalization processes impair our ability of shaping the true form, that is the form that is clear and legible.

**Keywords-** *interrelation of form with the environment, globalization, regress of the town, invariant form*

## I. PROCESSES OF GLOBALIZATION VERSUS EVOLUTION OF THE TOWN FORM

As Popper maintains in his *Poverty of Historicism*, we are bound to fail in our predictions on the development of civilization. On the other hand, the processes of globalization show an astonishing similarity to the spreading processes of wildlife species. Examining the process of globalization, it is worth using the ready made tools of ethology. Then, we can on time notice the threats of cul-de-sacs. The research carried out by Freyer and Kueppers [1] proves that the cultural creations adhere to the same laws which apply to the evolution of the wildlife species. The more closely the observed symmetry is, the more complex the structures examined by us are. The towns in particular should confirm the ethological rules.

Similarly to life bodies, the towns are time variable complex structures, existentially coupled with their surroundings. The town is set up and then it develops in accordance with the encoded therein genetic material: design - genotype. This code determines the existential conditions of the "body".

The larger the amount of information about the environment is accounted for in the genotype, the better its perspectives for existence [2]. Donald MacKay states that: adaptation to the environment will always mean the body has created the image of the surroundings. Quality of any form - life or artificial - can be measured with the amount of information about the environment contained therein. The fundamental law of ethology says that as long as the inter-

relation of form of the species with its environment/habitat exists, then, the evolution progresses in the right direction. Form excellence is measured by an ethologist with that form's inter-relations with the environment. Still, the form - environment match criterion is in explicit contrast with such features of the process of globalization as homogeneity (resulting from the economy of large batches), or the universality of the design - genotype. Surroundings cannot be deemed universal. In case of insufficient relations between the town and the environment, the town - as any other life body - may adversely develop in two ways: via competition within the same species or via regress. As evolution can progress adversely, in the way which may render no benefits, then the urban view upon globalization needs to be provided with the weapons offered by the ethological tools.

Therefore, in the opinion of the ethologist, competition within the same species:

Competition of males in the reproduction of the species is based on the efficiency of their signaling organs which attract the females. The longer the quill of male *argus* is, the better his chances for the attraction of the female and reproduction of his genes. The price he needs to pay though is a smaller chance of escape from the predator as the longer and more beautiful the quills, the more difficult it is to move for the animal. In fact what poses the chance of the highest reproduction rate is subject to selection but not what guarantees better adaptation of the offspring to the living conditions (in this case - quick escape). Thus, competition within the same species is not the inter-relation between the body and the environment. It is just the informative inter-relation between the competitors [3]. Evolution does not reinforce the adaptation, it does not copy any relation of the form with the environment.

Reproduction is the phenomenon which applies not only to life bodies. Trying, by all means, to implement a different genotype, e.g. of the urban plan, often results in the escape to apply a similar trick. Acquiring contracts for the implementation of the form provided with the signaling elements - efficiently attracting the investor - is an example of a competition within the same species, which takes place between the representatives of particular species: architects. Signaling elements are simply "fashionable" forms, stereotypical spatial solutions, long run technologies and unification that flatter common tastes - and are characterized with low costs.

Attraction signals are like the Trojan horses which stimulate the expansion, aggression of primitive forms, not encoded into the surroundings, creations being in extreme opposition to forms that are unique and valuable. Slight differences in the location do not count in the competition within the same species, what is important is just an attraction which allows for the multiple reproduction. The imposed form is in fact the classical syndrome of globalization. Any area, designated, for example, for one family houses may be marred with the creations - the disabled creations, as a result of the breach of the basic principle of inclusion of the form into the unique surroundings.

Architecture used as the symbol of the cross-regional corporation (e.g. stores of big, commercial chains, characteristic seats of big banks, global chain restaurants) serves as another example of using the signaling elements in "organs –tentacles". Application of architectural forms imposed upon the surroundings brings to mind the phenomenon examined by A. Festetics [4]. He showed the manner of using a characteristic costume for the purposes of aggressive manifestation of one's individuality, which gives rise to the feeling of being under threat in the surroundings. For example, Hungarian and Slovakian folk dresses appear in their original form where the representatives of these nationalities live in an isolated enclave on the area inhabited by a different nationality. Similarly, architectural enclaves of large cross-regional corporations, showing territorial aggression, trigger hostility among the local communities. Frequent fights with the supermarkets break out under a number of different slogans: claiming that the local labour market is being depleted of work places, or that social behaviour adversely changes due to shopping on Sunday or even that the functional structure of the town is being destroyed. However, the main, often subconscious, reason behind these disputes, is the very aggression of form.

Another adverse aspect of globalization is the regress of the form of the town. Sometimes, the organic form undergoes regress, then it is called a redundant form [5]. Such form is initially characterized with high degree of universality (and this is another feature of globalization). Thus, it can easily move and adapt to a number of niches, superseding the bodies adapted only to one particular surroundings, thus unique forms, forms featuring more values. Having superseded the original creations, the redundant form can regress, as it no longer has any competition. Thus, the parasitic body, initially an independent and extremely efficient body in the environment, having found its host, can reduce its form exclusively to extensive food supply and digestion organs, as it so happens in the case of *sacculina snail species*. The forms-parasites, depending on the degenerative stage, show redundancy of their construction or construction inadequate for its environment. Not searching far: typical forms of suburban, universal development, expand on the host body to absurd size, posing threat to the host's existence. For the connection with the city, only a simple supply connection is needed; no form creating inter-relations between the host and the parasite is required.

## II. NEW TECHNOLOGIES AND THE END OF CULTURE

The flow of technology in the first stage of globalization [6] results in the flourishing of high cultures - as Hans Freyer claims. The invigorating impulse for each form derives from the application of new technologies. They allow the forms for more precise adjustment to the environment, they bind the forms with the given location. They lead to the unique character of the form and allow for precise exposure of its "radiance showing through the matter" in the new light. The traditional form provides its user (observer), via the application of newer and newer means, with the information called *genius loci*. And man associates his higher feelings exactly with a particular place in the world and with the community, that he gradually gets to know and which inhabits that very place, only to refer these feelings later to the entire mankind and the entire world [7].

The initial stage of globalization is followed by the stage of consolidation, uniformity and disappearance of variability. The technology, in this stage, is so much specialized that it supersedes the variety of original forms. This results in the above described regress. Kueppers [8] proves that the destruction of cultural values also involves the total disappearance of natural variety. Huxley and Popper prove that cultural differences get bridged as a result of the application of technology. The economy of mass production supersedes the uniqueness of forms. Specialized technological systems, which impose long batches of elements, obviously destroy the *genius loci*. Today, the same goods are produced worldwide by means of the same technology, only to be sold on the global markets participating in the rat race using the same advertising methods. The variety of production techniques, which lies behind the creative drive, simply disappears. The architecture of the final, extremely technological stage of globalization is getting directed towards the form of a bit more complex container, optimized but identical in each corner of the world. Then, if everything is the same everywhere, the concept of, among others, local patriotism, loses its sense. Without getting further into the issue, loss of local patriotism is nothing else but also the disintegration of small social structures, which are so carefully stabilized by the traditional city.

The process of uniformity is today being reinforced with the application of the unified tools for the support of the design processes, which encode the genotype of the spatial forms by means of a computer. This process brings to mind the body cloning process (*nomen omen* - because cloning is one of the most frequent operations carried out at the computer assisted design work). Computer cloning, as biogenetic cloning, provides the copies with the features of the matrix, even those features that are undesirable.

Aldous Huxley thought that big investors applied apparently, partly self-generated doctrines which supported the processes of uniformity. These doctrines are to suppress all the heresies such as the attempts to adjust the form to the environment (What's typical is definitely always cheaper than what's atypical) [9]. The designing systems for big corporations or big suppliers of technologies stimulate the motivation of loyalty as follows – this loyalty is to eliminate the varieties of forms. T. Kuhn named this process "autoimmunisation". This

leads to the decline of form and the truth of the world that's embedded in such a form [10]. The more creative technology gets computerized, the more it imposes a priori forms. The forms supplied by the computer are as much universal as they are untrue. They do not establish any fundamental nor unique relationships with the surroundings, which relations then create the *genius loci* of the place. What's more, in accordance with the generalized Le Chatelier's law of equilibrium, a reactive impulse is triggered towards the excessive variability of form: tight girder of computer "autosshapes" triggers a reaction of the creator to the limitations set by his own tool. This results in a series of void forms, even more weakly attached to the surroundings.

However, safe evolutionary changes, which do not cause the degeneration of the biological species, must be accommodated within certain boundaries, set with the so-called "index of evolutionary mutation". Also in any culture a set of acceptable changes must be limited [11]. In the meantime, the variability of computer forms generated with impunity is excessive. It pushes architecture towards subjectivism and illegibility. It leads directly to the collapse of architecture: scope of tradition contributed by every generation of designers is growing one generation after the other [12], and the language the creator and the recipient share is getting blurred. This, for the city, means a total disaster.

### III. IS THERE A CHANCE FOR POSITIVE SCENARIO?

The research consisting in the comparative analysis shows that the form creating skill is one of the drives behind the self-development of mankind [13]. Man, creating the form, develops skills that are crucial for his species. This is not just exclusively about the form creator, but first of all, about the numerous recipients and users of that form. The prerequisite of such self-development has always been the criterion of the form truth [14]. This is the only complete concept that is a useful criterion. It originates - which is important - from the first ontologists. The terms they use are extremely anachronistic. This is an advantage, though, because the research apparatus of sciences, partially responsible for the shape of present day cities, reduces the quality determinants ("what doesn't exist, cannot be measured"). Thus, we need to translate the invariable criterion of the truth of form into the language of modern science, and using the occasion hereof, to state that there is some helplessness in the process for that reason metaphors need to be involved.

Therefore:

True form is exclusively the creation of nature. It makes up a mould, a reflection of outer space (or speaking more precisely, it results from the great number of inter-relations with the environment). Co-existing with life forms, thanks to the truth comprised therein, man has acquired the skill of assessing the value of an artificial form. You can contemplate the truth also by means of an artificial form, looking at the form as a unique invert image of the universe. This ability is the only spatial invariable of self-development of *homo sapiens*, it can be acquired by us thanks to the widespread understanding of the language of spatial forms. However, the daily and prevalent feeling of natural order, once experienced in direct contact with natural environment, is now experienced

by narrower and narrower group of human beings. The "noise of a big city" more and more often interferes with the signals of nature that get weaker and weaker. The laws of nature, whose part man also is, recede further and further, and man himself - on a scale as never before - is under the threat of regress so characteristic for the evolution the species undergo in separation from the natural environment [15]. Metaphors included in the definitions of the true form are derived from its verbal ephemerality. As everyone knows, the human brain is composed of layers: nature of evolution has had the following effect - human intellectual abilities get located in external, the youngest parts of the brain, which grown on the primary parts, which manage the animal instincts of the body (responsible for life and survival). The aesthetic feelings derived from the observations of space are located in the oldest parts of the brain. They do not give in to verbalization, except for the cognitive horizon, they cannot be explained in a straight forward way.

### IV. INVARIABLES

The already described index of mutation, which delimits the safe boundaries of the evolution of the created forms is, for the city, determined with two extreme states and conditions, the trespass of which results in the total destruction of the city. The first such state and condition is the uniformity of the environment: all forms which get consolidated due to the highly-specialized technology fulfil the space that is characterized with prevailing technological features. The second such state and condition is the space excessively varied and chaotic. Within the borderlines set between the excessive uniformity and chaos, those features of space that invariably make up a city are contained therein. These invariables reach inside the evolution and have been formed within the process, which can be summarized as follows:

Each body uses the environmental image for vegetation purposes. This image is composed of the structure of reflexes. For example, sudden increase in acidity of the environment results in the reflex of evacuation of bacteria. More complex bodies react to the stimuli from the environment in a similar way. In case of man, reflexes make up an extensive comparative matrix for a great number of data collected from the environment. It's always been so that if the external stimuli were felt as signaling safety, they triggered the feelings of comfort and law and order of existence. The comparative matrix, in the process of evolution over countless generations, has become to represent a certain type of a model of order, and as far as beautiful form is concerned, beautiful surroundings has started to evoke in the end the feeling of aesthetic pleasure. The comparative matrix, which has grown as a spatial invariant, is the feeling of order for man, both in his subjective perspective and in the general perspective. The city, in the process of evolution aimed at its adjustment to the needs of the community, included indispensable spatial features in that matrix of order, these features organize the group inhabiting a respective territory. The shape of a traditional town comprises the truth about the values shared by its community. Ethology claims that the laws of nature, extracted in a piece of art, represent the *sine qua non* condition for the development of higher feelings [16]. As these feelings - that's obvious - are the

only drive behind the right direction of the evolution of *homo sapiens*. The same emotional reactions evoked in the observers can only be triggered by “true” forms. These reactions are responsible for strong aesthetic emotions, called by physiology as “holy rain”. It is an atavistic reflex aimed at the preservation of the group identity and the values shared by the community [17]. Holy rain, commonly known as “goose bumps” or “chills” can be evoked only with the sign being a spatial invariable embedded in the consciousness or subconsciousness of the group members [18]. The only criterion of objective formal value, incomprehensible to the extent as it is jointly experienced, is the fact of triggering the commonly sensed feelings.

Intuition of beauty is not a constant value [19]. It changes together with the development of personality, undergoing different, difficult to define cycles. It must be renewed on regular basis in the reaction to the layout of the surrounding forms. The duty of an architect - shaping larger and larger areas of more and more artificial environment - is to create true forms. The true form of the town establishes order over our existential continuum [20], it supports the solutions for practical, life tasks allocating them with the images, the clarity of the structure. The crisis of the intuition of beauty, the commonly felt intuition, may mean a collapse of civilization and the advent of the barbarian era [21]. A piece of art cannot exist without clear and objective references. Are we able to retain for the future our greatest achievement - the town? The technological question an architect often asks himself: “how to make things uniform” and the experimental question: “what extra form can I still invent?” must be superseded with the question asked by Kant: “what shall I do to create true forms?”.

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# Soviet Signs in Grigoriy Kanovich's Writing

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**Abstract** – The present article provides the analysis of Soviet images-signs created in the borough novels by the Russian Jewish writer Grigoriy Kanovich. The closed world of the Jewish borough pierced by the linear time scale is the space that is affected by the world at large (Russia, later the USSR), from which historical processes are issued that change the lives of the people. Kanovich managed to create Soviet images-signs bearing important information not only about the Jewish world but the fate of the world in general.

**Keywords** – Soviet signs; Stalin; Soviet power; borough; destruction.

## I. INTRODUCTION

Grigoriy Kanovich is one of the brightest representatives of the contemporary Russian Jewish literature. In his writing a significant place is occupied by the trilogy about the Jewish borough Mishkine: the novels "A Kid for Two Groszes" («Козленок за два гроша») [1], "Don't Avert Your Face from Death" («Не отврати лица от смерти») [2], "The Charm of the Satan" («Очарование сатаны») [3]. The novels "Candles in the Wind" («Свечи на ветру») [4] and "Tears and Prayers of Fools" («Слезы и молитвы дураков») [5] constitute a specific exposition for this trilogy being united with it by a single sign space of Jewish borough. The closed world of Mishkine pierced by the linear time scale is the space that is affected by the world at large (Russia, later the USSR), from which historical processes are issued that change the lives of the people. In an interview the writer defined a very important feature for his writing: "For me Jews and the Jewish people are the starting grounds for philosophical and life reflections about humankind on the whole" («Для меня евреи, еврейский народ – стартовая площадка для философских и жизненных размышлений о человечестве в целом») [6]. Kanovich really managed to create Soviet images-signs bearing important information not only about the Jewish world but the fate of the world in general.

In the novels of the Soviet period, the author either does not address the Soviet subject matter at all ("Tears and Prayers of Fools") or creates several heroic images of revolutionaries ("Candles in the Wind"). In the course of time, that may be conditioned by the historical events of the late 20<sup>th</sup> century, first and foremost by the break-up of the Soviet Union in 1991, and the changes in Kanovich's own life (his repatriation to Israel in 1993), there was a significant transformation of the Soviet imagery in the writer's works ("Don't Avert Your Face from Death", "The Charm of the Satan").

Soviet signs in Kanovich's novels may be represented by the following classification system:

1. Signs related to the topic of revolution, revolutionary battle, the very idea of which is alien for Jewish consciousness. Jewish revolutionaries are depicted as a creation of the soviet Russian reality.
2. Signs related to the above-mentioned group backing up the topic of forced intrusion of the Soviet Union into the space of Lithuania and the space of borough.
3. Signs representing the Soviet power as a structure (characters as the representatives of Soviet power, changes in the everyday life course (words, songs), deportation).
4. Spatial signs of the Soviet Union.

## II. SIGNS RELATED TO THE TOPIC OF REVOLUTION

The novel "Candles in the Wind" is set in a dramatic period of the history of Lithuania from 1937 to 1943. The revolutionary battle and the images of fighters for the sake of workers in the viewpoint of the main hero narrator, Daniel are represented in a rather detached manner. He is interested not so much in the wide political context but rather in that of the family and borough. Despite that Jews had also joined the revolutionary battle, Lithuanians were those who would go on a strike: "What is a strike, we learned from uncle Stasis... Why hadn't our granddad, the grave-digger, Herr Damskiy ever gone on a strike?... Are they really satisfied with everything in life?..." («Что такое забастовка, мы с Пранасом узнали от дяди Стасиса... Почему ни разу не бастовал дед, могильщик, господин Дамский?... Неужто они всем довольны в жизни?...»)<sup>1</sup>. It was the Lithuanian Stasis who dragged father Daniel Saul into the battle of the working people. Daniel had gone on a strike only against his grandmother's decisions, and his heart was troubled by father's wish to go to Spain. However, Daniel naively suggests that revolutionary fight is similar to his protest against the desire of his relatives to make him a barber: "I will better become a local Marx (who is he, by the way?), get onto a barrel and make thunderous speeches, until I get hoarse" («Я лучше стану местечковым Марксом (а кто он такой?), залезу на бочку и буду произносить громовые речи, пока не охрипну»)<sup>2</sup>. Neither the name of Marx nor the word "barricades" or "Riva and Lucia" («Рива и Люция»)<sup>3</sup> (this is how Daniel and his granny perceive the word "revolution") had entered the active word-stock of the local people. The old Jew, Daniel's

<sup>1</sup> G. Kanovich, "Candles...", p. 86.

<sup>2</sup> G. Kanovich, "Candles...", p. 57.

<sup>3</sup> G. Kanovich, "Candles...", p. 268.

granddad, is sure that, having got engaged in a battle alien to his people, his son Saul becomes a murderer, first and foremost, of his own relatives, because he leaves them. The soviet power and revolution are still distant for the local Jewish residents of the borough. Tailor Saul's arrest is a reason for philosophizing about the inability of making the world longer or shorter, because God has made it long ago. The local tailor sees in the revolution just one shortcoming: people stop shaving and cropping their hair, they think about humankind and the future instead of their appearance. Stasis' son has the same abstract notion of the revolution: "We are all grave-diggers. Those who are working people. Grave-diggers for the wealthy. Thus spoke my Dad" («Мы все могильщики. Трудящиеся которые. Могильщики для богатей. Так говорит мой отец»)<sup>4</sup>.

It must be noted that in the early novel "Candles in the Wind" of 1979, the image of a revolutionary and the representative of the soviet power are slightly poeticized and made heroic. Daniel meets Pranas in the ghetto where the latter comes to take Jewish children from it, risking his own life: "There he comes, the builder of the new life, along the street in a grey coat, with a yellow lata attached to it like a flower" («И вот он идет, строитель новой жизни, по улице Стекольников в сером пальто, к которому, как цветок, приколота желтая лата»)<sup>5</sup>. The grown-up fighter for the rights of the working people accounts for his coming to the ghetto as follows: "So, you have come to name the pioneer unit after the courageous hawk, Valeriy Chkalov? – I came to save it..." («Ты что, пришел присвоить пионерской дружине имя отважного сокола Валерия Чкалова? – Я пришел, чтобы спасти ее...»)<sup>6</sup>.

### III. SIGNS RELATED TO THE TOPIC OF FORCED INTRUSION

The tanks that had come to the Jewish borough with large five pointed stars on the armour arouse curiosity instead of fear in the early novel "Candles in the Wind". Moreover, Daniel is going to take away his beloved by a tank because it is safe and impressive. Jews talk without fears to the tanker who has come to the cemetery about the local cemetery and who owns barber shops under the soviet regime.

Lomsargis' suppositions in the novel "Don't Avert Your Face from Death" about the animosity of the soviet power to rich owners become true: the representatives of the local security body come to the homestead to arrest its owner. Approaching the house, the young people act like robbers who, however, gradually grow accustomed to feel as the masters of life. The native home is no longer safe, because those who have taken power have tanks on their side that have menacingly frozen on the polygon near Mishkine.

The strong master of the house, peasant Lomsargis relates the arrival of the soviet airplanes with breaking the traditional order of things established by the Lord. The airplane that was hanging above the Black Thicket was adding to the nature sounds an alarming, pestering sound that was not dissolving in

the air, with stars on its wings like glowing coals that might set on fire not only the Black Thicket but the whole Lithuania.

### IV. SIGNS REPRESENTING THE SOVIET POWER AS A STRUCTURE

The representative of the soviet power in the novel "Don't Avert Your Face from Death" idealized the space of the Soviet Union creating a myth that in the Soviet Union "the sun was shining differently and the wind was always blowing into one's back instead of one's face, and people live like hand and glove – singing the same songs, eating the same food" («и солнце иначе светит, и ветер всегда не в лицо, а в спину дует, и люди живут душа в душу – одни песни поют, одну пищу едят»)<sup>7</sup>. The omnipotent Stalin was in the centre of the world created by the revolutionary Meilakh Blokh. The scenes played by him and his camera mates in the labour camp prison of Kaunas with Stalin, Mussolini, and Hitler were always ending with Stalin's victory. However, not everyone favoured this game because one cannot play Stalin, like one cannot depict the sun. Meilakh, contrary to the party regulations, considers that Stalin is great by his being present in every communist, in all spaces. Aaron had cut out of a Jewish paper photos of the political figures and was playing with his confreres "a strange kind of a game that only they could understand, in which Stalin was always a kind of a trump card being able to beat both Chamberlain and Daladier, and Hitler" («в какую-то странную, только им понятную игру, в которой Сталин был всегда чем-то вроде козыря и спокойно мог побить и Чемберлена, и Деладье, и Гитлера»)<sup>8</sup>. Stalin occupies the first place in the party even among smokers. The pipe given as a present to Meilakh Blokh, according to the revolutionary, by Stalin himself, is worthy of being placed in the museum.

However, this new myth is opposed to the reality and the notion of the historic deed carried out by the local Jews. Blokh's wife calls Stalin's pipe stinking and perceives the new life unlike it had been in the pre-soviet Lithuania: "around in the wind there were flags waving, portraits of a balding man with a beard hanging, orchestras playing in his honour, wheat was withdrawn, rich men were evicted from their homes" («вокруг развевались на ветру знамена, висели портреты лысого мужчины с бородкой, в его честь гремели оркестры, изымалась пшеница, выселялись из домов богатей»)<sup>9</sup>. Meilakh Blokh's appointment as the town mayor destroyed the notion of the local tailor about respectability, virtuosity and stability of the old order of life. When, wishing to show the greatness of Stalin, the soviet officer was drawing the whole world with his hand, Elisheva wished to open up the circle because the fields, woods, countries and people closed within the circle were as in a huge prison where even its creator Stalin was himself a prisoner.

In the novel "The Charm of the Satan", the representatives of the soviet power threaten Elisheva with Siberia where the Jewish woman could be sent to along with the Lithuanian man Lomsargis as she refuses telling them where Lomsargis is hiding. They warn the young girl that she should not rely on the

<sup>4</sup> G. Kanovich, "Candles...", p. 212.

<sup>5</sup> G. Kanovich, "Candles...", p. 418.

<sup>6</sup> G. Kanovich, "Candles...", p. 420.

<sup>7</sup> G. Kanovich, "Don't Avert...", p.40.

<sup>8</sup> G. Kanovich, "Don't Avert...", p.12.

<sup>9</sup> G. Kanovich, "Don't Avert...", p.94.

help of the relative Aaron who is studying in Moscow methods of fighting against the class enemies. The nomination of a class enemy replaces the words “mother”, “father”, “sister”, and “compatriot”. Sickle and hammer are not perceived as tools for work but rather become a bolt that eliminates a choice. People in the soviet space are not united by anything apart from this bolt, either kin relations or nationality.

In order to justify treason, disrespectful treatment, a wish to make profit, the recent friend of Elisheva, Povilas (the novel “The Charm of the Satan”) calls Lomsargis a person harmful for the soviet regime who shamelessly oppressed the working people. Elisheva who did not wish to exist in the context of the new power and reject the eternal ethical values, is asking: “Whom have you, Povilyuk, read this clever stuff from? Marx? Or Lenin? Maybe you have made it up at leisure between drinking two shots? Tell me, please, who, according to you, is a harmful person for the working people – isn’t it the one who is working like a horse from early till late? Who is richer than you? More pious? Clever?” («У кого ты, Повилиук, эту мудрость вычитал? У Маркса? Или у Ленина? А может, на досуге между двумя рюмочками сам придумал? Объясни мне, пожалуйста, кто, по-вашему, вредный для трудящихся человек – не тот ли, кто сам с утра до ночи ишачит? Кто богаче вас? Набожней? Умнее?»)<sup>10</sup>. Elisheva emphasizes the falseness of the “wisdom” of the soviet power as these are not the generally human values that have been coined up by Marx and Lenin or, what is even more humiliating for the soviet power, by the officials of the local NKVD “between drinking two shots”. Elisheva herself cannot realize what is a class enemy, because no such notion exists for Rex, Lomsargis’ dog, his bees, his grove. The representatives of the soviet power are distanced from their native land, they start living by unnatural rules coined up by people and not given from the heavens.

With the foundation of the soviet power, the lexicon of the local residents of the Jewish borough is enriched with new words. In the novel “Don’t Avert Your Face from Death” the daughter of the tailor, Elisheva does not accept the rules of the soviet regime. “Nationalization”, “komsomol”, “Siberia”, “Kremlin” – these words smell in her perception of violence and orphanhood. Elisheva determines the representatives of the new power using the words well familiar to her: “the gravediggers for the living” («могильщики живых»)<sup>11</sup>. The tailor of the borough also refuses to shout “Long live!” to the new power. He is sure that the Jewish people could be destroyed by the glorification of the alien regime, alien armies and their leaders. The words “nationalization”, “Stalin’s constitution” are unfamiliar to the traditional world of the Jewish borough because they match “neither bazaar, nor a shop or the prayer house” («ни для базара, ни для лавки, ни для молельни»)<sup>12</sup>.

New songs are the signs of the new power in the novel “Don’t Avert Your Face from Death” together with strange music that often brings destruction. With the arrival of the soviet troops, the market square in front of the catholic church was turned into a scene for Russian army orchestra and dancing

Red Army soldiers. The whole borough came to watch them, yet people treat these events differently: some with love and some with hatred. “Oh, kalinka, kalinka, kalinka mine...” («Эх, калинка, калинка, калинка моя...») sung by Aaron along with the soldiers is opposed to the ante-mortem wheeze and mumble of his father, the sounds that the representative of the new power finds it hard to listen to. The local tailor calls the performance of the Jewish folk dance by soldiers “a strange round dance” («странным хороводом») and concludes with indignation: “It is easy to dance Jewish dances but to love Jews...” («Еврейские танцы танцевать легко, а вот любить евреев...»)<sup>13</sup>. One of the local Jews is stricter in his assessment of the soviet power: “they sing and rob, rob and sing” («поют и грабят, грабят и поют»)<sup>14</sup>.

The singing duels between the representative of the soviet power Aaron and tailor Bankvecher are symbolical. Aaron has replaced the love songs by “International” and the song “The morning decorates with a tender light the walls of the old Kremlin...” («Утро красит нежным светом стены древнего Кремля...»). Tailor Bankvecher opposes his song tested by time, the one his granny used to sing at the cradle, to the new tradition. Raizel lets her husband sing the new songs because she thinks that song has never hurt anyone. However, this replacement of the traditional, one’s own by the alien, soviet has become tragedy for Raizel: her son dies at birth, and the lullaby of her great grandmother and father “When you become rich, my son...” («Когда ты станешь богатым, сыночек...») sung by the miserable mother by the cradle of her dead infant loses its character of the happy prediction. It becomes a lullaby of wake not only for the infant but the borough as well as the world, because the local gravedigger is certain: “when you bury a child, you bury the upcoming day” («когда хоронишь ребенка, то закапываешь завтрашний день»)<sup>15</sup>.

Deportation of the rich Jews is a horrible event that the local Jews face but cannot understand (a sign of the soviet power). When the winners are smoking the pipe presented by Stalin, the small chamber of Meilakh Blokh is filled with a “pale cloud smelling of Siberia” («белесой, пахнущей Сибирью тучкой»)<sup>16</sup>. In this case a certain ambiguity arises: is it the smell of the Siberia where Stalin had been sent to or the one where the borough Jews would soon be deported? Chopin’s soft and sad music coming as if from the heavens accompanies the farewell of the Jewish family deported to Siberia from their home, homeland and probably also life. For the Brukhis family whose furniture plant had been nationalized, the odour of freshly baked pastry and burning candles emanating a temple smell are replaced by a flat of a washerwoman smelling of the laundry blue and unfresh linen; instead of the house they have a lorry basket, the engine whereof silences the prayer and shakes the heaven. The representative of the local NKVD for whom no relations exist, either kin or national, enjoys the power given to him, as nobody but him and his superior, Aaron Dudak cannot enter the nationalized house of the owner of the furniture plant.

<sup>10</sup> G. Kanovich, “The Charm...”, p.56.

<sup>11</sup> G. Kanovich, “Don’t Avert...”, p.159.

<sup>12</sup> G. Kanovich, “Don’t Avert...”, p.207.

<sup>13</sup> G. Kanovich, “Don’t Avert...”, p.121.

<sup>14</sup> G. Kanovich, “Don’t Avert...”, p.103.

<sup>15</sup> G. Kanovich, “Don’t Avert...”, p.272.

<sup>16</sup> G. Kanovich, “Don’t Avert...”, p.52.

Gradually Povilas becomes an embodiment of the on-going tragedy at Amos Brukhis: "He never averted his eye from the self-satisfied Povilas with his mysterious planchette in which the sentences of the Brukhis, Drukman, and Tarails were folded" («Он не спускал глаз с самодовольного Повиласа, с его загадочной планшеткой, в которой, казалось, стопкой сложены приговоры и Брухисам, и Друкманам, и Тарайлам»)<sup>17</sup>.

The hay meadows of the master of the homestead Lomsargis (novel "The Charm of the Satan") smell of grass and herbs, while in the years run by the ragamuffins they reek of dung and blood. The strong peasant's dominion is his homestead with its own system of relations, certain values, labour and devotion being the main ones among them where even a dried apple-tree is given a chance of rebirth. The fear of being pushed into a stock-car from the depths of Russia carrying one to Siberia makes the master of the homestead abandon his "subjects": geese, hens, cows, horses, carps. He is threatened not only by the material loss but also by death in the middle of nowhere in Siberia, the vastness of which makes one devoid even of the possibility of being mourned.

The wagons in which people are deported to Siberia are called stock-cars not because cattle were transported in them but because it is not people created by the image and likeness of God but cattle who strip the world devoid of security and faith in eternal values. Danuta in her talk to Aaron does not ask but ascertains: "Can you call a human the one who not only does not love his neighbour but kills them out of hatred or who in broad daylight appropriate a furniture plant that belongs to someone else, drives the owners from their home and for no reason deports them to polar bears to Siberia?" («Разве можно назвать человеком того, кто не то что не любит своих ближних, но из ненависти их убивает или кто среди бела дня присваивает чужую мебельную фабрику, выгоняет владельцев из дому и ни за что ни про что ссылает к белым медведям в Сибирь?»)<sup>18</sup>.

Along with the signs of the on-going tragedy in the novel "Don't Avert Your Face from Death" there is still an ironic connotation of the soviet power representatives. Hence, the unyielding Meilakh Blokh has been wounded twice in his rear that provokes his father-in-law to make a jeering remark: "So, Meilakh, do you now consist of only one buttock?" («Ты что, Мейлах, из одной только задницы состоишь?»)<sup>19</sup>. The deputy of the Mishkine department of NKVD, Aaron Dudak even in human's need to excrement "managed to discern a class aspect. How is it – some people are using a shabby outhouse in the yard, while others use a water closet tiled with china. No justice anywhere" («ухитрялся усматривать классовое начало. Как же – одни ходят в дворовый, скособочившийся сортир, а другие – в туалет, выложенный кафельными плитками. Нигде нет равенства»)<sup>20</sup>. Having arrived to the homestead of the Lithuanian Lomsargis, Povilas revels in power, listening to the sound of his own voice, enjoys his gestures of a superior. However, he is concerned not with

the interests of soviet power but he envies Elisheva who may become after Lomsargis' death a mistress of the good homestead. Elisheva's opinion of the new master of life is even more despising: she compares Genis who has drunk a glass of alcohol infusion to a drenched puppy.

In the novel "The Charm of the Satan" published in 2007, the representatives of the new power, soviet signs are devoid of the least ambiguity in the author's point of view.

## V. SPATIAL SIGNS OF THE SOVIET UNION

In the artistic world of the novel "The Charm of the Satan", spatial signs acquire special significance. The small world of Mishkine has become a pawn between two systems: that of Stalin and that of Hitler. This small provincial Jewish town is opposed to the vast space of Moscow, Siberia, Germany that appear in the novel in a mediated way, we do not see the spaces as such but their values and their impact on the small town.

The still life in Mishkine starts disintegrating with the ensuing soviet power: "Red Army entered Lithuanian in 1939 and in 1940 everything went upside down" («В Литву в тридцать девятом вступила Красная армия, и в сороковом все полетело вверх тормашками»)<sup>21</sup>.

The apprentice of the tailor Bankvecher, Aaron goes to Moscow that has become the "sacred land" for him. Having betrayed the old cemetery for the Kremlin and abandoned his job of a tailor, Aaron assumes a different mission – to change the world created by God. Aaron, having left behind his native, customary space of the small Jewish town, has not only changed a needle for a revolver but also frankness and openness to being able to lie and bypass. Danuta, not accepting any subterfuges from her son, gives a stern characteristics to his activity: "Hard as you may try to enforce justice by such means, you will only multiply sorrow and injustice in this world, my son" («Сколько такими способами не насаждай справедливость, ты только, сынок, приумножишь на белом свете горе и несправедливость»)<sup>22</sup>.

The space of the Kremlin makes Aaron lose his family and the memory of it. Aaron was very willing to boast of the success of those who replaced family for him, but Bankvencher "carefully took off from the envelopes the unfamiliar kopeck-worth stamps with either an image of a brave Red Army soldier in a pointed helmet demonstrating his heroic might to an imagined class enemy or a Stakhanovite weaver irradiating her happiness over the whole planet" («осторожно снимал с конвертов незнакомые, копеечного достоинства, марки, на которых красовались либо бравый красноармеец в островерхом шлеме, демонстрировавший свою богатырскую силу воображаемому классовому врагу; либо стахановка-ткачиха, озарявшая всю планету своим счастьем»)<sup>23</sup>. The old Jew is well aware of the "kopeck worth" of the new power.

The photographs sent to Aaron show those places in Moscow that must, according to him, become the new eternity:

<sup>17</sup> G. Kanovich, "Don't Avert...", p.181-182.

<sup>18</sup> G. Kanovich, "The Charm...", p.19.

<sup>19</sup> G. Kanovich, "Don't Avert...", p.96.

<sup>20</sup> G. Kanovich, "Don't Avert...", p.179.

<sup>21</sup> G. Kanovich, "The Charm...", p.92.

<sup>22</sup> G. Kanovich, "The Charm...", p.22.

<sup>23</sup> G. Kanovich, "The Charm...", p.106.

the Kremlin where is the residence of Stalin, the old friend of Blokh and all the workers around the world, the house where the eternally live Lenin is resting, the exhibition of the national economy, the metro. Aaron's description emphasizes his belonging to the Red Army (he is wearing a shoulder-belt and a field cap); he is proud of belonging to the space of the soviet Moscow.

After his grandson's death, Bankvencher reads to his daughter Aaron's letters and shows photographs. However, the words of love, laments of separation and longing are read by the old Jew not from the letters but from his memories. But his son-in-law Aaron, making career in Moscow loses ties with his family and home more and more and loses memory. Not in vain does Raizel ever touch the photographs, it seems to her that a totally alien man is depicted on them.

The tragedy of one family and house is gradually expanded in the novel.

The space of Moscow is related to the vastness of Siberia and stock-cars in which the undesirable for the soviet regime owners of houses were carried away.

The soviet power in the novel written by Kanovich in the soviet Lithuania is still juxtaposed to that of Hitler. Daniel who goes to ghetto (in the novel "Candles in the Wind") recalls how they welcomed the Soviet Union and the Red Army in the Jewish borough and notes: "Now there was no freedom at all but the Red Army was far from the borough" («Сейчас свободой и не пахло, а Красная Армия была далеко от местечка»)<sup>24</sup>. Swastika makes a bad impression on Daniel convicted to the ghetto, "completely unlike the sickle and hammer. People reap with the sickle and forge with the hammer. But what one can do with swastika?" («не то что серп и молот. Серпом жнут, молотом куют. А что делают свастикой?»)<sup>25</sup>.

In the novel "Don't Avert Your Face from Death", Elisheva ascertains that Stalin, though he does not exterminate Jews, is as great a rascal as Hitler. In the novel "The Charm of the Satan", Kanovich recurrently emphasizes the synonymic nature of the space of Moscow, Siberia, and Germany. The processes that had started in the soviet time were carried on by Germans who crossed the Nemuna in 1942. German airplanes drop a bomb on the furniture plant of Brukhis who was deported to Siberia. The echo of the blasting German explosive seems to resound in the vastness of Siberia.

Lomsargis, telling Elisheva about separation of the Jews of the borough from the other population and gathering them in the synagogue, notes that they are then sent to work either in Poland occupied by Germans or Germany, like it had been in 1940 with the affluent owners undesirable for the soviet regime. As the owner of the furniture plant had been deprived of his house by the soviets, now Lithuanians who are in the service of Germans are taking away the houses of all Jews in Mishkine.

Aaron is related with Zelyonaya roscha (the Green grove) where Jews had been massacred; according to his mother, he

had been conceived at this place. Aaron who has left the Jewish borough in Stalin's name and those who in Hitler's name are destroying the world in Mishkine taking away all Jews from there are united by a single space, that of death, they are charmed by the same Satan, disregarding the fact that in the given historical moment they are situated on different sides of the front.

The heroes, being aware of the affinity between the soviet and hitlerian power, place the representatives of both powers side by side. In the first days of the war Danuta reproaches the policeman Juozas: "Was it worth for you to learn the tailor's craft for so many years and then roam the streets with a rifle?" («Стоило ли тебе столько лет учиться шить, чтобы потом по улицам с обрезом шастать?»). His answer is: "And was it worth for your Aaron to wear out his pants sitting by the sewing-machine if now he escorts people to Siberia?" («А стоило ли твоему Арону у того же Банквечера за швейной машинкой штаны просиживать, чтобы людей в Сибирь вывозить?»)<sup>26</sup>.

A similar scene took place also during the arrest of the fascist collaborators Bankvecher and his daughter. Raizel asked her father to keep silent and not to humiliate himself before Juozas and his partner because "their ears are plugged by the devil" («дьявол им уши заткнул»). According to the policemen, that same devil was plugging the ears of Aaron "when he was arresting the people" («когда тот людей арестовывал»)<sup>27</sup>.

The master of the homestead Lomsargis, fleeing the new masters of life stops on the crossroads where the beggar of the borough is waiting for Messiah. Semyon summons Lithuanians to stand by him on the road and wait because, as he thinks, Messiah does not come because everybody is waiting separately. Semyon remains on the crossroads alone because, as the Lithuanian peasant says, "in the times of ignorance it is impossible to be waiting together. Only separately. And everybody has his own Messiah. Some have Hitler, some have Stalin, some have the devil with horns" («в неразумные времена ждать вместе невозможно. Только врозь. Только врозь. И у каждого свой Мессия. У кого – Гитлер, у кого – Сталин, у кого – черт рогатый»)<sup>28</sup>. Stalin, Hitler and the "devil with horns" arranged in one line put both the closed space of Mishkine and the whole world under the sign of destruction.

Novels of borough by Kanovich register the destruction not only of a Jewish borough. Soviet signs are a projection of a big historical world succumbed to the Satan's Charm before World War II. The on-going historical tragedy and the consciousness of the man of a particular epoch are represented by Kanovich in his novels through the system of images, among which soviet signs stand out as rather significant, in the last novel of the trilogy they are synonymic to the signs of Hitler's Germany.

<sup>24</sup> G. Kanovich, "Candles...", p.357.

<sup>25</sup> G. Kanovich, "Candles...", p.480.

<sup>26</sup> G. Kanovich, "The Charm...", p.46.

<sup>27</sup> G. Kanovich, "The Charm...", p.126.

<sup>28</sup> G. Kanovich, "Don't Avert...", p.249-250.

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# F. J. Gerstner and Stereotomy of Arch

## Reflection of Structural Mechanics in Stereotomy of Arch

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**Abstract** — Stereotomy was a very important construction technique from the very beginning of structural engineering to the 19th century. Most of the time it was considered as a matter of geometry. F. J. Gerstner showed that stereotomy is also a matter of structural mechanics.

**Keywords** — *stereotomy; vault; structural mechanics of arch; history of structural mechanics; history of technology; Gerstner; thrust line*

### I. INTRODUCTION

Stereotomy is an authentic record in a building structure, it is a kind of its builders handwriting. Ancient *pontifex* or *principalis artifex* or medieval *magister operis* or *magister lapidum* was the person directly responsible not only for the whole building process, but also the person responsible for an adequate strength and stability of the whole structure. And it is very likely that it was he who determined stereotomy of critical structural elements. In this paper, we are looking for the rules that were used to construct stereotomy of arches and for a contribution of F. J. Gerstner to this field.

### II. STEREOTOMY AND STRUCTURAL MECHANICS IN PRAGUE

Basis for the development of advanced numerical and analytical methods for the calculation of load capacity and stability of structures are given by the turn of the 17th and 18th Centuries, when independently Gottfried Wilhelm Leibniz and Isaac Newton laid the foundations of infinitesimal calculus.

Just a few years earlier, Robert Hooke, who discovered - inter alia - the law of elasticity of material, indicates the ideal shape of arch as an inverted catenary<sup>[1]</sup>, transcendental curve which mathematical expression using differential calculus found a few years later brothers Jakob and Johann Bernoulli. And about the same time, Amédée François Frézier, Savoy architect and military engineer, published (already using infinitesimal calculus) his comprehensive work in the field of stereotomy<sup>[2]</sup>.

Later in Bohemia (Czech Republic today) stereotomy and structural mechanics intermingled for more than one century. A significant benefit in both of these fields brought from the late 18th century Franz Joseph Gerstner, prescient reformer of Prague polytechnique. In 1869 the legendary professor Josef Šolín, who lectured and published important works both in the field of structural mechanics, elasticity, and in the field of stereotomy, became the first professor of structural mechanics

at the Czech-language part of Prague polytechnique. Stereotomy was taught also by another important structural engineer, professor František Klokner, student of Šolín and a founder of Research and Experimental Institute of Materials and Building Construction in Prague, one of the oldest in Europe. And a world-known Czech structural engineer Zdeněk Bažant was in 1917 appointed a full professorship just in the field of stereotomy<sup>[3]</sup>.

Stereotomy is a technique that solves the tasks of building structures (walls, arches, stairs, etc.). It studies how to cut material into pieces of exact shapes and how to put these pieces together to get required object. It includes various materials processing (e.g. cast-iron, wood... ..and stone). Stereotomy is seen as a precursor or as a special part of the later descriptive geometry. But as the example of the Czech ambience shows, stereotomy is also a matter of structural mechanics.

### III. BEGINNING OF STEREOTOMY

The oldest stone arches have been found in the ancient Egyptian first Dynasty, approximately in the middle of the 4th Millennium BC. Though these vaults are not very sophisticated we can talk about stereotomy cautiously already here. Later period, as exemplified by Sabef mastaba chapel in Gizeh (6th Dynasty, about the middle of the 3rd Millennium BC) and the graves of queens in Dahshur (12th Dynasty, about the beginning of the 2nd Millennium BC)<sup>[4]</sup>, however, we can mark already clearly sophisticated in terms of stereotomy. The stones were purposefully processed before inserting into the vaults – we can find functional stone keys in their shapes [see IV

Another interesting period which should not be overlooked in this short outline is the full development of a key stone structure, which some authors place in the Greco-Roman cultural ambience and date back to the turn of the 3rd and 4th Centuries BC. And in this ambience, approximately in the middle of the 1st Century BC, comes probably the oldest written note about stereotomy of arch. It is a description in chapter eight, paragraph 3 and 4, in the sixth book of the Ten Books on Architecture by Vitruvius Polio. Vitruvius states in paragraph 3: "... We must also manage to discharge the load of the walls by means of archings composed of voussoirs with joints radiating to the centre..." and in paragraph 4: "... Likewise in houses where piers are used in the construction, when there are arches composed of voussoirs with joints radiating to the centre..." Vitruvius raises questions even about the mechanics of vault and about influence of stereotomy to it:

"... when the wedges, under the pressure of the load of the walls, begin to press along their joints towards the centre, and thus to thrust out the abutments..." (ibid.)<sup>[5]</sup>. Although his conclusions were incorrect statically, they were followed for many centuries<sup>[6]</sup>.

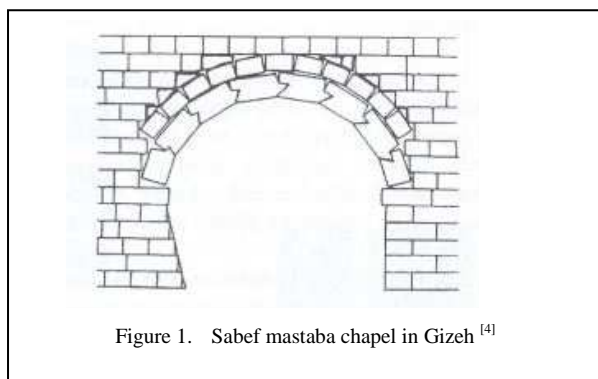


Figure 1. Sabef mastaba chapel in Gizeh<sup>[4]</sup>

#### IV. STEREOTOMY AS A TECHNOLOGICAL INNOVATION

Best Roman architects and engineers knowledge, ancient stone building traditions of the Syrians and specific requirements of military engineering led stereotomy to its late antique peak, which is found in early Christian Syria. From there, in the very beginning of the Middle Ages, spread the art of stereotomy back, both to the Latin part of Europe, to Byzantium and to just emerging world of Islam<sup>[7]</sup>.

As already mentioned by Viollet-le-Duc, the strongest impulse for transmission of stereotomy from the Middle East to the West were done probably during early crusades, when a dramatic change in the structure of the most distinguished buildings first in France and later in other parts of Europe occurs. Thanks to mastered technology of stereotomy the earlier massive walls and vaults of rubble masonry were replaced with energy-saving skeletons made of precisely manufactured components and voussoirs, which later allowed even a flying vaulting. And at this time we can find another evidence of the rule according to which the stereotomy of arch and vault was solved. This is a folio from the Sketchbook of Villard de Honnecourt (the first half of the 13th Century), which shows stereotomical construction of a double semicircular arch with a hanging bolt. Note the same prescription of joints led to the center of arc as in Vitruvius. [see IV

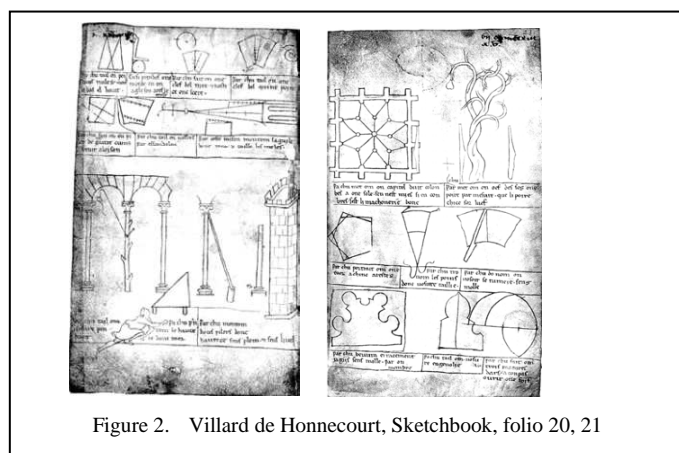


Figure 2. Villard de Honnecourt, Sketchbook, folio 20, 21

#### V. STEREOTOMY FROM GEOMETRY TO MECHANICS

In the age of Renaissance Vitruvius was rediscovered - not only emerging theoretical treatises or architectural designs inspired by antiquity, but even actual construction details including stereotomy can show how much was Vitruvius after 15 centuries accepted again.

A breakthrough achievement from the perspective of history of stereotomy was the work of Amédée François Frézier who published in 1737-1739 the aforementioned three-volume set summarizing essentially all contemporary knowledge about stereotomy. According to Frézier stereotomic lines should be lead perpendicularly to the intrados curve. This solution was important mainly for various types of compressed or upward arches and was also a practical tool for direct stereotomic measurements. Gaspard Monge thanks to his previous long years practice in stereotomic models of vaults invented a rectangular projection on two perpendicular planes<sup>[8]</sup>.

Charles Coulomb, Giuseppe Venturoli and François de Nieuport<sup>[9]</sup> applied stereotomy as a geometric tool for solving statics of arch. Even though they were very close to the right solution, they still did not realize that stereotomy itself is a matter of structural mechanics<sup>[6]</sup>.

What is significant for all this historical development: stereotomy was applied as a geometric solution.

Qualitatively different view on stereotomy of arch brought Franz Joseph Gerstner in the late 18th Century. Gerstner defined a thrust line of a vault<sup>[10]</sup> as a function of shape and load and he noticed that the ideal direction of stereotomic planes is their perpendicularity to this thrust line [see IV Gerstner realized that this is the ideal position of the stereotomic plane in which a zero cohesion with no influence on stability of arch can occur. Gerstner found a solution of stereotomy of arch which structural engineers felt but did not see for several millennia.

V. Ihre Seitenflächen  $r$   $r'$  sollen auf alle Wölbungslinien, die durch ihre Dicke hindurchgehen, senkrecht seyn. Hierzu wäre zwar nöthig, daß diese Seitenflächen selbst nach einer krummen Linie gehauen würden, ihre Länge ist aber selten so beträchtlich, daß diese Krümmung von einer geraden Linie merklich unterschieden wäre.

Figure 3. F.J.Gerstner: Einleitung in die Statische Baukunst, 1789<sup>[4]</sup>

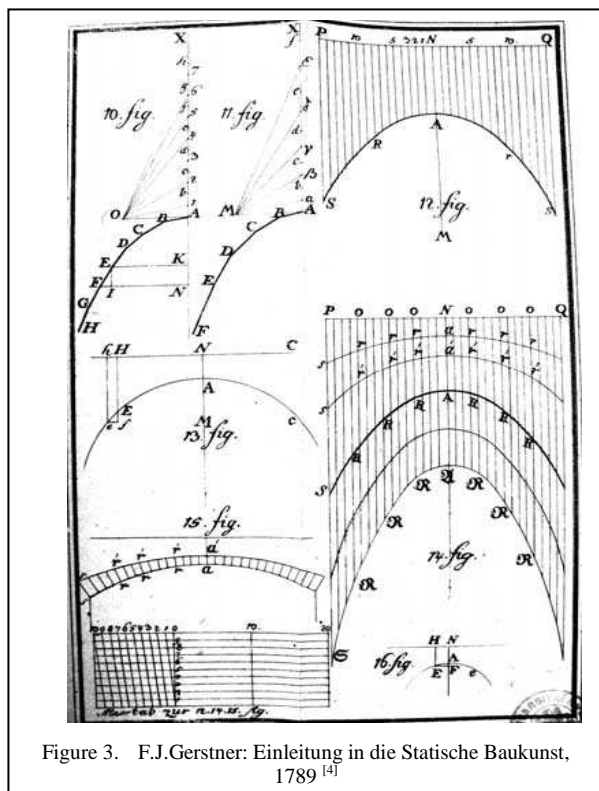


Figure 3. F.J.Gerstner: Einleitung in die Statische Baukunst, 1789<sup>[4]</sup>

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# SECTION 10.

*Linguistics*

# English and Romanian Abbreviations

## A Challenge for Translators

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**Abstract-**Acronyms, initialisms or simply abbreviations may seem insignificant in the field of lexicography. Acronyms and initialisms are frequently used in medical, economic, law, engineering texts and in many other different domains. The objective of this research is to analyze the problems related to the translation from English into Romanian of different acronyms and initialisms. Also it examines both the formulation of English acronyms and their reformulation into Romanian; it highlights the challenges they pose to the translator and how those challenges can be surmounted.

**Key words:** *acronyms, initialisms, abbreviations, translations, translator*

### I. INTRODUCTION

Translation is a complex process where a fragile balance is achieved between the equivalence of the text translated and the linguistic means chosen. “The fidelity/treachery rate, which along the years was the subject of many writings and brought many translators on the edge of desperation, sometimes pushing them up to craziness, is now de-dramatized by an operation of removal. Fidelity does no longer tie directly the original text to the target-text, and treason is justified by translation strategies that no longer impose compulsory conformity with it.” [1]

Abbreviations can cause many difficulties during the translation. First of all despite the history of translation originates since ancient times when people needed to communicate with people from different communities, abbreviation is a comparatively new linguistic phenomenon and thus its translating is not well studied yet. This phenomenon perfectly reflects the spirit of our times, when there is a need to transmit much information during the shortest period of time.

Abbreviations are formed by certain patterns and knowing these patterns can greatly simplify the process of translation. Abbreviations mostly occur in scientific and journalistic styles, where ambiguity and uncertainty are not accepted. They mostly occur in the names of organizations, associations, committees, etc.

### II. METHODS AND MATERIALS

Translation of abbreviation consists of the process of reformulation of abbreviation from one language to another. The process of reformulation consists of several steps. First of all it is necessary to interpret each word, which constitutes abbreviation. The order of words can be changed after translation. New initials can be completely different and abbreviations can have absolutely nothing in common in

different languages. It is also necessary to remember that not all the words are abbreviated in all languages. There are combinations of words that make the abbreviation in one language but are translated like several separate words in another. These easy steps help to deal with abbreviations of any difficulty.

In addition, there are special vocabularies of abbreviations, which contain the most widely used abbreviations and their translations. Such vocabularies can greatly simplify the process of translation. In translation of abbreviations it is very important to know the culture and history of the country of the source language. In translation of abbreviation this knowledge is more important than being familiar with the culture of the country of target language. For the professional translation of abbreviation translation should be aware of all changes in the cultural, political, economic and social life of the country of the source language. To translate abbreviations in this way will be much easier and context is very important in this case.

Some acronyms have the same letters in both English and Romanian but not in the same order. For instance we have AIDS: SIDA, EU: UE, etc. The reason for this can be explained by the translation technique of transposition which has to do with the replacement of one grammatical unit or part of speech by another. This is inevitable since the grammatical structure differs from language to language. This difference is particularly highlighted in the position of adjective as regards Romanian and English languages. Whereas in English, qualifying adjectives always precede their nouns, it is the opposite in Romanian except for a few but frequently occurring adjectives. This explains why we have the following acronyms:

EU (European [adjective] Union [noun]) — UE (Uniunea [noun] Europeană [adjective])

IMF (International [adjective] Monetary [adjective] Funds [noun]) — FMI (Fondul [noun] monetar [adjective] internațional [adjective])

From the above, it can be noted that the words involved in the two languages are similar, which explains why the same initial letters occur in the acronym translation. On the other hand, the grammatical rules of the two languages mandate a different order of nouns and adjectives.

This form of translation could be regarded as reformulation of abbreviations of one language to another. In most cases the order of initials change due to difference in the grammatical structure of the languages involved; e.g. UNO (ONU).

Following the above mentioned categories, there are two short lists of common international acronyms, especially those from international institutions, and not leaving out acronyms of interstate and private person organization and those of multinationals. Also, in this stage of modern InfoTech, this vocabulary would not be complete without some internet acronyms. They are categorized in two groups: inversion of order of letters and borrowed acronyms.

The following list of abbreviations shows *the inversion of order of letters*.

TABLE I.

ENGLISH	ROMANIAN
AIDS - Acquired Immune Deficiency Syndrome	SIDA - Sindromul Imunodeficienței Dobândite
V.A.T. - value added tax	TVA – Taxa pe valoarea adăugată
IAEA - International Atomic Energy Agency	AIEA - Agenția Internațională pentru Energie Atomică
IGO - Intergovernmental Organization	OIG - Organizație Interguvernamentală
IMF - International Monetary Funds	FMI – Fondul Internațional Monetar
IMO - International Maritime Organization	OMI – Organizația maritimă internațională
ESCB - The European System of Central Banks	SEBC - Sistemul European al Băncilor Centrale
ITU - International Telecommunications (Union)	UTI - Uniunea Internațională a Telecomunicațiilor
NGO - Non-Governmental Organization	ONG – Organizație non-guvernamentală
OECD - Organization for Economic Cooperation and Development	OCDE - Organizația pentru Cooperare și Dezvoltare Economică
UN - United Nations	ONU - Organizația Națiunilor Unite
OIC - Organization of Islamic Conference	O.C.I. - Organizația Conferinței Islamice
EMU - Economic and Monetary Union	UEM - Uniunea economică și monetară
WHO - World Health Organization	OMS - Organizația Mondială a Sănătății
WCO - World Customs Organization	OMV - Organizația Mondială a Vămirilor
IAEA - International Atomic Energy Agency	AIEA - Agenția Internațională pentru Energie Atomică

*Borrowed acronyms* are the acronyms that are identical in the two languages: English and Romanian. These occur for the same reason that brings about the use of borrowed terms or loan words generally.

The issue of borrowed terms may be explained through one of the techniques of translation. Borrowed words usually arise from language contact of various linguistic communities. This may be due to wars, colonization, trade, etc., or for a need to maintain originality or local nuance of the SL text in the TL text or for simple stylistic reason which is the case with journalists. And at times it is simply the case of a weaker culture being subsumed by the stronger one. This is the case with most of the modern IT acronyms. That is why in Romanian we have acronyms such as FTP, CD-ROM, electronic mail or e-mail, even though the acronym poștă electronică, mesaj or corespondență (for e-mail) exists in Romanian.

TABLE II.

ENGLISH	ROMANIAN
I.D.A – International Development Association	I.D.A. – Asociația internațional de dezvoltare
IUPHAR – International Union of Pharmacology	IUPHAR – Uniunea Internațională de Farmacologie Fundamentală și Clinică
NATO – North Atlantic Treaty Organization	NATO – Organizația Tratatului Nord-Atlantic
ICAO – International Civil Aviation Organization	ICAO – Organizația Aviației Civile Internaționale
NASA – National Aeronautics and Space Administration	NASA – Administrarea Națională a Aeronauticii și Spațiului Cosmic
LASER – light amplification by stimulated emission of radiation	LASER – amplificarea a luminii prin stimularea emisiunii radiației
UNICEF – United Nations International Children's Emergency Fund	UNICEF – Fondul Internațional pentru Urgențe ale Copiilor al Națiunilor Unite
WIPO – World Intellectual Organization	WIPO – Organizația Mondială a Proprietății Intellectuale
IARC – International Agency for Research on Cancer	IARC – Agenția Internațională de Cercetări în domeniul Cancerului
INTERPOL – International Criminal Police Organization	INTERPOL – organizație internațională de cooperare a forțelor de poliție
CDROM – Computer Disc/Read only Memory	CDROM – Compact disc
www – World Wide Web	www – rețea mondială
FTP - File Transfer Protocol	FTP - Protocolul de Transfer al Fișierelor
DVD - Digital Video Disc or Digital Versatile Disc	DVD

It is often said that some of the essential qualities of a good translator are: sound knowledge of his working languages and general knowledge. Furthermore, it is recommended that the translator should work into his mother tongue or first language. In fact this is a prerequisite for gaining employment into international organizations. This implies that the translator is deemed to be naturally more fluent in his first language which is supposed to be the language of his immediate environment for his formative years. Meanwhile, regarding translation of abbreviations to borrow the expression of E.B. Sgarbossa in her article in 2005 August edition of the *ATA Chronicle*, the "source language may turn out to be the source of trouble." [2]

As mentioned earlier, abbreviations often stand for names of organizations, associations, and educational institutions. Mastery of the language of the target text may not be as important in this case as familiarity with the source-language culture. Abbreviations of multinationals would be easily comprehensible to an Anglophone American translator, but as they should be translating into Romanian he would be confronted with abbreviations which are promptly discernible to a Romanian translator. The difficulty is even higher with abbreviations of multinationals.

In spite of the cultural issues, to deal with problems of abbreviations a good translator must have the latest information worldwide at his disposal, through reading of newspapers, journals, international magazines, the consulting of which has been facilitated by the Internet. And of course while on the job, there are also popular online dictionaries to get around the complex task of translating acronyms,.

Another useful tool for the translator to have at his disposal a glossary of abbreviations of the subject field he is working

on. In some cases; the translator may also have to consult his client or the author or the source text for more clarification of the terms.

### III. CONCLUSIONS

‘Translations are of common interest, as they imply communication between people of different languages. Nowadays, more often than not, everywhere we go, we get in contact with foreigners and interpreting or translation is the means by which we communicate with them, if we cannot speak the same language. The multicultural world we live in brings new challenges for the translator giving him/her several possibilities of offering a reliable translation.’ [3]

In this era of globalization, the issue of translating acronyms is becoming less emphasized due to the constantly widening vocabulary, thanks to the modern information

technology. We are being faced with a deluge of new acronyms daily and before these get officially translated from English into Romanian, the Romanian speaker is already using the English acronym and is used to it.

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# SECTION 11.

*Ecology*

# Ecology and ethics: landscape architecture and sustainability

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**Abstract—** The present articles aims at analyzing the ecological dimension of the landscape in the context of the integrated and vast perspective of Landscape Architecture, which ethical vision considers the landscape both as a holistic system, living and dynamic, in constant transformation, and as a good of natural and cultural origin to be preserved. Through the thoughts of different authors we develop a reflexion on the consideration of ecology and culture as a foundation of the intervention in the contemporary landscape. In the context of the changeable dynamics typical of contemporary landscape, the intervention is based on sustainability principles, within of an ethical responsibility that seeks the long-term development of both Nature and Society.

**Keywords-** ecology, culture, ethics, landscape, landscape architecture, sustainability

## I. INTRODUCTION

The human activities develop systematically, cumulatively and continuously over the Earth, for thousands of years, producing significant alterations in its face. From this transformation process of the territory results the construction of the landscape. This happens, apart from the direct action of the Nature, directly from the human action over the ecological matrix aiming at the transformation of the natural ecosystems, in the sense of effectively using the resources and it is, implicitly, influenced by its culture. Meanwhile, while it increased the rhythm, the scale and complexity of the human interventions over the territory based on a short term sight and in the search for a quick return, we have been witnessing a progressive landscape and environmental degradation. This translates into situations that jeopardize the physical stability of the landscape, its ecological integrity, cultural identity and economical sustainability, as well as the quality of life of Man himself and his perspectives of the future. In the context of the last decades, of intense development and quick degradations, it is necessary to adopt and consolidate a new model of relationship between Man and Nature. When equating this new model, it is fundamental to consider two important questions. On the one hand, to understand the contribute and the role of ecology in the context of the emerging currents or philosophical attitudes. And, on the other hand, using the thoughts of several authors to frame the contemporary landscape intervention on the assumption that, based on an ethical commitment in the context of a new morale, it will provide socially and environmentally sustainable landscapes.

## II. ECOLOGY AND LANDSCAPE: NATURE AND CULTURE

From the decade of 1960 upon considering the development of knowledge on ecology of which the systemic and holistic thought integrates, Landscape Architecture abandons a predominantly anthropocentric vision and starts to present a more ecocentric attitude, in the sense of making proposals for a bigger integration between man and the environment [1]. This change of attitude reveals the adoption of an ethical positioning that is manifested in the attribution of intrinsic and moral value to the harmonious relationship of Man with Nature, in the context of an idea of a new landscape philosophy which principles aim at framing and new kind of relationship between society and environment.

For the current systemic vision that covers the relationship of man with the territory, defended by the emerging environmental paradigm that regulates itself by an valuing philosophy intrinsic to Nature and of an ethics of life in harmony with it, it is determinant the contributions of a vast group of studies of distinct authors.

While other sciences isolate the context of their object of study, ecology appears as a scientific subject in 1866 and is considered by Morin as the first «new science», systemic science by definition, it considers the inter-relationships between all components be it physical, biological or social entities [2]. So ecology studies the interactions between organisms and between them and their environment, including Man in both cases [3]. In this sense, ecology necessarily contributes for the “communication” between nature and culture, given that it is the first time that a science, and not a philosophy, deals with the problematic of the relationships between humanity and nature [4].

Relationships that the interdisciplinary and holistic approach of landscape ecology considers, to be in the basis of the concept of landscape, which definition points to the interaction between human and natural factors [5]. In this sense, the landscape is considered as a complex and dynamic system where the different natural and cultural processes interact and evolve together, being subject to permanent transformations [6]. So the global comprehension of the landscape demands a global approach that integrates its several dimensions: (i) sensory, connected to the way the landscapes are appreciated by the populations; (ii) the socioeconomic, relative to the social factors and the human activities that

continuously construct and alter the landscape; (iii) the cultural, correspondent to the historical factors and identity values; and (iv) ecology, that includes the physical and biological components of the ecosystems [7]. A perspective that determines the way to address this huge societal challenge of altering the direction of land transformation to provide a hopeful future, three key components are presented: (i) the science of ecology, (ii) design and planning, and (iii) culture and ecology in landscape design [8].

### III. SUPERFICIAL AND DEEP ECOLOGY OR CONSERVATION VERSUS PRESERVATION

According to the evolution recorded in the environmental and cultural paradigms, the understanding and the approach of the problems and its environmental issues in a social perspective, it considers since the beginning the appearance of two differentiated currents, although sometimes hard to distinguish and that Naess conceives as Shallow Ecology – relative to a conservationist attitude, and other defined as Deep Ecology – related with a preservationist position [9].

The first of these currents considers nature as a resource which conservation is understood as a means to improve its utilization by man. Without assuming the attribution of a value intrinsic to nature, the conservationist approach has as a main objective to avoid its degradation protecting man of the negative consequences that may result, guaranteeing its safeguard for the future generations.

However, this attitude of resource conservation and economical growth based on management rules, by allowing the manipulation of nature by man in the never-ending search for more and better comfort and a superior lifestyle, it seems to compromise, from a certain moment, its own survival.

As an antithesis to the dominant paradigm in the western culture, based in the common individualist and liberal conception of society which nuclear values support themselves in economical growth, in control and domination of nature, and in the right and capability of man to utilize the natural resources to achieve his ends, a second philosophical proposal is developed by Naess, Deep Ecology.

For this, they happen beyond the specific nature of the ecological science, that we had the opportunity to analyze, a new sociological conception proposed by Durkheim, based on the understanding of society as a holistic, collective, caring and organic entity [10]. What takes Bertran to consider that if we substitute the morale as social discipline by morale as ecological discipline and consequently the social system by the global ecosystem, we start to understand nature as a collective good (not only of the social community but also of the biotic community), a perception that we deem decisive in terms of morality [11].

### IV. ECOLOGY AND ETHICS IN THE CONTEXT OF LANDSCAPE INTERVENTION

It is in the context of the new organic social morale and of recent relational science that starts to analyze the development of the preservationist current.

Based on an ecocentric position of resource preservation, of intrinsic valuing of Nature and the acceptance of the environmental ethics, the deep ecology seems to represent, currently, the maximum degree of ecological conscience.

It is from the contributions of Marsh (1864), Muir (1892) and Leopold (1949) that, in a first phase, this approach develops.

Perkins Marsh in his work «Man and Nature: or Physical Geography as Modified by Human Action» draws attention to the fact that human actions, seemingly insignificant, are cumulative and produce through time deep and noxious transformations in the natural systems.

Muir, responsible for the constitution of the second National Park in the United States of America and founder of the Sierra Club (one of the most important defense and environmental protection mechanisms of that North American country) is responsible in the consideration of interdependence and inter-connection between the natural phenomena that occur in the Universe.

In turn, the importance of Aldo Leopold's work relates with the proposal of application in the context of ecology of the concept of ethics analyzed in philosophy. This author states that there is a lack of ethical commitment in the relationships of man with the planet Earth and with the other living beings. Upon seeing that the relationships of Man with Nature are strictly economical and based exclusively in getting privileges, he warns to the fact that changes in the moral conduct necessitate social alterations, and so he defends the rights of the ecosystems and the land ethic in one of the chapters of his most important work entitled «Thinking like a Mountain». In it he formulates his biotic community theory and the fundamental theory that can be resumed as follows: an intervention is suitable when it intends to preserve the integrity, the stability and the beauty of the biotic community, being considered erroneous when it manifests the opposite tendency [12].

This argument translates in a new orientation for the studies on the environment and the intervention on the landscape is still valid nowadays.

With this author, the vision of the Universe as a complex machine which parts are divisible and analyzed separately is substituted by the vision of the world as a living organism which elements are inseparable and integrated in a whole, formulating this way a true holistic theory.

In this sense, ecology, understood as the philosophy of nature, has an organic and holistic essence based on the idea that the cosmos is a unit that grows and develops from the inside as an integrated group, with a structure and a function.

Ian McHarg is another fundamental author to the development of this approach, upon considering complicity and cooperation between Man and Nature, and ecology as harmony between the social systems and the natural systems. In his work «Design with Nature» he proposes the understanding of the Earth, in its whole, as a dynamic ecosystem that integrates both the processes and the biophysical factors as well as the anthropic ones, and which knowledge is indispensable for the correct implantation of the human activities, through human

ecological planning preserving spaces of bigger environmental value and identifying both limitations and the opportunities of potential uses [13].

As Steiner et al. (2000) refers, the central theory of McHarg consists in the consideration of ecology as a foundation of the arts disciplines that intervene in the landscape through planning and designing [14]. For that it is necessary an “agreement” of philosophical, ethical and aesthetic character, between the men, that stops the destruction of the planet, given that the method of interpretation and intervention in the landscape, introduced by McHarg, is based in the understanding of the processes that configure the landscapes, using them as a foundation of the intervention.

The referred author continues in the decades of the eighties and nineties of the XX century to maintain as a central theme of his work the importance of ecology in the landscape's planning and design. In his last works he approaches the planning of ecological and human basis, considering that the interaction between the natural and cultural systems belongs to the dynamics of the ecosystems and affects, lastly, the behavior, the well-being and health of both Society and Nature [15].

From this perspective, McHarg, by claiming that the domain and conquest should be eliminated as a biblical commandment in what concerns the relationship of Man with Nature, and adding that we should feel part of the ecological relationships, approaches the essence of deep ecology. Given that it defends the need for a new social and moral philosophy, by putting the human being in the same plan as all other living beings, it considers it as an integrating part of Nature and not as a superior being.

In the development of this idea, coining it in 1973, Naess introduces, in 1984, the principle of self-realization and the principle of biocentric equality, according to which all entities of the biosphere are parts of an integrated whole, considered equal as to their intrinsic value. And consecrates the *Homeostasis* as the first moral law of nature, considering it as the model of an ethic of participation and integration under an essentially ecocentric principle [16]. This prudent approach focuses directly on the preservation of diversity, be it biological or cultural, which length should be considered an ethical responsibility.

Toulmin (1982) contributes decisively to the validity and the importance of integration between nature and culture, when considering that man should face the natural world as his true “home” assuming with it a relationship of respect and balance [17].

In this sense, and considering that there is no landscape in our planet that does not constitute a cultural heritage, it is recognized that the practice and the set of ethic principles proposed by deep ecology lean directly over the preservation of the biological diversity, but also cultural, as just referred.

The maintenance of biodiversity and cultural diversity, inserted in the context of “shared responsibility”, forcing man to guarantee the preservation of the multiple ways and varieties of life and culture (species, communities, habitats and the

ecological and social processes to which they are subject), is an ethical responsibility.

It is, indeed, a not only ecological vindication, but also social, ethical and political with the double objective of preserving Nature and, at the same time, to guarantee the best habitability for Man.

Apart from the objections it may create [18], this line of thought contains ideas and proposals that defend the integration between *natura* and *cultura* in the construction of landscapes that articulate and connect, coherently, the natural and artificial systems, attributing them an identical value.

These landscapes, constructed with respect for the pre-existing ecological and cultural structures, integrate them as parts of the concept of Humanity as one can understand in the approaches of Leopold, Fox and Naess.

Giddens, referring to the thought of the latter author, refers that the deep ecology underlines the interconnection character between nature and the human community, something, that the “primitive” cultures understood, but that modern civilizations abandoned [19].

This enunciated bases itself in the proposal of an ethic of land centered in nature as a whole, as explained by Leopold, and that Man, by considering and following it, goes from conqueror and master of the Earth, as a community, to its plain member and citizen, thus justifying the respect for the global ecosystem he integrates.

## V. CONTEMPORARY LANDSCAPE: ETHICS AND SUSTAINABILITY

In this sense, to intervene responsibly in the landscape, operating against the process of simplification, trivialization and speculation to which is currently subject, is to deliberate ethically and aesthetically over the surface of the earth, considering:

(i) the preservation and the protection of the biosphere and the values of the planet's biodiversity; (ii) the equilibrium between the needs of man and the natural and cultural resources, through the maintenance of the environmental equilibrium between use and abuse; and (iii) the production and construction of structures and elements of culture, in nature, based in a renewed conception that demands a more interactive vision between the new needs of the contemporary man (to produce, invent, enjoy, survive) and the respect for the natural space [20].

In this context, an ethical approach over the landscape, committed to the goal of enabling that, both in Nature as in Society, may develop in the long run. Reason by which, in the context of Landscape Architecture, the ethical responsibility is to construct landscapes, and create places where everyone may find inspiration, may relate, interact between themselves and the environment, considering that the inhabitants of the rural settlements, urban or suburban may benefit from the diversity and heterogeneity from both Nature, and the social groups to which they belong [21]. In this perspective, Folch (believes that the emerging moral order (a new and socio-ecologically advanced environmental morale) should count, in large scale,

with the values emanated from the systemic and holistic thought of ecology, fundamentally with the values of sustainability, considered as of vital importance to define a strategy of equity and of planetary solidarity at social and ecological levels [22].

More recently, in the context of the Iberian-American Symposium on environmental ethics and sustainable ethics held in Bogota, in 2000, the Manifest was elaborated by an ethic for sustainability.

This document considers that the concept of sustainability promotes a new nature-culture alliance and that environmental ethics orients the processes and social behavior aimed at the construction of a just and sustainable future for all humanity. In this perspective, it defines the ethics of sustainability as the ethics of life and for life, based on a new knowledge capable of understanding the complex interactions between Society and Nature [23]. So it defines landscape as a system that connects diverse ecological and cultural inter-related processes, presenting it as an extraordinary ecological connection between Mind and Nature. And, in the long run, as a manifestation of an emerging idea: the idea of cultural ecology based in the notions of global landscape [24] where the built space and the open space have identical value, and of new ecology [25] that when applied simultaneously over the urban, suburban, rural and natural spaces, structures itself over concepts as system [26], metamorphosis [27], space-time [in-depth] thickness [28] or dynamic ecological equilibrium [29].

The intervention in the contemporary landscape implies, then, a global vision on the territory, as well as a perspective of continuity, diversity and unity at the level of the urban ecosystem and natural and agricultural systems. Intervention that understands the group of actions and processes made according to the objectives of ecological sustainability that will guarantee the perpetuation in time of the resources and natural and cultural values that serve as a support to the social and economical development.

## VI. CONCLUSION

In the reflection made in this article on the importance of ecology and culture as a foundation of the contemporary territorial intervention, the systemic concept of landscape assumes an enormous relevance by integrating natural and cultural components, in the context of the integrated approach inherent to the theory and to the *praxis* of Landscape Architecture in which ecology is understood as harmony between the social and natural systems. Being sustainability one of the central objectives of the acts on the landscape, its dimension and ecological aptitude appears as a foundation of the process of planning and landscape design. And that requires an ethical commitment with the perpetuation of the cultural heritage that the landscape represents and of which depends the national identity, as assumed by the European Landscape Convention.

Only a landscape intervention based in an ethical responsibility of maintaining the biological and cultural diversity, in the context of a new morale, will provide social and ecologically sustainable landscapes.

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# Ecological Evaluation of the Achieved Level of Life Quality and Business Activity of Territories: “Price” for Raising the Well-Being of Population

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**Abstract** — The authors developed a method to assess people's quality of life from the environmental load. To analyze the effects of environmental conditions on the quality of life of individual administrative districts and regions of the Republic of Tatarstan, first we have assessed the level of individual well-being and environmental stress areas. In was based on the methodology of constructing composite indices. This resulted in the comprehensive indicators of habitat quality (KSO) and welfare (HPI). IP index shows the ratio between the level of welfare of the population and the level of environmental protection. We have introduced an innovative index to determine the so-called environmental "price" of the welfare of the population, this tool provides a direct opportunity to develop a system of measures of state influence on the ecological environment in order to optimize the socio-economic development of the territory. Assessment tool developed by the well-being of the population on the environmental load of the region can highlight areas of particular risk (in terms of the environmental component) for which you want to develop measures to improve the environment and balanced socio-economic development.

**Keywords-** *Environmental and economic well-being, Modelling, Quality of life, Innovative index*

## I. INTRODUCTION

Final aim of any progressive society development is creation of favourable conditions for long, healthy life of people, being problem-free in financial respect. Analysis of trends observed in changes in level and quality of life of the population permits to judge how efficiently the society manages to cope with this task.

Problems of scientific research into a complex of characteristics describing quality of life and health of population occupy a significant place in the present-day world. The latter fact is connected, in the first place, with a situation of a systems crisis formed in the domestic economy,

as well as with lowering of living standards, experienced by the major part of the population of our country. In this connection the problems of theoretical understanding and practical implementation of questions relating to complex assessment of life quality, health and well-being of population together with studying of factors forming and changing them under the transition economy conditions become especially urgent.

A whole complex of factors exerts influence on life quality and well-being of population of any region to this or that extent. The most important place among the abovementioned factors is occupied by social-and-economic and ecological, as well as institutional and medical-and-demographical factors, including various characteristics of financial welfare and health of the people and quality of surrounding natural environment.

Within the last three decades growth of interest in the problem of life quality has been connected with the fact that the society has realized global problems of modern times, as well as with requirements of international standards and European Union countries, established with respect to social-and-economic status optimization and economic potential modernization on the basis of innovation technologies, and also with Russia striving for becoming a full WTO member.

The necessity to quantitatively assess quality of life has arisen under the aforementioned conditions, with such an assessment permitting to obtain data about diverse living conditions of society members. However, the obtained data are not always able to become a basis for life quality management, and various methodological approaches to its quantitative assessment are pretty often used in different regions. In order to eliminate this shortcoming and obtain reliable comparable parametric values, the authors have introduced a new term, which hasn't been used before, along with its determination model, that is: "Population Well-Being Index".

Population Well-Being Index, in the authors' judgement, is a set of characteristics reflecting: favourable social-and-economic conditions; degree of the needs and interests system satisfaction for optimal life of individuals and separate social groups; state of health; quality of ecological system's components as a whole, with such quality ensuring that: various factors (social-and-economic, ecological, institutional, biological, chemical, physical etc.) have no detrimental effect on health of the people, favourable conditions are provided for their vital activity, and opportunities for further development of human potential of the present-day and future generations and sustainable society development exist.

Population Well-Being Index is included in the family of the notions of way, style, level, quality and cost of life of the people, which are close, but still not identical to it by content. Having features similar to that of the above mentioned notions, the offered Index is characterized by the following parameters as its main distinguishing features: public health index, representing systematizing factors of well-being and the most important value of human life; institutional peculiarities, ensuring optimal functioning of all spheres of human life; state of surrounding natural and artificial habitat, in which various factors have no detrimental effect and favourable and safe vital activity conditions are finally provided for population residing on the given territory.

Thus, there can be three aspects forming well-being of the population distinguished:

satisfaction of needs of the population (main group):  
labour, material, family, spiritual needs;

activity categories – main spheres of human activity:  
labour, daily chores, rest;

living conditions, including characteristics of social environment, surrounding natural habitat conditions and conditions of surrounding artificial (second nature) habitat created by the man.

## II. MAIN PART

To identify interrelations between these characteristics and estimate population well-being indices the authors have set the tasks to: pick out criteria describing problem-free residence of the people on the territory, calculate an integral index – the Population Well-Being Index, and perform econometric modelling of influence exerted by ecological factors on the offered Index.

To solve the problem consisting in determination of quantitatively measurable indicative indices of the population well-being, the authors, being based on integrated multivariate study, have picked out several blocks of factors, exerting the strongest influence on the level of well-being of the population residing on the given territory, namely:

- Population housing rate;
  - Rate of transport and communication facilities provision for the population.
- To quantitatively evaluate the population well-being by each block of factors we have determined indicative indices on the basis of the conducted research. Selection of criteria, required to form an integral factor (index) of the population well-being, has been made from the available statistical data base [1], [2], [3]. The system of indices doesn't contain expert indices or indices based on public inquiry results.
- Public health criteria:
    - Life expectancy, years;
    - Natality rate per 1000 inhabitants;
    - Mortality rate per 1000 inhabitants;
    - Infant mortality rate per 1000 children born alive.
  - Living standard:
    - Average monthly wage assigned to employees working in the sphere of economics, rub.;
    - Average per capita cash incomes to minimum of subsistence ratio, %.
  - Social sphere:
    - Provision of children aged 1 to 6 with places in pre-school institutions, places per 1000 children.
    - Quantity of schoolchildren per one teacher in municipal institutions of general education, men.
    - Specific share of full-time schoolchildren studying in state institutions of general education, who study in the second shift, as of the beginning of the academic year 2010/2011, % (negative index).
    - Specific share of students who have passed the Uniform State Examination (EGE) in the quantity of school-leavers of municipal institutions of general education, who have taken the unified state examination, %.
    - Quantity of hospital beds per 10 000 inhabitants.
    - Quantity of doctors per 10 000 inhabitants. 18. Paramedical personnel strength per 10 000 inhabitants.
    - Paramedical personnel strength in municipal health-care institutions per 1 doctor on the average, men.
    - Quantity of places in cultural and leisure-time entertainment institutions per 1000 inhabitants.
    - Quantity of books available in public libraries per 1000 inhabitants, thousand copies.
  - Consumer market of goods and services:
    - Retail trade turnover per capita, rub.
    - Volume of paid services per 1 inhabitant.

- Labour sphere:
  - Quantity of small- and medium-scale business entities per 10 000 inhabitants, pieces.
  - Level of registered unemployment, % of economically active population (negative index).
- Population housing rate:
  - Dwelling house introduction into service, sq.m.
  - Average housing rate, sq.m. of total floor space per 1 inhabitant.
  - Rate of transport and communication facilities provision for population:
  - Rate of the population provision with automobiles in private ownership per 1000 inhabitants, pieces.
  - Rate of the population provision with cellular phones and Internet-communication per 100 families, pieces.

Some of the abovementioned indicative indices are both of quantitative and quantitative-and-qualitative nature. They characterise some social aspects of the Russian economy development in a qualitative respect [4].

To solve the first task, consisting in comparison of the listed social-and-economic indices, included in calculation of the Population Well-Being Index determined for population residing on the territory of municipal entities, we offer to apply empirical approach, which is based on the index method of unification of indices having different dimensionality [7], well-known in statistics. This method permits to calculate an integral index – “Population Well-Being Index”. This Index can be used both for paired and multiple comparisons.

To get point ratings a range scale of real values is drawn up by each of the indices determined for all the regions. Ranges are determined on the basis of minimum and maximum values of this index. After that the ranges are divided into 100 equal intervals (with the view of a more detailed data analysis), where each interval corresponds to a certain quantity of points, equal to the interval number (from the 1st to the 100th). And namely the point rating sum, determined by all the indices of this region and derived in compliance with the 100-point calibration scale, represents the “Population Well-Being Index”. Indices can be drawn up by separate groups or sets of indices in order to more accurately evaluate individual aspects describing the state of affairs in the region.

In such a way, the Population Well-Being Index (PWBI), determined for this or that district as an index characterizing the level of well-being of the population residing in the given district, will be characterized by a sum of point rating values determined for indices chosen by us:

$$I_R = \sum_{i=1}^N P_i, \quad (1)$$

where  $i$  – index;

$N$  – number of indices in a set;

$P_i$  – point rating, corresponding to a value of the  $i$ -th index.

Thus, the Population Well-Being Index has been calculated in a step-by-step mode, which permitted us to rank municipal entities of the Republic of Tatarstan by the degree of problem-free residence on this territory [5].

Population well-being level has been estimated with the help of a scale given in Table 1.

TABLE I. POPULATION WELL-BEING INDEX EVALUATION

Characteristic of the Population Well-Being Index	Point sum
High (optimal)	71 and higher
Satisfactory	51 – 70
Insufficient	31 – 50
Low (arousing anxiety)	less than 30

To analyse the dynamic influence of ecological environment on quality of life of population residing in separate administrative districts and regions, as well as to analyse efficiency of work performed by administrations, governmental bodies and local self-government bodies, one has to fulfill the 2nd task of the research: calculation of an integral index of habitat quality (KSO).

The integral index of habitat quality (KSO) is measured in points and represents a design index. Its calculation is based on points-factor evaluation method. According to this method, indices of air, water and soil quality having different dimensionality are converted to points. Such a conversion permitted to get generalized parameters by an aggregate of indices characterizing the degree of ecological well-being in the Republic of Tatarstan.

Components of ecological system existing in municipal districts of the Republic of Tatarstan have been got by means of data averaging by habitat risk factors taken for the year of 2009. In such a way, “integral index of habitat quality” is a complex index, taking into account ecological load experienced by population residing on the given territory, which consists of pooled points-factor estimate of influence exerted by components of: air and water resources quality, land resources condition, vegetable world condition and condition of waste products and consumption residues handling system [6], [7].

There have been the following factors chosen as indices estimating habitat quality:

Volume of hazardous (polluting) substance emissions into the atmospheric air from stationary sources located on the territory of a municipal entity, thousand tons.

Share of used, neutralized waste in total volume of waste formed in the process of production and consumption in the municipal entity, shares (Used is an index of waste formed in the process of production and consumption in the municipal entity, with the deduction of used and neutralized waste, thousand tons).

Volume of hazardous (polluting) substance emissions into the atmospheric air from automobile transport registered on the territory of a municipal entity, thousand tons.

Volume of polluting substance emissions from stationary sources per capita, kg/man (negative index).

Share of polluted (untreated) waste waters in the total water disposal volume in the municipal entity, %.

Drinking water quality by sanitary-and-chemical and microbiological indices: specific share of special tests by sanitary-and-chemical indices.

Polluted waste waters discharge into surface objects, mln. cubic metres (negative index).

Share of disturbed lands in the municipal entity, %.

Share of collected and neutralized emissions of polluting substances in total quantity of polluting substances drawn off from all stationary sources located on the territory of the municipal entity, %.

Share of collected secondary material resources in total volume of formed solid household and industrial waste, %.

The index "Share of collected and neutralized emissions of polluting substances in total quantity of polluting substances drawn off from all stationary sources located on the territory of the municipal entity, %" was taken into consideration when calculating values of the index "Volume of hazardous (polluting) substance emissions into the atmospheric air from stationary sources located on the territory of a municipal entity". In a similar way, used waste recording implies partial inclusion of secondary waste. That is why, to avoid double counting, 3 factors haven't been picked out as independent ones for calculation of a consolidated index of habitat quality, but they have directly affected the result [8], [9], [10].

The procedure of determination of the consolidated index reflecting habitat quality is analogous to the previously described approach to identification of the Consolidated Population Well-Being Index. The primary statistical data used for calculation are given in Appendix 1.

Calculation of the consolidated index of habitat quality has been made with the help of a specially developed software product.

Level of ecological well-being of the population is estimated with the help of a scale given in Table 2.

TABLE II. POPULATION WELL-BEING INDEX EVALUATION

Characteristic of the Population Well-Being Index	Point sum
High (optimal)	71 and higher
Satisfactory	51 – 70
Insufficient	31 – 50
Low (arousing anxiety)	less than 30

### III. RESULTS

Simulation of the system of interaction between ecological environment and population well-being level has demonstrated The essence of the IP-index can be graphically depicted by means of drawing a bubble diagram, reflecting the KSO value along the x-axis for municipal entities and IBN values – along

direct relation between the factors considered. A population well-being level determined for the respective municipal district or city is higher in those areas where ecological environment level has maximum negative index values. In this connection a multi-factor model determining relation between IBN and ecological parameters displays a direct relation. This fact doesn't permit to develop a system of governmental influence on ecological environment in the Republic of Tatarstan.

In this connection it is offered to introduce a new index demonstrating correlation between IBN and KSO. The IP index plays the role of such an index. The IP index demonstrates correlation between the population well-being level and ecological environment development level  $IP = IBN/KSO$ . Lower IP index value is the evidence of a higher degree of well-being level dependence on ecological environment level. The higher is ecological pollution level value, the lower is IP index value.

A set of independent factors involved in IP model has comprised only those factors which produce adverse effect on habitat quality, so as to ensure an in-depth analysis of negative influence produced on relative well-being of population by ecology.

For instance, in spite of high values of life quality, income level and social-and-economic development indices in whole, the IP value for Kazan makes 2,03 points, while for Baltasinskiy district  $IP = 12,9$  points. Therefrom one can draw the following conclusion: large value of ecological pollution level significantly reduces return on funds and efforts invested in the district development, and consequently it is necessary, above all, to exert influence upon those territories of the Republic of Tatarstan, in which IP index has the lowest values. Decrease in KSO level will permit to increase IP level for this or that municipal district, provided that the population well-being index remains invariable.

The hypothesis of necessity to determine the level of ecological influence on ecological potential return index of the territory (IP) has been taken as a basis for a new multi-factor model. At the same time, this model permits to establish the degree of influence that the respective factor characterizing ecological situation exerts on IP. Such an advantage of the described method determines the direct opportunity to develop a system of measures of governmental influence on ecological environment with the purpose of IP optimization.

The considered approach permits to group municipal districts of the Republic of Tatarstan by the degree of optimal or, oppositely, nonoptimal correlation between the population well-being index and ecological pollution index. And namely in those areas where this ratio (IP index) has minimal value one has to exert influence upon ecological situation, in the first place. At the same time, the degree of such influence will be determined on the basis of a model establishing interaction between the IP index and ecological factors.

the y-axis. As we can see, the area formed in the coordinate system can be divided into 4 conditional quadrants, characterizing different degrees of a favourable social-and-

economic development of the population under the existing ecological load conditions. It's obvious that regions located in the I quadrant are in the best state, because, in addition to a high development level typical to it, it is also the leader by ecological situation indices (KSO point value is lower than an average point value). In contrast to the I quadrant, regions being in the worst state both in social-and-economic sphere and in the ecological situation aspect are concentrated within the bounds of the IV quadrant (for example, Sabinskiy district). Regions characterized by sustainable development were depicted in the II and III quadrants (above the diagonal line,

plotted with red colour) (and besides, the farther the region is from the origin of coordinates, the higher is social-and-economic development rate). Special attention should be paid to regions located in these quadrants, but below the diagonal line. In our opinion, a plan of measures, which will permit to improve ecological conditions and stabilize the existing situation, should be developed namely in these regions. It is so because real ecological indices characterizing the above indicated regions are not justified by the current population well-being level.

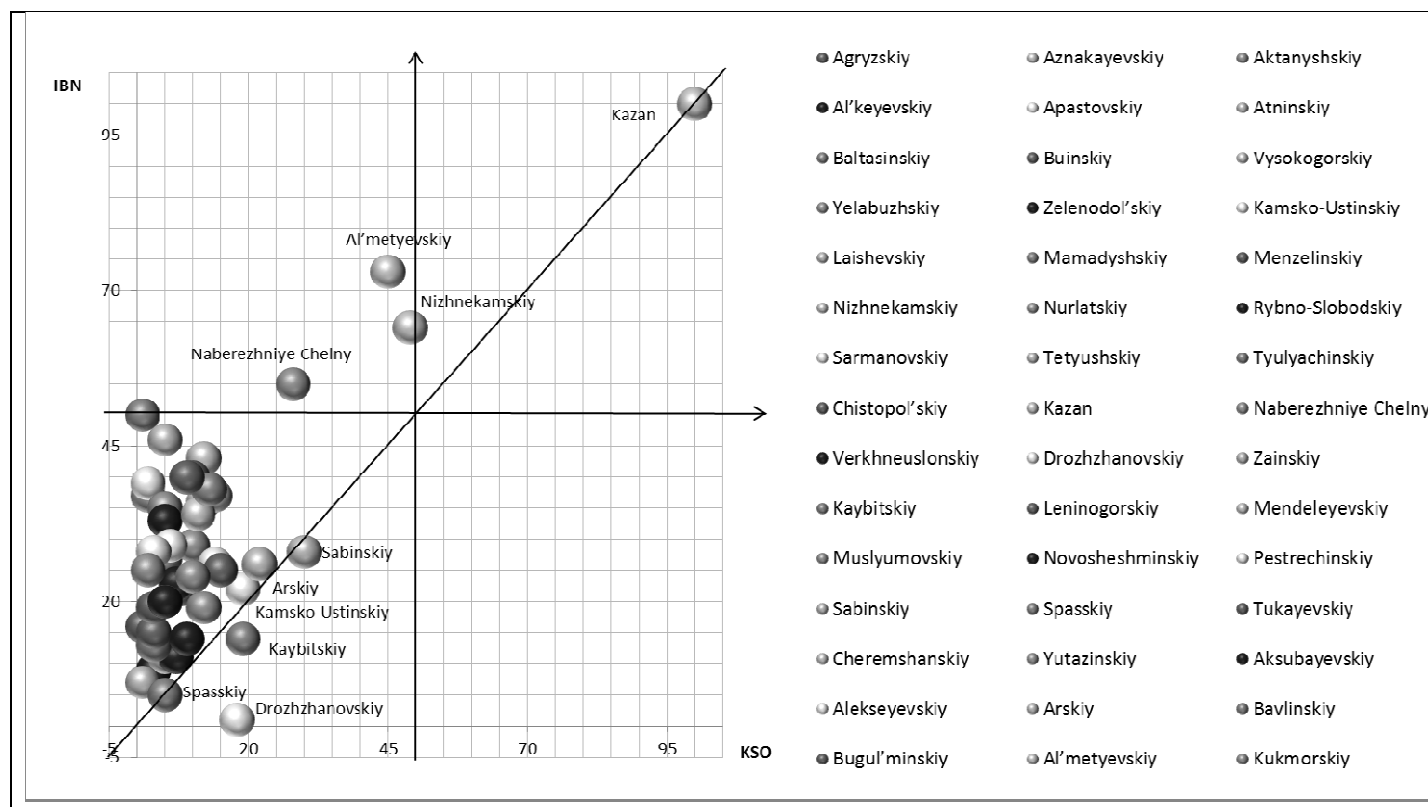


Figure 1. Matrix of the ecological and economic development

In this way, the developed toolset, destined to estimate population well-being relative to ecological load experienced by the given region, permits to pick out special risk zones (from the point of view of the ecological component), for which one should develop measures on ambient environment condition improvement and balanced social-and-economic development provision.

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# SECTION 12.

*Agriculture*

# Effect of Location and Physics-chemical Soil Traits on the Content of Different Iron Fraction in Pseudogleys of Western Serbia

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**Abstract—** This study was conducted on pseudogley soil having different physico-chemical characteristics. Soil samples were collected from tilled fields and meadows at six different locations in Western Serbia. Soil pH, cation exchange capacity, and the content of the finest soil fractions (powder, clay) had the highest effect on the distribution of different forms of iron in the test pseudogleys. The highest iron content was found in the residual fraction (V) (24,689 mg kg<sup>-1</sup> in tilled field soil, and 23,564 mg kg<sup>-1</sup> in meadow soil). Reductant releasable Fe occluded in oxides (III) was the second most dominant fraction in the soil (4,425 mg kg<sup>-1</sup> in tilled field soil, and 3,665 mg kg<sup>-1</sup> in meadow soil). The iron content of the soil organic fraction (IV) was low (270 mg kg<sup>-1</sup> in meadow soil, and 194 mg kg<sup>-1</sup> in field soil). The content of specifically adsorbed iron and iron bound to carbonates was low (2.18-2.73 mg kg<sup>-1</sup>), and that of Fe in the exchangeable fraction (I) was negligible, about 0.14 mg kg<sup>-1</sup>. The content of exchangeable, specifically adsorbed and largely oxidized iron increased with decreasing soil pH, CEC and sand content, and with increasing silt particle size. The iron content in the residual fraction increased with increasing soil pH, CEC, clay content, silt plus clay content, as well as with decreasing sand content. The concentration of residual iron was found to be significantly correlated with the clay content and clay plus silt content. The high positive correlation ( $r=0.72^{**}$ ) between the iron content in HF and HNO<sub>3</sub>, and that in the residual fraction (V) suggests a low level of iron available to plants in the test pseudogleys of Western Serbia. Therefore, the sequential extraction procedure provides a reliable estimate of the content and availability of iron in the soil.

**Keywords-** distribution; forms; iron; location; pseudogley; soil.

## I. INTRODUCTION

Pseudogleys cover significant areas of Serbia, accounting for about 285,000 ha or 78.73% of the total land area in Western Serbia [1]. These soils are found in moderately moist to moist climates, and they have disturbed water and air relationships characterized by an occasional decrease in very moist i.e. wet and dry phases. Therefore, this soil is

unfavorable for the cultivation of most plants. The unfavorable soil moisture regime is due to the compact lower Btg horizon which is poorly permeable or impermeable. Under dry conditions, the soil surface horizon undergoes intense desiccation, whereas the deeper impermeable horizon hardens. During the wet phase, reduction conditions occur in the soil, resulting in the reduction of different elements, primarily iron (Fe<sup>3+</sup> to Fe<sup>2+</sup>), manganese, etc. Since the wet phase is short, only more susceptible substances undergo reduction. During the dry phase, oxygen enters the soil, and oxidizes the substances that were reduced during the wet phase (Fe<sup>2+</sup> to Fe<sup>3+</sup>).

Pseudogleys are rather poor in alkalis, being medium to strongly acid in reaction. They have a highly unfavorable structure, and a low content of organic matter. The acid reaction of pseudogley, its low humus content, and a low supply with available phosphorus and potassium are limiting factors for higher crop yields [2].

Iron is one of the most common elements in the Earth's crust, ranking fourth in abundance after oxygen, silicon and aluminium. In the soil, iron forms a variety of minerals such as hematite, goethite, limonite, notronite, and pyrite. Iron is also present in the form of grain-coatings in oxidized material, and in many secondary minerals [3]. Iron hydroxides play a key role in the biogeochemical cycle, in the bioavailability of iron itself [4, 5] and in the bioavailability of other elements [6]. The bioavailability, mobility and chemical reactivity of heavy metals in soils are often associated with their distribution among certain soil fractions and the dynamic equilibrium among them [7, 8]. It is well known that main factors affecting the mobility of heavy metals in soil include: pH, content and quality of soil organic matter, content and quality of clay fraction, iron and manganese oxides. Apart from soil pH, which is a key parameter, the content and mainly the quality of soil organic matter can influence the availability of heavy metals in soil [9].

Heavy metals (Fe) appear as free and complex bonded in soil solutions, nonspecifically absorbed (exchangeable) in soil colloids, specifically as precipitates with different chemical compounds (oxides, phosphates, sulfides) and in structural lattices of primary and secondary minerals (silicates) [10]. Heavy metals soluble in water and exchangeable absorbed fractions in soil are extracted with neutral salts – NaOAcNO<sub>3</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>, NH<sub>4</sub>Oac, CaCl<sub>2</sub>, MgCl<sub>2</sub> [11], [12]. Heavy metals bound to carbonates could be dissolved with NaOAc – pH 5.0 [13]. Several methods have been proposed for the extraction of metals bound to organic matter. These two steps are designed to dissolve easily reducible Fe and Mn oxides and oxidize organic matter, thereby dissolving metals bound in the "oxide" and "organic matter" soil fractions, respectively.

The objective of this study was to assess the distribution and forms of iron in the environmental conditions of pseudogley soils in Western Serbia using a sequential extraction procedure. This investigation is of importance not only for the understanding of the mobility and availability of Fe in pseudogley soils but also for the speciation of other elements that interact with these Fe species, also including potentially toxic elements.

## II. MATERIAL AND METHOD

The investigations were conducted on pseudogley soil taken from the Ah horizon at six different localities in Serbia (Kraljevo, Koceljevo, Lajkovac, Gorobilje, Mionica, Vladimirci) (Fig. 1). The sub-samples were taken from field and meadow ecosystems at a depth of 0 to 20 cm, after which they were air-dried, crushed in a porcelain mortar and sieved through stainless steel screens. Particles 2 mm in size were used for soil characterization and Fe-fraction analyses.

## III. DETERMINATION OF SOIL CHARACTERISTICS

Soil pH was determined in a suspension with water and 1M KCl mixture, with the ratio of soil/solution 1:2.5 after a 0.5 hour equilibration period; the organic content was determined using the humus method by Kotzmann [15]., available P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O - using the Al method by Egner-Riehm [16]. CEC - using 1M NH<sub>4</sub>OAc, pH 7, and particle size distribution - by a pipette method. The total iron content was determined by atomic adsorption spectrophotometry (AAS, Model Carl Zeiss Jena AAS 1N) after soil digestion in acid (HF, HNO<sub>3</sub> and HClO<sub>4</sub>) mixtures.

### Sequential fractional procedures

Iron (Fe) in different soil fractions was extracted using the procedure proposed by [13]. The methods used for the fractionation procedure are outlined below:

1. Water soluble and exchangeable metals were determined by 0.1M CaCl<sub>2</sub> extraction (pH 7.0). An aliquot of 10 g of soil was agitated in plastic pots with 100 cm<sup>3</sup> of solution for 20 min, and then filtered.



Figure 1. . Geographical locations of the investigated soil samples in Western Serbia

2. Water soluble and exchangeable metals were determined by 0.1M CaCl<sub>2</sub> extraction (pH 7.0). An aliquot of 10 g of soil was agitated in plastic pots with 100 cm<sup>3</sup> of solution for 20 min, and then filtered.

3. Specifically adsorbed metals and metals bound to carbonates were determined using 1 M NaOAc extraction (pH 5.0). Again, 10 g of soil was added to 100 cm<sup>3</sup> of solution, and agitated for 5 h at room temperature and then filtered. In this case the sum of 1) and 2) was obtained and by subtraction, fraction 2 was obtained.

4. Reductant releasable Fe occluded in of Fe and Mn oxides was determined as follows: An aliquot of 2.5 mg of soil was placed in a test tube for rotation. After extraction of fractions, 1 and 2.50 cm<sup>3</sup> of 0.04 M hydroxylamine hydrochloride was added (in 25% of HOAc, pH 3). The tubes were then kept in a water bath for 6 h at 85°C and stirred. Then, the mixture was made up to 50 cm<sup>3</sup> with distilled water, the tubes were closed, agitated for 10 min, and centrifuged for 10 min at 3000 rpm. The clear solution was decanted into reagent bottles, while the remaining soil was rinsed away with 20 cm<sup>3</sup> of distilled water.

5. Metals bound to organic matter were determined in the following way. A 7.5 cm<sup>3</sup> aliquot of 0.02 M HNO<sub>3</sub> and 12.5 ml of H<sub>2</sub>O<sub>2</sub> pH 2.0 were added to the test tubes containing the soil that remained from the previous three extractions. The tubes were kept in a water bath at 86°C for 2h, and stirred. After cooling, 7.5 cm<sup>3</sup> of 30% H<sub>2</sub>O<sub>2</sub> was added and again kept at 86°C for 3 h. After cooling, 12.5 cm<sup>3</sup> of 3.2 M NH<sub>4</sub>OAc in 20% HNO<sub>3</sub> was added. The final volume was made up by the

addition of distilled water and then the tubes were closed. Then, they were shaken for 30 min and centrifuged for 10 min at 3000 rpm. The clear solution was decanted into reagent bottles.

6. Metals structurally bound in silicates (residual fraction) were determined by calculation as the difference between the total content determined by  $\text{HNO}_3\text{-HF-HClO}_4$  and the sum of the first four fractions.

#### IV. STATISTICAL ANALYSIS

The results obtained for different contents of iron (total iron, accessible iron and different chemical fractions) in pseudogley soil were subjected to statistical analysis using Student and Pearson correlation coefficients [17].

#### V. RESULTS AND DISCUSSION

Table I. gives main characteristics of the test pseudogley samples. The test soils had very poor physical and chemical characteristics. Particle size analysis showed that, apart from an average content of clay particles ( $< 2 \mu\text{m}$ ) of 48.3% (tilled fields) and 45.4% (meadows), the soils had a high percentage of silt particles (2-50  $\mu\text{m}$ ), averaging 39.3% (tilled field) and 42.9% (meadow). The total percentage of silt and clay particles in the soil was very high, i.e. above 86%, whereas the sand fraction content (0.05-2.0 mm) was very low – about 12%. According to the above properties, these soils were classified as very silt loam soils.

TABLE I. THE PHYSICO-CHEMICAL CHARACTERISTICS OF PSEUDOGLEY IN WESTERN SERBIA

Soil characteristics	Tilled field			Meadow		
	Mean	Range	S.D.	Mean	Range	S.D.
pH( $\text{H}_2\text{O}$ )	5.4	4.9-6.1	0.4	5.5	5.1-3.2	0.4
pH(KCl)	4.3	3.9-5.6	0.4	4.4	4.0-4.9	0.4
Humus content, %	2.9	2.2-3.7	0.5	4.2	2.9-6.6	1.2
$\text{P}_2\text{O}_5$ mg 100 $\text{g}^{-1}$	7.6	3.4-10.1	2.2	7.6	4.4-10.2	1.9
$\text{K}_2\text{O}$ 100 $\text{g}^{-1}$	10.8	8.8-13.5	1.6	9.7	8.2-11.6	1.3
CEC m.e 100 $\text{g}^{-1}$	19.0	14.1-24.8	4.0	18.2	13.3-25.7	4.3
Sand, %	12.4	5.5-21.8	5.7	11.7	4.8-20.6	5.8
Silt, %	39.3	30.2-48.2	6.9	42.9	31.0-55.2	8.3
Clay, %	48.3	44.0-53.9	3.0	45.4	37.9-50.2	3.7
Silt + Clay, %	86.6	78.6-92.4	4.9	88.3	80.3-95.4	5.8

S. D.- Standard deviation

The content of readily available phosphorus in the test locations was low, ranging from 3.4-10.1 mg 100  $\text{g}^{-1}$  in samples taken from tilled fields and 4.4-10.2 mg 100  $\text{g}^{-1}$  in meadow soil samples. The pseudogleys in the test locations had a higher supply of  $\text{K}_2\text{O}$  than of  $\text{P}_2\text{O}_5$ . Soil pH ranged from 3.9 to 5.6, averaging 4.3, which makes this soil extremely acid. The cation adsorption capacity (CEC) was relatively high, ranging from 13.3 to 25.7 m.e 100  $\text{g}^{-1}$  soil, with an average of about 19.0 m.e 100  $\text{g}^{-1}$ . The average humus content of tilled field was low (2.9%), whereas that of meadow soil was considerably higher (4.2%).

The iron content of different fractions of test pseudogleys, expressed as mg  $\text{kg}^{-1}$ , is presented in Table II. The results show that the iron content was highest in the residual fraction (V) – 24,689 mg  $\text{kg}^{-1}$  (tilled field) and 23,564 mg  $\text{kg}^{-1}$  (meadow), followed by fraction (III) oxide of Fe and Mn – 4,425 mg  $\text{kg}^{-1}$  in meadow and 3,665 mg  $\text{kg}^{-1}$  in field soil. The results comply with those obtained by [18], who identified the highest iron content in the residual fraction (over 80%) in the horizons of a nutrient-poor forest soil. Also, [19] report that at a low soil pH and in highly leached non-carbonated soils during the pseudogleying process, the content of the Fe fraction occluded in Fe and Mn oxides increases, most likely due to the dissolution of amorphous and partially crystalline oxides and hydroxides. The iron content of the organic fraction (IV) was low, 270 mg  $\text{kg}^{-1}$  in meadow and 194 mg  $\text{kg}^{-1}$  in field soil. [20] found that Fe complexation by organic matter occurs at a lower soil pH, whereas higher pH values are suitable for the adsorptive binding of iron oxides to organic matter. Specifically absorbed iron bound to carbonates (II) was low, 2.18 mg  $\text{kg}^{-1}$ , while Fe content in the exchangeable fraction (I) was negligible (0.14 mg  $\text{kg}^{-1}$ ). At low pH and low levels of organic acids and organic matter, a low content of exchangeable and water-exchangeable iron fractions is formed. In addition, low carbonate levels and low microbial activity induce an extremely low level of readily available fractions of iron in the soil [18], [19], [21].

TABLE II. DISTRIBUTION OF IRON IN DIFFERENT FRACTIONS OF PSEUDOGLEY OBTAINED BY SEQUENTIAL ANALYSIS PROCEDURES (MG  $\text{KG}^{-1}$ )

Fraction	I	II	III	IV	V
Field Fe $\pm$ SD	0.14 $\pm$ 0.07	2.18 $\pm$ 0.65	3665 $\pm$ 1713	194 $\pm$ 84	24689 $\pm$ 5281
Meadow Fe $\pm$ SD	0.15 $\pm$ 0.08	2.73 $\pm$ 1.13	4425 $\pm$ 548	270 $\pm$ 146	23564 $\pm$ 4443

Significant correlations in tilled field and meadow soils were observed between most iron fractions (Table III). In tilled field, a positive correlation ( $r=0.74^{**}$  and  $r=0.78^{**}$ ) was found between the exchangeable fraction and specifically adsorbed iron and iron bound to oxides, as and between fractions II and III ( $r=0.79^{**}$ ), which indicates mutual influences of these three fraction.

Interdependence between Fe content in these three soluble fractions and other extracted fractions was not found. It points to the low mobility of iron in studied pseudogleys.

TABLE III. CORRELATION COEFFICIENT FOR THE IRON CONTENT IN DIFFERENT CHEMICAL FRACTIONS IN FIELD AND MEADOW SOILS

Fraction	I	II	III	IV	V	Fe total
<b>Fields</b>						
I	1.00					
II	0.74**	1.00				
III	0.78**	0.79*	1.00			
IV	NS	NS	0.52*	1.00		
V	NS	-0.71**	NS	NS	1.00	
Fe total	NS	-0.79**	NS	NS	0.98**	1.00
<b>Meadows</b>						
I	1.00					
II	-0.58*	1.00				

III	NS	NS	1.00			
IV	NS	NS	-0.45*	1.00		
V	NS	-0.63*	NS	NS	1.00	
Fe total	NS	-0.61*	NS	NS	0.99**	1.00

NS – there is no statistical significance

\*\* statistically significant at the probability level of 0.01

\*statistically significant at the probability level of 0.05

In both pseudogleys, negative correlations were detected between the total iron and residual iron with specifically adsorbed iron (fraction II). In the meadow pseudogley, significant but weaker correlations were observed between fractions II and IV, and fractions I and II ( $r=-0.45^*$  i  $r=-0.58^*$ ). In both pseudogleys, a strong positive correlation was identified between fraction V and HF ( $r=0.98^{**}$  and  $r=0.99^{**}$ ), suggesting lower iron mobility in these soils.

The relationship between iron fractions and soil properties is given in Table IV. A significant negative correlation was determined between the exchangeable fraction (I) and soil pH ( $r=-0.78^{**}$  and  $r=-0.79^{**}$ ) in tilled field soils and ( $r=-0.65^*$ ) in meadow soil, where the decrease in pH induced an increase in Fe solubility. The exchangeable iron fraction (I) showed a negative correlation ( $r=-0.55^*$ ) with the sand content, and a positive correlation with the silt content ( $r=0.50^*$ ), which was due to the iron fraction being weakly bound to sand particles and more strongly to fine silt particles occurring to a significant degree in the test pseudogleys. The positive correlation between iron in the exchangeable fraction and the silt implies that these factors had a dominant influence on the distribution of iron in this fraction.

The negative correlation between specifically adsorbed iron (II) and pH (and CEC for tilled fields) of the soil indicates that the solubility of iron in this fraction decreases with increasing soil pH due to the fact that high pH value favors the oxidation of  $Fe^{2+}$  to  $Fe^{3+}$  which results in precipitation of iron (III) salt and oxides. Similar results were obtained previously by some other authors [18], [22]. Also, the significant negative correlation between specifically adsorbed iron (II) and oxidized iron (III) with clay content ( $r=-0.79^{**}$ ) in meadow soil indicates that the increase in clay content results in an increase in CEC value and, hence, the association of iron and the solid soil phase, leading to reduced mobility and accessibility of the iron in this fraction.

The positive correlation between the iron content in fraction II and the silt content ( $r=0.50^*$ -tilled field and  $r=0.87^{**}$ -meadow) indicates that iron is unstably bound to silt particles, since increasing particle size led to increasing solubility of the iron in the fraction. Similar interpretations of the obtained results were reported by [19].

Organically bound iron was positively correlated with CEC in both soils (tilled field and meadow) and negatively correlated with the clay content and  $P_2O_5$  (tilled field). In addition, a negative correlation was found between organically bound iron in meadow soil and silt plus clay content ( $r=-0.74^{**}$ ), and a strong positive correlation with the organic matter content ( $r=0.90^{**}$ ).

TABLE IV. CORRELATION COEFFICIENTS BETWEEN THE IRON CONTENT IN DIFFERENT CHEMICAL FRACTIONS AND SOME SOIL CHARACTERISTICS OF FIELD AND MEADOW

Fraction/Soil Characteristic	I	II	III	IV	V	Fe total
pH(H <sub>2</sub> O)	-0.78**	-	-	NS	0.90**	NS
pH(KCl)	-0.79**	-	-	NS	0.81**	NS
Humus content,%	NS	NS	NS	NS	NS	NS
P <sub>2</sub> O <sub>5</sub> mg 100 g <sup>-1</sup>	NS	NS	NS	-	NS	NS
K <sub>2</sub> O 100 g <sup>-1</sup>	NS	NS	NS	0.81**	NS	NS
CEC m.e 100 g <sup>-1</sup>	NS	-0.57*	-0.66	0.51*	0.54*	0.87**
Sand, %	-0.55*	NS	NS	NS	-0.66*	-0.55*
Silt, %	0.50*	0.51*	NS	NS	NS	NS
Clay, %	NS	NS	NS	-	0.80**	0.80**
Silt + Clay, %	NS	0.54*	NS	NS	0.84**	0.86**
Meadow						
pH(H <sub>2</sub> O)	-0.65*	-0.79	-0.88	NS	NS	NS
pH(KCl)	NS	-0.72	-0.84	NS	NS	NS
Humus content,%	NS	-0.49*	NS	0.90**	NS	NS
P <sub>2</sub> O <sub>5</sub> mg 100 g <sup>-1</sup>	NS	NS	NS	NS	NS	NS
K <sub>2</sub> O 100 g <sup>-1</sup>	NS	NS	-0.51	NS	NS	NS
CEC m.e 100 g <sup>-1</sup>	NS	-	-	0.74**	0.63*	0.97**
Sand, %	NS	NS	NS	NS	NS	NS
Silt, %	0.64*	0.87**	0.89	NS	NS	NS
Clay, %	NS	-	NS	NS	0.75**	0.79**
Silt + Clay, %	NS	0.73**	NS	-	0.51*	0.81**

NS – there is no statistical significance

\*\* statistically significant at the probability level of 0.01

\*statistically significant at the probability level of 0.05

The increased content of clay particles, notably montmorillonite, characterized by a high adsorption capacity, and the high content of orthophosphoric acid ions that show a strong chemical reactivity led to a reduction in organically bound iron in the soil (IV). The higher pH of meadow pseudogley induced a stronger bond of iron to both oxides and organic matter of the soil [19], [20]. Accordingly, the results clearly indicate that pH, CEC and the content of the finest particles (clay and silt) in the soil are dominant factors affecting iron distribution in these fractions.

The iron bound to the residual fraction (V) was negatively correlated with the sand content ( $r=-0.66^*$ ) and positively correlated with soil pH, CEC, clay content and silt plus clay content in both groups of test pseudogleys. The negative correlation between residual iron and sand, and the positive correlation with the clay content and silt plus clay indicated that most of iron in this fraction was bound to clay particles and silt. The clay fractions usually contain high amounts of metals (Fe) due to high adsorption, as well as the content present in the crystal lattice. These variations in the amounts of residual iron with clay are in accordance with the findings of other studies [23], [24].

## CONCLUSIONS

The physico-chemical characteristics of the test pseudogleys had a significant effect on the content and forms of iron in different locations in Western Serbia. Soil pH, CEC and the content of finer fractions (silt and clay) had the highest effect on the distribution of different forms of iron.

The highest amount of iron was found in the residual fraction (24,689 mg kg<sup>-1</sup> in tilled field and 23,564 mg kg<sup>-1</sup> in meadow soil), unavailable to plants.

The low content of organically bound iron in fraction IV (270 mg kg<sup>-1</sup> - meadow and 194 mg kg<sup>-1</sup> - tilled field) was due to the low level of humus in the test pseudogley, particularly in field soils.

The content of specifically bound iron and iron bound to carbonates (II) was low (2.18-2.73 mg kg<sup>-1</sup>), whereas that of iron in the exchangeable fraction (I) was extremely low (about 0.14 mg kg<sup>-1</sup>), which may limit the availability of this important plant nutrient.

The weak correlation between the iron content in the residual fraction (V) and other fractions (exchangeable and specifically adsorbed fractions) indicates very low mobility of iron in the test pseudogley soils. The low plant availability of the iron in the pseudogley could be due to its occurrence in the least soluble fraction (Fraction V).

Sequential extraction enables adequate determination of the content and availability of iron in the pseudogleys analyzed.

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# SECTION 13.

*Natural science - mathematics*

# Solving parametric linear systems iteratively

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**Abstract**— In this paper we Consider linear systems whose matrix and right-hand side vector depend affine-linearly on parameters varying within prescribed intervals. A new C-XSC implementation (C- for eXtended Scientific Computing) for the symmetric single step method for computing an enclosure for the solution set is proposed. This method requires to bound the range of a multivariate function over a given box and often delivers intervals which are too wide for practical applications. We computed tight enclosures of the parametric solution set by using an Interval Centered Form which is arithmetic for intervals (which are representing uncertainties). The most important property of this method is to reduce the effect of the dependency problem which is inherent in the computation with standard interval arithmetic. We used this Form to tightly bound the range of a multivariate nonlinear function over a box, a task to which many problems in mathematics and its applications can be reduced. We applied this technique to improve the efficiency of the solution for parametric systems. Numerical examples illustrating the applicability of the proposed method are solved, and compared with other methods.

**Keywords:** *parametric linear systems, validated interval software, C-XSC, symmetric single step method.*

## I. INTRODUCTION

Solving parametric linear systems involving uncertainties in the parameters is an important part of the solution to many scientific and engineering problems. Usually, in most engineering design problems, models in operational research, linear prediction problems, etc.[10,21] there are complicated dependencies between coefficients. The main reason for this dependency is that the errors in several different coefficients may be caused by the same factor[3,18,11]. More precisely, consider a parametric system

$$A(p) \cdot x = b(p), \quad (1)$$

where  $A(p) \in \mathbb{R}^{n \times n}$  and  $b(p) \in \mathbb{R}^n$  depend affine linearly on a parameter vector  $p \in \mathbb{R}^k$ .

Since, each individual component of  $A(p)$ ,  $b(p)$  is an affine-linear combination of the  $k$  parameters [17]

$$a_{ij}(p) := a_{ij}^{(0)} + \sum_{v=1}^k p_v a_{ij}^{(v)}, b_i(p) := b_i^{(0)} + \sum_{v=1}^k p_v b_i^{(v)} \quad (2)$$

Denote the  $k + 1$  numerical matrices

$$A^{(0)} := (a_{ij}^{(0)}), A^{(1)} := (a_{ij}^{(1)}), \dots, A^{(k)} := (a_{ij}^{(k)}) \in \mathbb{R}^{n \times n}$$

and the corresponding numerical vectors

$$b^{(0)} := (b_i^{(0)}), b^{(1)} := (b_i^{(1)}), \dots, b^{(k)} := (b_i^{(k)}) \in \mathbb{R}^n.$$

Hence, the parametric matrix and the right-hand side vector can be represented by

$$A(p) := A^{(0)} + \sum_{v=1}^k p_v A^{(v)}, b(p) := b^{(0)} + \sum_{v=1}^k p_v b^{(v)}$$

and the parametric system (1) can be rewritten in the following form

$$(A^{(0)} + \sum_{v=1}^k p_v A^{(v)})x = b^{(0)} + \sum_{v=1}^k p_v b^{(v)} \quad (3)$$

where the parametric vector  $p$  varies within the range  $[p] \in I\mathbb{R}^k$ .

The solution set of (3), called parametric solution set, and is defined as

$$\Sigma^p := \Sigma(A(p), b(p), [p]) := \{ x \in \mathbb{R}^n \mid A(p) \cdot x = b(p) \text{ for some } p \in [p] \}$$

Since the solution set has a complicated structure (it does not even need to be convex), which is difficult to find, one looks for the interval hull  $\Diamond(\Sigma)$  here  $\Sigma$  is a nonempty bounded subset of  $\mathbb{R}^n$ . For  $\Sigma \subseteq \mathbb{R}^n$ , define  $P\mathbb{R}^n \rightarrow I\mathbb{R}^n$  by<sup>1</sup>

$$\Diamond(\Sigma) := [\inf \Sigma, \sup \Sigma] = \bigcap \{ [x] \in I\mathbb{R}^n \mid \Sigma \subseteq [x] \}$$

The calculation of  $\Diamond(\Sigma)$  is also quite expensive.

Since it is quite expensive to obtain  $\Sigma^p$  or  $\Diamond(\Sigma^p)$ , it would be a more realistic task to find an interval vector  $[y] \in I\mathbb{R}^n$  which tightly encloses  $\Sigma^p$  ( $[y] \supseteq \Diamond(\Sigma^p) \supseteq \Sigma^p$ ).

Probably the first general purpose method computing outer (and inner) bounds for  $\Diamond(\Sigma^p)$  is based on the fixed-point interval iteration theory developed by S. Rump. In [22] Rump applies the general verification theory for system of nonlinear equations for solving parametric linear systems involving affine-linear dependencies. This method was generalized in [19] by proving that a sharp enclosure of the iteration matrix expands the scope of application of the method over problems involving the so-called column-dependent matrices. Meanwhile, there were many attempts to construct suitable methods for solving parameter dependent interval linear systems [3,23,21,18,17,20,9,16]

<sup>1</sup>  $P\mathbb{R}^n$  is the power set over  $\mathbb{R}^n$ . Given a set S, the power set of S is the set of all subset of S

In practice it is usually required that the matrix  $A(p)$  is an H-matrix.

The goal of this paper is to introduce a new C-XSC software (C- for Extended Scientific Computing)[8] for the symmetric single step method by using Interval Centered Form to tightly enclose multivariate nonlinear functions to find the solution set of parametric interval systems, i.e., interval vectors, which contain all possible solutions of this system. We will compare our method to other methods.

The paper is organized as follows. In Section 1 some Basic notations is introduced. In section 2 the dependency problem is presented. The Interval Centered Form is introduced in Section 3. The main results of this paper are presented in Section 4. Another modification for the symmetric single step method is introduced in Section 5. Numerical and practical examples illustrating the features of the proposed method are provided in Section 6. The paper ends with concluding remarks.

## II. BASIC NOTATIONS

We use the following notations  $\mathbb{R}, \mathbb{R}^n, \mathbb{R}^{n \times n}, I\mathbb{R}, I\mathbb{R}^n, I\mathbb{R}^{n \times n}$ , to denote the set of real numbers, the set of real vectors with  $n$  components, the set of real  $n \times n$  matrices, the set of intervals, the set of interval vectors with  $n$  components and the set of  $n \times n$  interval matrices, respectively. By interval we mean a real compact interval

$$[x] := [a, b] := \{x \in \mathbb{R} \mid a \leq x \leq b\}$$

For  $[x], [y] := [c, d] \in I\mathbb{R}$  we define

- The mid-point  $\text{mid}([x]) := \frac{(a+b)}{2}$ ,
- the Radius  $\text{rad}([x]) := \frac{(b-a)}{2}$ ,
- the absolute value  $\|x\| := \max\{|a|, |b|\}$ ,
- the distance  $q([x], [y]) := \max\{|a-c|, |b-d|\}$ ,
- minimal absolute value (mignitude)  
 $\prec [x] \succ := \min\{x \mid x \in [x]\} = \begin{cases} \min\{|a|, |b|\} & \text{if } 0 \notin [x] \\ 0 & \text{else} \end{cases}$  (4)

For interval vectors and interval matrices, these quantities are defined componentwise.

If for two interval vectors  $[u], [v] \in I\mathbb{R}^n$  we have  $[u_i] \cap [v_i] \neq \emptyset, i = 1, 2, \dots, n$ , then  $[u] \cap [v] := ([u_i] \cap [v_i])$ , otherwise  $[u] \cap [v] := \emptyset$ . In addition, for  $[u], [v] \in I\mathbb{R}^n$  we define  $[u] \subseteq [v]$  iff  $[u_i] \subseteq [v_i], i = 1, 2, \dots, n$ . Furthermore, we repeat some relations concerning the distance:

$$\begin{aligned} q([u], [v]) &\leq q([u], [w]) + q([w], [v]), \\ q([u] + [w], [v] + [w]) &= q([u], [v]), \\ q([u] + [v], [w] + [z]) &\leq q([u], [w]) + q([v], [z]), \\ &\text{if } [u], [v], [w], [z] \in I\mathbb{R}^n \end{aligned}$$

For square interval matrices we define the comparison matrix (Ostrowsky matrix)

$$\prec [A] \succ := (c_{ij}) \in \mathbb{R}^{n \times n} \text{ using (4) by setting}$$

$$c_{ij} := \begin{cases} -|a_{ij}| & \text{if } i \neq j, \\ \prec [a_{ij}] \succ & \text{if } i = j. \end{cases}$$

A square matrix  $[A] \in \mathbb{R}^{n \times n}$  is called regular if all  $A \in [A]$  are nonsingular.

If  $\text{mid}([A]) \cdot [A]$  is regular then  $[A]$  is strongly regular. An interval matrix  $[A]$  is an H-matrix iff there exist a vector  $v > 0$  such that  $\prec [A] \succ v > 0$ .

**Definition 1** [24] Let  $A, B, C \in \mathbb{R}^{n \times n}$ . Then  $A = B - C$  is a regular splitting of  $A$  if  $C \geq 0$  and  $B$  is nonsingular with  $B^{-1} \geq 0$ .

**Theorem 1** [24] Assume that  $A \in \mathbb{R}^{n \times n}$  is nonsingular, that  $A^{-1} \geq 0$  and that  $A = B - C$  is a regular splitting of  $A$ . Then  $\rho(B^{-1}C) < 1$ , where  $\rho(\cdot)$  denotes the spectral radius of a matrix.

Regular splitting was introduced in [24], where one can also find the proof of Theorem 1.

## III. DEPENDENCY PROBLEMS

The dependency problem arises when one or several variables occur more than once in an interval expression. Dependency may lead to catastrophic overestimation in interval computations. For example, if the interval  $[x] = [1, 2]$  is subtracted from itself  $[x] - [x] = [1, 2] - [1, 2] = [-1, 1]$  is obtained as the result and not the interval  $[0, 0]$  as expected. Actually, interval arithmetic cannot recognize the multiple occurrence of the same variable  $[x]$ . The result is  $\{x - y \mid x \in [x], y \in [y]\}$  instead of  $\{x - x \mid x \in [x]\}$ . In general, when a given variable occurs more than once in an interval computation, it is treated as a different variable in each occurrence.

For a less extreme example, take  $f(x) = (5 + x) \cdot (5 - x)$  for  $x \in [x] = [-1, 1]$ . Using the basic formulas of standard interval arithmetic[1,13], we get

$$5 + [x] = [4, 6]$$

$$5 - [x] = [4, 6]$$

$$(5 + [x]) \cdot (5 - [x]) = [6, 16]$$

The interval formulas give an interval whose diameter is 20, whereas the exact interval result  $f([x]) = [24, 25]$  has a diameter of only 1. Note that when one operand in the product

$(5 + x) \cdot (5 - x)$  is at the maximum value 6, the other must be at the minimum value 4; the combination  $4 \cdot 4$  and  $6 \cdot 6$ , which gave the extreme values of  $F([x])$ , never occur.

A simple remedy for this example is to rewrite  $(5 + x) \cdot (5 - x) = 25 - x^2$ , which has only one occurrence of the variable  $x$ . An interval computation of this new expression will give the exact result. Unfortunately, this remedy is often impossible to apply in practice.

Several other methods have been proposed to attack the dependency problem. The main class of methods is known as

generalized interval arithmetic [4,7], in several incarnations and generalizations, such as mean-value form [10] and slopes [6]. The purpose of Interval Centered Form [12] is to reduce the effect of the dependency problem when computing with standard interval arithmetic.

#### IV. INTERVAL CENTERED FORM

Given any real rational expression  $f(p_1, p_2, \dots, p_k)$  and any vector of real numbers  $c = (c_1, c_2, \dots, c_k)$  at which the value of  $f$  is defined (i.e., not at a singularity of  $f$ ), we can write  $f$  as [6,13]

$$f(p_1, p_2, \dots, p_k) = f(c_1, c_2, \dots, c_k) + g(p_1 - c_1, p_2 - c_2, \dots, p_k - c_k) \quad (5)$$

by substituting  $p_i = c_i + u_i, i = 1, 2, \dots, k$  into the expression for  $f(p_1, p_2, \dots, p_k)$  and forming

$$g(p_1 - c_1, p_2 - c_2, \dots, p_k - c_k) = g(u_1, u_2, \dots, u_k) \quad (6)$$

By using (6) to form the expression for  $g$  in (5), we can substitute interval variables  $[u_1], \dots, [u_k]$  for the real variables

$u_1, \dots, u_k$  occurring in the expression for  $g(u_1, \dots, u_k)$  and obtain an expression we can denote by  $g([u_1], \dots, [u_k])$ ; interpreting the arithmetic operations as interval arithmetic operations, the resulting expression  $g([u_1], \dots, [u_k])$  is a rational interval expression.

We form the expression

$$F([p_1], [p_2], \dots, [p_k]) = f(\text{mid}([p_1]), \text{mid}([p_2]), \dots, \text{mid}([p_k])) + g([p_1] - \text{mid}([p_1]), [p_2] - \text{mid}([p_2]), \dots, [p_k] - \text{mid}([p_k])) \quad (7)$$

corresponding to (5) by substituting  $[p_i] - \text{mid}([p_i])$  for  $[u_i]$  in the rational interval expression  $g([u_1], \dots, [u_k])$ . The equation (7) then, gives an Interval Centered Form of a rational interval expression with real restriction  $f(u_1, \dots, u_k)$

#### V. ITERATIVE METHOD

In this section we assume that the reader is familiar with the concept P contractions for proving the convergence of a fixed point iteration to a unique fixed point for an arbitrary starting vector. For the details please see [1, 2].

##### A. The symmetric single step method

We assume throughout that the matrix  $A(p)$  is nonsingular, and moreover that its diagonal entries  $a_{ii}(p)$  are all nonzero. We can express the matrix  $A(p)$  as the matrix sum [1,24]

$$A(p) = D(p) + L(p) + U(p), \quad (8)$$

Where  $D(p)$  is a diagonal matrix, and  $L(p)$  and  $U(p)$  are respectively strictly lower and upper triangular matrices. We can write (1) as

$$D(p) \cdot x = b(p) - (L(p) + U(p)) \cdot x \quad (9)$$

Then

$$x = D^{-1}(p) \cdot (b(p) - (L(p) + U(p)) \cdot x), \quad (10)$$

where

$$L(p) = \begin{pmatrix} 0 & 0 & \dots & 0 \\ a_{21}(p) & 0 & \dots & 0 \\ \vdots & \ddots & \ddots & \vdots \\ a_{n1}(p) & \dots & a_{nn-1}(p) & 0 \end{pmatrix} \quad (11)$$

$$U(p) = \begin{pmatrix} 0 & a_{12}(p) & \dots & a_{1n}(p) \\ \vdots & 0 & \ddots & \vdots \\ \vdots & \ddots & \ddots & a_{n-1n}(p) \\ 0 & 0 & \dots & 0 \end{pmatrix} \quad (12)$$

$$D^{-1}(p) = \begin{pmatrix} \frac{1}{a_{11}(p)} & 0 & \dots & 0 \\ 0 & \frac{1}{a_{22}(p)} & \dots & 0 \\ \vdots & \ddots & \ddots & \vdots \\ 0 & 0 & \dots & \frac{1}{a_{nn}(p)} \end{pmatrix} \quad (13)$$

Since the diagonal entries  $a_{ii}(p)$  of  $A(p)$  are nonzero, we can carry out the following iterative method derived from (9):

$$[x_i^{(l+1/2)}] = (b_i(p) - \sum_{j=1}^{i-1} a_{ij}(p)[x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}(p)[x_j^{(l)}] / a_{ii}(p), \quad 1 \leq i \leq n, \quad (14)$$

$$[x_i^{(l+1)}] = (b_i(p) - \sum_{j=1}^{i-1} a_{ij}(p)[x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}(p)[x_j^{(l+1)}] / a_{ii}(p), \quad 1 \leq i \leq n, l \geq 0 \quad (15)$$

where the  $[x^{(0)}]$ 's initial interval vector. We call this iteration procedure the symmetric single step method. By using (2) we can rewrite (14) and (15) in the following form:

$$[x_i^{(l+1/2)}] = \frac{(b_i^{(0)} - \sum_{j=1}^{i-1} a_{ij}^{(0)}[x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}^{(0)}[x_j^{(l)}])}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}} + \frac{\sum_{\gamma=1}^k p_{\gamma} (b_i^{(\gamma)} - \sum_{j=1}^{i-1} a_{ij}^{(\gamma)}[x_j^{(l+1/2)}])}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}} - \frac{\sum_{j=i+1}^n a_{ij}^{(\gamma)}[x_j^{(l)}]}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}}, \quad 1 \leq i \leq n, \quad (16)$$

$$[x_i^{(l+1)}] = \frac{(b_i^{(0)} - \sum_{j=1}^{i-1} a_{ij}^{(0)}[x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}^{(0)}[x_j^{(l+1)}])}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}} + \frac{\sum_{\gamma=1}^k p_{\gamma} (b_i^{(\gamma)} - \sum_{j=1}^{i-1} a_{ij}^{(\gamma)}[x_j^{(l+1/2)}])}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}} - \frac{\sum_{j=i+1}^n a_{ij}^{(\gamma)}[x_j^{(l+1)}]}{a_{ii}^{(0)} + \sum_{\gamma=1}^k p_{\gamma} a_{ii}^{(\gamma)}}, \quad 1 \leq i \leq n, \quad p \in [p] \quad (17)$$

##### B. Symmetric single step with interval centered form

If we have a deep look in the equations (16) and (17), we can find that the parameter  $p_{\gamma}, (\gamma = 1, 2, \dots, k)$  occurs more than once (between the numerator and denominator). In general, when a given variable occurs more than once in an interval computation, it is treated as a different variable in each occurrence. This causes widening of computed intervals and makes it more difficult to obtain sharp result in calculations. One should always be aware of this consideration and take appropriate steps to reduce its effect. We have discussed a way to do this in last section called Interval Centered Form.

In our case, from (16) and (17), the rational function will be in the form:

$$f(p_1, p_2, \dots, p_k) = \frac{\sum_{i=0}^k [\alpha_i] p_i}{\sum_{j=0}^k \beta_j p_j} \quad (18)$$

where  $[\alpha]$  and  $\beta$  are interval vector and real vector respectively, and  $p_0 = 1$ . Then the interval centered form of this function will be in the following form:

$$\frac{\sum_{i=0}^k [\alpha_i] p_i}{\sum_{j=0}^k \beta_j p_j} = \frac{\sum_{i=0}^k [\alpha_i] \cdot \text{mid}([p_i])}{\sum_{j=0}^k \beta_j \cdot \text{mid}([p_j])} + \frac{\sum_{i=0}^k \sum_{j=1}^k (\beta_j [\alpha_i] - \beta_j [\alpha_i]) \cdot \text{mid}([p_i]) \cdot \text{rad}([p_j])}{\sum_{j=0}^k \beta_j \cdot \text{mid}([p_j]) (\sum_{j=0}^k \beta_j \cdot \text{mid}([p_j]) + \sum_{i=1}^k \beta_i \cdot \text{rad}([p_j]))} \quad (19)$$

By using the equation (19) in the equations (16) and (17), we can get better results.

**Theorem 2.** Consider parametric linear system (1), where  $A(p)$  and  $b(p)$  are defined by

$$a_{ij}(p) := a_{ij}^{(0)} + \sum_{v=1}^k p_v a_{ij}^{(v)},$$

$$b_i(p) := b_i^{(0)} + \sum_{v=1}^k p_v b_i^{(v)}, \quad (i, j = 1, 2, \dots, n)$$

We define  $L(p)$ ,  $U(p)$  and  $D^{-1}(p)$  as in (11), (12) and (13), respectively. Then, the sequence  $[x^{(l)}]_{l=0}^{\infty}$  calculated according to the iteration method (symmetric single step method defined as in (16) and (17)), converges for all interval vectors  $[x^{(0)}] \in I\mathbb{R}^n [x^*]$ , where  $[x^*]$  is the unique fixed point of the equation (10).

## VI. MODIFICATION

In this section we consider modifications of the preceding iterative methods which are based on the fact that if for any of these methods one is starting with an interval vector containing the limit, then all iterates contain the limit. Therefore the enclosure of the limit might be improved by forming intersections after each iteration step.

### Symmetric single step method with intersection

**Theorem 4.** Let  $A(p) \in \mathbb{R}^{n \times n}$  and  $b(p) \in \mathbb{R}^{n \times 1}$  be given. We define  $L(p)$ ,  $U(p)$  and  $D^{-1}(p)$  as in (11), (12) and (13), respectively. Let  $[x^*]$  is the unique fixed point of the equation (10). We assume that we have an interval vector  $[\text{initial}] \in I\mathbb{R}^n$  satisfying  $[x^*] \subseteq [\text{initial}]$ . We consider the Symmetric single step method with intersection.

$$\begin{cases} [x^{(0)}] := [\text{initial}] \\ \text{for } i = 1 \text{ to } n \text{ do} \\ \quad [x_i^{(l+1/2)}] := \\ \quad [x^{(l)}] \cap \left\{ b_i(p) - \sum_{j=1}^{i-1} a_{ij}(p) [x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}(p) [x_j^{(l)}] / a_{ii}(p) \right\} \\ \text{for } i = n \text{ down to } 1 \text{ do} \\ \quad [x_i^{(l+1)}] := \\ \quad [x_i^{(l+1/2)}] \cap \left\{ b_i(p) - \sum_{j=1}^{i-1} a_{ij}(p) [x_j^{(l+1/2)}] - \sum_{j=i+1}^n a_{ij}(p) [x_j^{(l+1)}] / a_{ii}(p) \right\} \end{cases} \quad (20)$$

$$\text{Then } \lim_{l \rightarrow \infty} [x^{(l)}] = [x^*]$$

To get an interval vector  $[\text{initial}]$ . We assume that  $A(p) \in \mathbb{R}^{n \times n}$  and that  $b(p) \in \mathbb{R}^{n \times 1}$  is an H-matrix. Let  $D^{-1}(p)$ ,

$L(p)$ ,  $U(p)$  and  $[x^*]$  defined as in Theorem 2. Then we consider symmetric single step method with arbitrary  $[x^{(0)}]$ .

We assume that

$P := \prec [D([p])] \succ^{-1} [L([p]) + U([p])]$ , where  $\rho(P) < 1$  (see Theorem 11.4 in [1]).

For  $m > l$  we get [2]:

$$\begin{aligned} q([x^{(m)}], [x^{(l)}]) &\leq q([x^{(m)}], [x^{(m-1)}]) + \dots + q([x^{(l+1)}], [x^{(l)}]) \\ &\leq P^{m-1} \cdot q([x^{(m)}], [x^{(0)}]) + \dots + P^l \cdot q([x^{(l)}], [x^{(0)}]) \\ &= P^l \cdot (I + P + \dots + P^{m-l-1}) \cdot P^{m-l} \cdot q([x^{(l)}], [x^{(0)}]) \\ &\leq P^l \cdot \left( \sum_{i=0}^{\infty} P^i \right) \cdot P^{m-l} \cdot q([x^{(l)}], [x^{(0)}]) \\ &= P^l \cdot (I - P)^{-1} \cdot P^{m-l} \cdot q([x^{(l)}], [x^{(0)}]) \end{aligned}$$

Since  $\lim_{m \rightarrow \infty} [x^{(m)}] = [x^*]$ , it holds that (set  $l := 1$ )

$$q([x^*], [x^{(l)}]) \leq P \cdot (I - P)^{-1} \cdot q([x^{(1)}], [x^{(0)}]) = u,$$

Then

$$\underline{x}^{(l)} - u \leq \underline{x}^*, \quad \bar{x}^* \leq \bar{x}^{(l)} + u$$

Hence, we get  $[x^*] \subseteq [\underline{x}^{(l)} - u, \bar{x}^{(l)} + u] = [\text{initial}]$

### Algorithm 1. Parametric interval linear systems (H-Matrix)

1. Computation of an initial interval vector

$$P := \prec [D([p])] \succ^{-1} [L([p]) + U([p])],$$

$$[\text{initial}] := [\underline{x}^{(1)} - u, \bar{x}^{(1)} + u] \quad l \geq 0$$

2. Verification step

$$[x^{(1)}] := [\text{initial}]$$

repeat

if intersection = 0 then

Using equations (16) and (17) with (19)

else Using equation (20) with (19)

until  $[x^{(l+1)}]$  and  $[x^{(l)}]$  are equals

6.

if  $[x^{(l+1)}]$  and  $[x^{(l)}]$  are equals then

$$\hat{x} \in [x^{(l+1)}] \quad (\hat{x} \text{ the exact solution})$$

else no inclusion can be computed

## VII. NUMERICAL AND PRACTICAL EXAMPLES

Example(1):

$$\begin{pmatrix} 1 & p_1 \\ p_1 & p_2 \end{pmatrix} \cdot x = \begin{pmatrix} 2 + p_2 \\ 2 + p_2 \end{pmatrix},$$

where:  $p_1 \in [-0.6, -0.4]$ ,  $p_2 \in [1.8, 2.2]$

iteration = 9,

Proposed method	Elaraby [5]	Popova [18]
[4.808641, 6.833334]	[4.843137, 7.000000]	[4.877162, 6.551409]
[2.521604, 4.388889]	[2.607843, 4.666667]	[2.598498, 4.258645]

**Example(2):**

$$\begin{pmatrix} 3 & p & p \\ p & 3 & p \\ p & p & 3 \end{pmatrix} \cdot x = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

 where:  $p \in [0, 1]$ 

iteration =2,

Proposed method	Elaraby [5]	Popova [18]
[0.111111,0.333334]	[0.111111,0.333334]	[0.177533,0.772466]
[0.111111,0.333334]	[0.111111,0.333334]	[0.080561,0.469439]
[0.111111,0.333334]	[0.111111,0.333334]	[-0.382168,0.132168]

*N.B . We got the same result as Elaraby, because there is no dependency will be happened between the parameters.*

**Example(3):**

$$\begin{pmatrix} 1 + p_1 + p_2 & p_1 & p_2 \\ 0 & p_1 + p_2 & p_2 \\ 0.1 & 0 & 3 p_1 + p_2 \end{pmatrix} \cdot x = \begin{pmatrix} p_1 + 5 p_2 \\ 2 + p_1 + 3 p_2 \\ 1 + 2 p_1 + p_2 \end{pmatrix}$$

 where:  $p_1 \in [0.4, 0.5]$ ,  $p_2 \in [0.2, 0.3]$ 

iteration =10,

Proposed method	Elaraby [5]	Popova [18]
[-0.440114,-0.056444]	[-0.776142,-0.132614]	[-0.468005,-0.022753]
[3.574649,4.597432]	[3.325426,5.114795]	[3.631414,5.540667]
[1.258164,1.460008]	[1.103743,1.69829]	[1.256884,1.461288]

**Application:**

we consider a linear resistive network, presented in [14,15]. The resistive network consists of two current sources  $J_1$  and  $J_2$  and nine resistors. The problem of finding the voltages  $v_1, \dots, v_5$ , when the voltage of each conductance  $g_i, i = 1, 2, \dots, 9$  varies independently in prescribed bounds  $[g_i]_i, i = 1, 2, \dots, 9$ , leads to the following parameterized linear system

$$\begin{pmatrix} g_1 + g_6 & -g_6 & 0 \\ -g_6 & g_2 + g_6 + g_7 & -g_7 \\ 0 & -g_7 & g_3 + g_7 + g_8 \\ 0 & 0 & -g_8 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ -g_8 & 0 & 0 \\ g_4 + g_8 + g_9 & -g_9 & 0 \\ -g_9 & g_5 + g_9 & 0 \end{pmatrix} \cdot v = J$$

 where  $J = (10, 0, 10, 0, 0)^T$  and the parameters are

 subject to tolerances  $[g_i]_i = [1 - \delta, 1 + \delta], i = 1, 2, \dots, 9$ .

We solve the system for different values of the tolerances

 $\delta$  varying from 0.1% to 10% of the nominal value.

iteration =24, tolerance=0.1%

Proposed method	HBR method [14]	Elaraby [5]	Popova [21]
[7.01793,7.16388]	[6.8693, 7.2950]	[6.89898,7.29765]	[7.01337,7.16844]
[4.13776,4.22587]	[4.0689, 4.4971]	[3.97569,4.40530]	[4.11566,4.24797]
[5.39797,5.51111]	[5.2501, 5.6612]	[5.26906,5.65655]	[5.39177,5.51732]
[2.15854,2.20509]	[2.0183, 2.3568]	[2.04981,2.32733]	[2.13647,2.22716]
[1.07903,1.10278]	[1.0397, 1.1931]	[1.00461,1.18717]	[1.05937,1.2244]

**VIII. CONCLUSION**

The problem of solving parametric linear systems of equations is very important in practical applications. A simple method for determining an outer solution to the linear system considered has been suggested in section 5 by using the method presented in section 4. Some numerical and practical examples are solved. The methods that presented can be applied to big real life problems such as structural engineering [16, 21] without any problems..

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# SECTION 14.

*Natural science - chemistry*

# SECTION 15.

*Natural science - biology*

# Socio-economic differences in mortality of the female and male (age 15-49,9) in central Poland in the end of the 19th century

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**Abstract—** In this work, females and males (age 15-49,9) death rates in 5-years age range for two different parishes was researched. Our results confirm that the urban environment was less favorable for life than the rural one. DR analysis of a female and male groups in a large age range 15-49,9 regardless of their habitats has shown significantly lower mortality in rural population. An analysis of female groups in specific researched populations has shown that in consecutive age categories statistically significant differences in mortality cannot be found, regardless of a habitat. The analysis of death rate in specific male groups, however, has shown that the differences in consecutive age categories concern urban population from Torun (in rural Kowal Parish male mortality reaches the same value regardless of age). The analysis on DR of both populations in a large age group of 15-49,9 years old has shown significantly higher mortality of males than females, but only in urban population.

**Keywords-** SES differences, female mortality, male mortality, gender differences, historical biodemography

## I. INTRODUCTION

Genetic developmental processes of the body, the level of health, morbidity and mortality are constantly modified by environmental factors and lifestyle. However, whether an environmental stimulus will have a definite effect will depend on the sensitivity of the organism called eco-sensitivity. In the absence of reaction to a stimulus there is a tolerance of the body, and the answer will be, when the stimulus exceeds the tolerance limit. This in turn will be possible when the acting factor is sufficiently severe or prolonged accordingly [1], [2].

Many research results show that the differences in health state and bio-demographic parameters of population is influenced by many factors, both internal and external (ecological, social environment, genetic, and individual characteristics). Standards of living and socio-economic status (SES) greatly influence growth rate and puberty, as well as morbidity and mortality (for example [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14]). Researches confirmed that the higher economic status related in general to better health and lower mortality level [10], [11], [15], [16], [17]. The research on this subject concerning people and history of Poland, turns out to be limited because the current analysis is focused usually on spatial-limited parts of the country. There is also a deficiency of synthetic elaborates that could clearly define the character of relations described above and their variability in time and space [18].

Eco-sensitivity, depending on genetics, is different for different periods of ontogeny and of both sexes. The bigger one is during these periods of development, in which the faster the rate of growth characteristics for which the stimulus act, and in males. Periods of special susceptibility to external stimuli are called phase sensitive. In humans, the strongest is the period of rapid growth and development, ie from 1 to 3 years of age at the time of puberty (12-18 years old) and elderly (50-60 years of age). So can we notice the impact of socio-economic condition of the biological adults based on gender?

Therefore the main aim of this research is to comparative analysis on mortality of the females and males 15-49,9 years old within two local centers that are different in terms of size, development degree and industrialization in the central part of modern Poland, in the second half of 19<sup>th</sup> century.

Research hypothesis raised in this work finds population mortality (15-49,9 years old) strictly matched with generally defined gender and living conditions of population, including environmental and socio-economic factors. Populations that have been chosen for research (inhabiting villages of Kowal parish and Torun city) are characterized by different habitat – from one side it is a huge and fast-developing city (providing uncomfortable living conditions), from the other side there are non-industrial villages (positively influencing the population health state). They also remained under the rule of the different occupants (Fig. 1) - in terms of political, agricultural and social grounds providing different living conditions for populations inhabiting those lands. Area annexed by Prussia, which included Torun, provided better living conditions than it had place in Kuyavian village which was developing slowly, russified and economically confined by politics of the occupants [19], [20], [21], [22].

## II. MATERIAL AND METHODS

Information about the state and the biologic dynamics of populations living in 19<sup>th</sup> century (the researched period 1876-1894) in Torun and Kowal parish kept in the collections of National Archive in Torun. Parochial metrical documents, that were lodged as the duplicates of the books in National Archive in Torun, Department in Włocławek, in the group of Documents of The Civil State of the Roman-Catholic Parish of Kowal, with signatures 142-220.

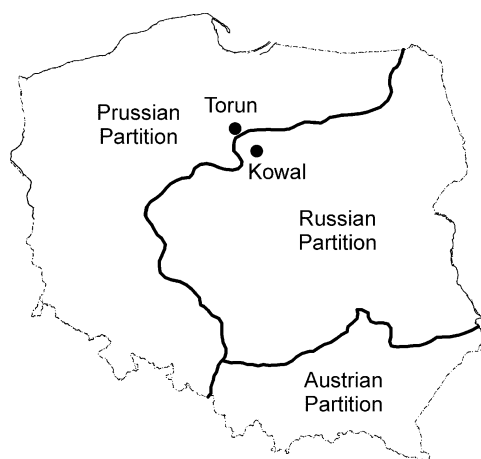


Figure 1. Map of 19<sup>th</sup> Prussian, Russian and Austrian Partitions with Torun and Kowal Parish on the background of contemporary Poland

Data concerning population of Torun was taken from the original Prussian statistical yearbooks collected into documents AmT No 17513 and 17514 (collections of The National Archive in Torun).

In this work, females and males death rate of age of 15-49,9 years in 5-years age range for both parishes was researched.

Analogically to infant death rate (IDR), that is used in research literature and illustrates proportion between mortality of children who had died before age of one year and the number of births in researched period a proportion between death number of people who had died in age of 15-49,9 years old ( $DR_{(15-49,9)}$ ) was estimated (considering gender range) together with overall number of births pertaining to the researched period [9], [23]. In the same way values of death rates of females and males who had died in age of 15-49,9 years old, in accordance with consecutive 5-years age ranges were estimated, without considering and also with considering gender of deceased people. We also estimated the average share of females and males (%) in overall number of deaths of adults 15-49,9 years old in consecutive 5-years age ranges.

Results were subjected to statistical analysis with using of non-parametric statistical U Mann-Whitney tests and ANOVA rang Kruskal-Wallis (MS Excel 2000, Statistica 9.0 PL, PAST - version 2.04 – <http://folk.uio.no/ohammer/past>). When the significance of discrepancies between researched tests was confirmed ( $p < 0,05$  and  $p < 0,001$ ), this significance was examined by U Mann-Whitney test (Bonferroni corrected) between subsequent groups, in pairs.

### III. RESULTS

The death rates (DR) of females and males of age of 15-49,9 years old have been calculated. An analysis of female groups in specific researched populations has shown that in consecutive age categories statistically significant differences in mortality cannot be found, regardless of a habitat (Fig. 2, 3).

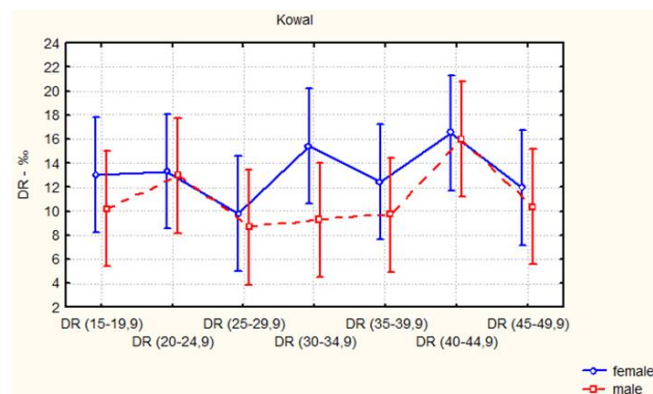


Figure 2. Values of deaths rates (%) concerning researched Kowal Parish population

Although it has been noticed that in population of Torun, the lowest mean values of these rates concern the youngest age group (15,54%), and further, in consecutive age categories these rates slightly increase reaching a value from 18,67% (30-34,9 years old) to 23,19% (20-24,9 years old). In rural population, the lowest mean DR has been noted for the age group of 25-29,9 (9,81%), and the highest for the oldest group - 40-44,9 years old (16,51%), (TAB. I).

The analysis of death rate in specific male groups, however, has shown that the differences in consecutive age categories concern only population of Torun (in population of Kowal male mortality reaches the same value regardless of age). The lowest mortality has been noted for the youngest age group of 15-19,9 years old (19,82%), but later it has significantly increased (significant differences have been noticed between the age group of 15-19,9 years old and the remaining age categories), (TAB. II).

Numerous analyses indicate shaping dissimilarities of birth rate, death rate, demographic dynamics. It has been also noted that biological condition of city populations is lower than in case of un-urbanized, unindustrialized rural populations and male individuals [18], [23], [24].

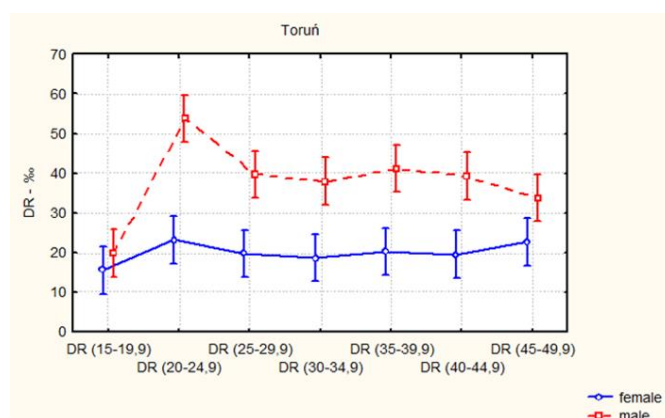


Figure 3. Values of deaths rates (%) concerning researched Torun population

TABLE I. COMPARISON OF THE DR MEAN VALUES (ABSOLUTE VALUE) IN PAIRS FOR THE SEQUENT AGE GROUPS FOR FEMALES

	Kowal						
	15-19,9	20-24,9	25-29,9	30-34,9	35-39,9	40-44,9	45-49,9
15-19,9		-0,3	3,2	-2,4	0,5	-3,5	1
20-24,9	-7,7		3,5	-2,1	0,8	-3,2	1,3
25-29,9	-4,2	3,5		-5,6	-2,6	-6,7	-2,1
30-34,9	-3,1	4,5	1		3	-1,1	3,5
35-39,9	-4,7	2,9	-0,6	-1,6		-4,1	0,5
40-44,9	-4	3,6	0,1	-0,9	0,7		4,6
45-49,9	-7,1	0,5	-3	-4	-2,4	-3,1	
Torun							

The analysis on DR of both populations in a large age group of 15-49,9 years old has shown significantly higher mortality of males than females, but only in city population (mean values of DR for the researched period reached: 139,62‰ – for females, and for males – 265,44‰;  $p < 0,001$ ).

Although in rural habitat female mortality was the same as the male one, but in fact a slightly higher mortality of females comparing to males can be noticed (mean values of DR in researched period reached 92,48‰ for females and 77,04‰ for males. If we consider the rate values for consecutive five years old age categories, we will notice that differences in Torun population were found almost in all researched groups. Similar mortality, regardless of gender, has been noted only for age groups of 15-19,9 years old, although in other age groups we can note higher mortality of males. In un-urbanized, unindustrialized population of Kowal no differences have been found regardless of the age group (TAB. III).

DR analysis of a female group in a large age range 15-49,9 regardless of their habitats has shown significantly lower

TABLE II. COMPARISON OF THE DR MEAN VALUES (ABSOLUTE VALUE) IN PAIRS FOR THE SEQUENT AGE GROUPS FOR MALES

	Kowal						
	15-19,9	20-24,9	25-29,9	30-34,9	35-39,9	40-44,9	45-49,9
15-19,9		-2,8	1,6	0,9	0,5	-5,8	-0,1
20-24,9	-33,9**		4,3	3,7	3,3	-3,1	2,6
25-29,9	-19,9**	14,1		-0,6	-1	-7,4	-1,7
30-34,9	-18,2**	15,7	1,7		-0,4	-6,8	-1,1
35-39,9	-21,3**	12,6	-1,4	-3,1		-6,3	-0,7
40-44,9	-19,4**	14,5	0,5	-1,2	1,9		5,7
45-49,9	-13,9°	20	6	4,3	7,4	5,5	
Torun							

\* - statistically significant differences ( $p < 0,05$ )

\*\* - statistically significant differences ( $p < 0,001$ )

TABLE III. VALUES OF THE DEATH RATES (DR) DIFFERENCES OF FEMALES AND MALES 15-49,9 YEARS OLD (‰) FROM THE 2<sup>ND</sup> HALF OF 19<sup>TH</sup> CENTURY.

Age category	The female-male death rates differences - DR (absolute value)		The Kowal-Torun death rates differences - DR (absolute value)	
	Kowal	Torun	female	male
15-19,9	2,81	-4,28	-2,53	-9,63**
20-24,9	0,36	-30,57**	-9,89*	-40,81**
25-29,9	1,17	-20,00**	-9,89*	-31,07**
30-34,9	6,17	-19,35**	-3,25	-28,77**
35-39,9	2,80	-20,88**	-7,80*	-31,47**
40-44,9	0,51	-19,66**	-3,05	-23,23**
45-49,9	1,62	-11,07*	-10,72**	-23,41**
15-49,9	15,44	-125,82**	-47,14*	-188,39**

\* - statistically significant differences ( $p < 0,05$ )

\*\* - statistically significant differences ( $p < 0,001$ )

mortality in rural population (mean values of DR in researched period reached 92,48‰ for Kowal and 139,62‰ for females living in cities;  $p < 0,05$ ; TAB. III). If we consider the female rate values in consecutive five years old age groups, we will notice that the differences have been found almost in all researched groups. Female mortality, regardless of habitat, was similar only for age groups of 30-34,9 and 45-49,9. Differences between death rate also regard to the male group. We observe significantly higher mortality of males living in cities than in villages, both in terms of DR values for large age range and in consecutive age categories (except the youngest group of 15-19,9 years old).

For consecutive age categories, in the age group of 15-49,9 years old, the mortality of females in both researched populations is similar (except the difference between the youngest and the oldest age group in population of Torun; Fig. 4, 5).

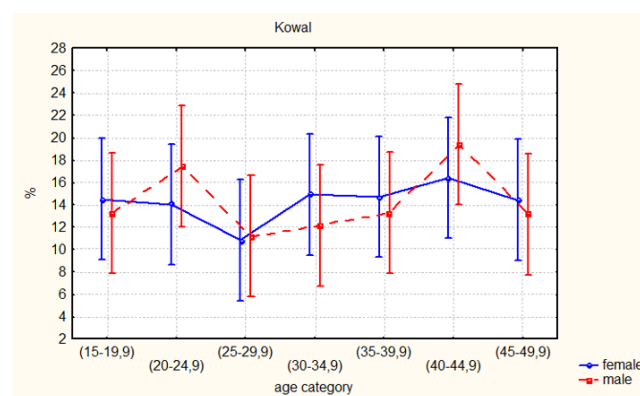


Figure 4. The average share of females and males (%) in overall number of deaths of adults 15-49,9 years old in researched Kowal Parish population

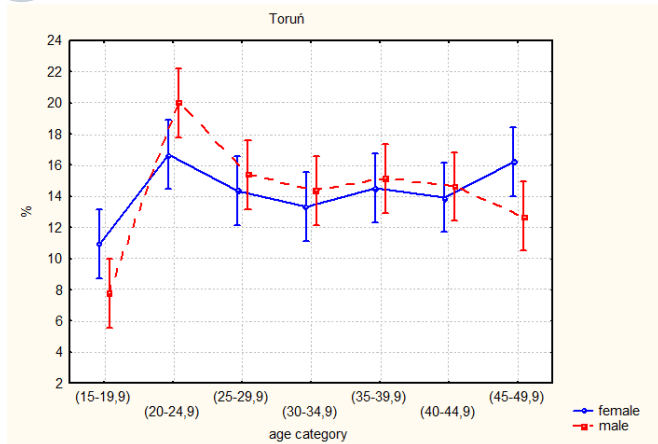


Figure 5. The average share of females and males (%) in overall number of deaths of adults 15-49.9 years old in researched Toruń population

By contrast, the situation of males looks different. In rural population we do not observe any significant differences, although we can note some changes in mortality of males living in the cities, for consecutive age categories. It has been concluded that the youngest group of 15-19.9 years old is the least numerous group among all of individuals between the age of 15-49.9, while in other age groups mortality of males was similar ( $p < 0.001$ ).

#### IV. DISCUSSION

Many studies indicated that in the 19<sup>th</sup> century rural populations were characterized by higher birth rate and stronger demographic dynamics than the populations living in larger cities or smaller towns [23], [25]. Higher morbidity and mortality in cities than in agricultural, non-industrialized areas and the negative impact of urbanization on mortality rates and state of health has been noted [15], [18], [26], [27]. Such impact has been observed foremost among populations of 19<sup>th</sup> century England, Wales, France, Norway or Germany [10], [28], [29], [30], [31]. In the Western Europe (comp. [10], [32], [33], [34]), the research is mostly focused on differences in mortality pertaining to infant period et after-infant period, but it does not include an extensive consideration of this problem with regard to older children, limited research also refers to adult mortality studies [18], [23], [35], [36].

The character of the relations between socio-economic factors and children mortality is markedly different in the following age groups, however, not only among children [10], [37]. It was found that the urban-rural differences in health state and mortality are determined by many factors, such as differences in lifestyle, ecological situation, access to health and social services, unequal distribution of incomes and resources [38]. Unfortunately, most studies are limited to a single community, socio-economic status is determined on the basis of different criteria, making it difficult to conduct comparative studies, although since the late 1970's the SES differences in mortality turned into a central topic for epidemiologists and demographers [39], [40]. Researches often states that there are differences in mortality between the sexes [41], [42] (according to [43]). In these work the analysis on deaths rates DR of both populations in a large age group of 15-

49.9 years old has shown significantly higher mortality of males than females, but only in urban population.

As Sen noted, "Considerable research has shown that if men and women receive similar nutritional and medical attention and general health care, women tend to live noticeably longer than men" [44]. There is a strong covariation between mortality and socio-economic status and gender, with the male mortality is more sensitive to social conditions than is female mortality [45] [46]. Urbanization may have given rise to growing excess male mortality was suggested e.g. by Hart [47] or Kula [48], who suggested that excess male mortality in cities was generally higher than in rural areas and rised up with increasing of industrialization level. In general, men have higher mortality rates than women, which in addition are less sensitive to the socio-economic conditions in which they live.

Consequently, when social conditions are more favorable to longer life, the male-female mortality gap is smaller [45]. It could be assumed that women are biologically protect and premature death. The increase in excess male mortality is often interpreted as the result of diminished social discrimination against women [47].

Our results confirm that the urban environment was less favorable for life, especially for men. Socio-economic status of the urban population in the 19<sup>th</sup> century was worse, because of the high density, lack of sewage and poor working conditions [16]. As expected, in the urban parish died significantly more men and women than in rural parish. Equation of the mortality level among urban and rural women in groups 30-34.9 and 40-44.9 might be due to a maternal mortality [49]. According to some researchers it could cause increased mortality among rural women in groups of 30-39 and 40-49 [49]. These differences were caused by different "family model" in the countryside and in the city (different age of marriage, age of born of the first child, different number of children). Maternal mortality was directly related to the number of pregnancies experienced and exposure to additional risks associated with pregnancy in the late stages of the female reproductive period [43], [50], [51]. Effects of environmental conditions on the mortality of men caused their excess mortality in almost all age groups.

Both centers were different not only in terms of urbanization level, but also due to location under different partitions. Area annexed by Prussia provided better living conditions than slowly, russified and economically confined to politics of the occupants Kowal Parish. Despite of this living conditions in rural area was better than in the city. It seems that the observed differences in the mortality of the adults from two centers in central Poland 19<sup>th</sup> resulted from ecological and cultural conditions, rather than from political and economical grounds (living under different partitions).

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# Evolution of hemagglutinin gene in archival influenza A (H3N2) viruses isolated in Southern Greece during 1980-2004

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**Abstract-**Analysis of the hemagglutinin gene sequences of 28 influenza A (H3N2) archival viruses isolated in Southern Greece during 1980-2004 was carried out in order to determine the molecular evolution of these viruses in Southern Greece. The amino acid sequences revealed substitutions at key amino acid residues (124, 133, 134, 142, 194 and 226), all linked with virus antigenicity and receptor binding specificity. Especially, at residue 226 there was an Ile to Val substitution, in all viruses analyzed. The substitution in residue 226 was absent from reference viruses, suggesting its relevance to egg-mediated adaptation.

**Key words:** Molecular evolution, influenza A (H3N2) viruses, hemagglutinin gene

## INTRODUCTION

Influenza viruses belong to the family Orthomyxoviridae, contain single stranded, segmented RNA genomes of negative polarity and are distinguished in three antigenic types. Viral types A and B are responsible for yearly epidemics of acute respiratory disease, worldwide, while type C viruses have sub-clinical importance. Type A viruses are further classified into antigenic subtypes based on differences in the surface glycoproteins, hemagglutinin (HA) and neuraminidase (NA). Via the mechanism of antigenic drift acting on the HA molecule of influenza viruses, the nature of their genomes and immune pressure by the host, novel antigenic influenza viral variants are periodically isolated against which there is limited immunity in the population [1, 2]. Selective pressure acting on influenza virus genetic mechanisms determines the evolutionary rate of change in all gene segments of influenza viruses, including HA and neuraminidase NA gene segments, which comprise the target of neutralizing antibodies and antiviral compounds. The precursor HA0 molecule is cleaved by cellular proteases into the HA1 and HA2 segments, that is a necessary step in viral infection. The HA molecule has a dual role in the early stages of viral replication. It binds to cellular oligosaccharide receptors containing sialic acid (SA) and mediates endocytosis [3].

Since their emergence in 1968, type A (H3N2) viruses have been associated with severe illness and influenza epidemics in many parts of the world.. Routine surveillance performed in

WHO national influenza reference centers contributes valuable information in the formulation of yearly influenza vaccine composition. Increasingly, in many virology and public health laboratories, molecular analysis of the HA gene is routinely performed together with conventional virus isolation and antigenic typing, thereby improving influenza surveillance and disease management [5]. The importance of molecular analysis is in determining the efficacy of viral HA binding to cellular receptor molecules, antiviral resistance genes and in identifying genome sequences of avian origin

In this study, we have analyzed, by RT-PCR and DNA sequencing, the HA gene

segment of 28 archival influenza A (H3N2) viruses isolated in Southern Greece from 1980-2004, representing 25 years of influenza surveillance. Also, in order to determine the extent of genetic and antigenic variation in the HA, we correlated the molecular data with the antigenic drift exhibited in these viruses, by the hemagglutination-inhibition method.

## Materials and methods

### Archival influenza A (H3N2) viral isolates

The hemagglutinin gene sequences of twenty-eight archival influenza A(H3N2) viruses, isolated in embryonated hen's eggs and identified by the hemagglutination-inhibition (HAI) method, at the National Influenza Reference Center, Southern Greece, during the period 1980-2004, were characterized in this study. Virus isolation and antigenic analysis were performed according to WHO standard protocols [7, 8 ].Specifically, 9 and 19 viral isolates from the 1980-1992 and the 1993-2004 surveillance seasons, respectively, were analyzed. The selection criteria were the antigenic and epidemiological profile of the virus. The HA sequences of the viruses were submitted to Genbank (Accession numbers: EU642547-EU642551, EU650318, AF316817- AF316821, EU835536-EU835538,EU502463, AF315570, AF315571 and AF315559-AF315569).

## RT-PCR, and DNA sequencing of HA gene segment

Viral RNA extraction, cDNA synthesis, RT-PCR and sequencing reactions were performed according to previously published protocol [7]. Sequence analysis was performed by the BLAST program and sequence alignments by CLUSTAL W and Molecular Evolutionary Genetic Analysis programs (MEGA 3.1), [4]. In each case, our influenza isolates were compared with influenza type A (H3N2) reference and clinical viral strains in the influenza database (Los Alamos National Laboratory, USA).

## RESULTS AND DISCUSSION

### Antigenic analysis of archival A (H3N2) viruses

During the 1980-2004 influenza surveillance periods, the majority (80%) of viruses isolated in Southern Greece, were type A and of those, 90% were identified as subtype H3N2. Based on HAI results, the H3N2 viral isolates were antigenically similar to vaccine strains of the respective surveillance periods, HAI titer of at 640 or greater (data not shown).

### Amino acid sequence analysis.

The nucleotide and amino acid sequences of the HA were determined for 28 archival influenza A (H3N2) viral isolates. The mean number of amino acid substitutions in the HA of our isolates compared with that of the reference strains ranged from 10-15%. Thus, the estimated annual rates of amino acid substitutions from 1980-2004 ranged from 3-5%. More specifically, in antigenic sites A and B of the HA1 region of the HA, there were a Val at residue 124, a Lys at residue 133 and a Val at residue 134 and a Phe at residue 142 substitutions for the majority (96%) of our isolates, also present in, A/Bangkok (H3N2) and A/Brazil-(H3N2)-like viruses, as well as in viruses of later lineages (1993-2001), such as A/Johannesburg/, A/Wuhan, A/Sydney, and A/Moscow (H3N2)-like viruses.

Isolates of the 1980-1992 period possessed substitutions characteristic of A/Bangkok (H3N2) like viruses. Substitutions at both residues 122 and 198 (Asn<sup>122</sup> to Lys and Ala<sup>198</sup> to Thr) were found in 2 A/Brazil-like isolates and 3 A/England-like isolates, respectively, of the period 1980-1992. These residues are located within the antigenic sites A and B of the HA1 region. At residue 194, which is located within antigenic site B and is implicated in the attachment of HA to its cellular receptor, there was an Asp substitution for all 1980-1992 and in viruses circulating until early 1999-2000 season, while there was observed a Glu substitution in isolates of the 2000-2004 period. Residue 226, which is implicated in receptor specificity and host range restriction, had an Ile to Val substitution in all viruses. The substitution in residue 226 was absent from reference viruses, suggesting its potential relevance to egg-mediated adaptation. Amino acid substitutions are shown in Table 1.

Sequence analysis of the HA gene segment, can provide a very sensitive approach to the assessment of genetic variability of viral isolates. Amino acid substitutions that can alter antigenicity, receptor binding specificity (RBS) and haemagglutinating ability of viruses may occur by multiple passages of the original samples in embryonated eggs. It has been shown that substitution at residue 226 alters H3 receptor specificity of human viral isolates towards erythrocytes from different species and restores their haemagglutinating ability towards avian erythrocytes [5]. Sequence analyses of HA from archival influenza type A (H3N2) isolates in Southern Greece revealed substitutions in amino acid residues 124, 133, 134, 142, 194 and 226, the latter is implicated in egg-mediated adaptation and may influence viral antigenicity and erythrocyte agglutinating ability. Substitution at residues 124 and 133 introduced N-glycosylation in our isolates, potentially altering their antigenicity (5, 6).

TABLE I. AMINO ACID SUBSTITUTIONS IN THE HA MOLECULE OF ARCHIVAL A(H3N2) VIRUSES

HA amino acid residue						
Viral Isolate	124	133	134	142	194	226
<b>1993-2004 period</b> A/Sparti/96/00 A/Athens/228/00 A/Athens/172/00 A/Grece/109/03 A/Greece/132/99 A/Athens/135/99	V	L	I	F	E	V
<b>1993-2004 period</b> A/Athens/94/98 A/Athens/1/98 A/Athens/2/98 A/Greece/103/98 A/Athens/76/98 A/Greece/109/99 A/Greece/106/98 A/Greece/10/98 A/Athens/7/98 A/Athens/16/98 A/Greece/18/98 A/Greece/19/98 A/Athens/220/98	V	L	V	F	D	V
<b>1980-1992 period</b> A/Athens/112/92 A/Greece/1/90 A/Athens/2/91 A/Athens/23/89 A/Greece/4/88	V	L	V	F	D	V
<b>1980-1992 period</b> A/Athens/2435/81 A/Athens/4135/83 A/Athens/2403/84 A/Athens/2342/81	V	L	V	F	E	V

V-Valine, L-Leucine, F-Phenylalanine, D-Aspartic acid, I-Isoleucine, E-Glutamic acid

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# SECTION 16.

*Natural science - physics*

# SECTION 17.

*Electronics, Electrical Systems, Electrical Engineering*

# Custom Options for Custom Processors

with the CCC Hardware Synthesiser

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**Abstract**—The proliferation and complexity of current integration circuits, including custom processing units is leading to a great extend to specification-to-market cycles that exceed the product lifetimes in the market. Thus, formal High-level Synthesis techniques are being investigated by industry and academia, as a rapid prototyping and rapid development solution to custom processing products. In this work, rapid development of custom processors with custom options, such as the location of big data, the type of the target micro-architecture and the re-use of predesigned custom arithmetic functional units, are exercised in a formal and automatic way, from abstract high-level algorithmic specifications. The utility of the presented synthesis methodology is evaluated with a number of compilation benchmarks including a hierarchical model of the RSA cryptographic algorithm.

**Keywords**- Custom Processor Design; High-level Synthesis; Formal Methods; ADA; VHDL; RTL Synthesis; High-speed Simulation

## I. INTRODUCTION

The recent evolution in Integrated Circuits (IC) technology, have enabled the proliferation of extremely IC and System-on-a-Chip (SoC) products. These digital systems that are found in embedded and portable products, consist of very complex components, such as processor cores, custom processing units, interface blocks, memories, design hierarchy, buses and interconnections. Therefore, and in order to deal with this system complexity, new formal High-Level Synthesis (HLS) methodologies are needed, so as to achieve development automation, implementation quality and fast specification-to-product times. Current HLS tools are still not widely accepted by the engineering community because of their incompatible source languages and their poor results, particularly for large applications with complex module and control-flow hierarchy. The existing commercial or academic HLS tools, impose several proprietary extensions or restrictions on the programming subset that they accept as input, and suboptimal heuristics on the HLS transformations that they utilize. These tools are suitable for linear, dataflow dominated designs, such as pipelined DSP, image processing and streaming.

The main contribution of this work is the formal CCC high-level synthesizer [1], which is based on compiler-compilers and formal logic relations. Thus, the resulting provably-correct implementation, by definition, matches the functionality of the source code. Therefore, only fast behavioral verification is required, eliminating the need for lengthy RTL or even worse, annotated gate netlist simulations. The discussed, prototype

HLS toolset<sup>1</sup>, optimizes the schedules of operations into control steps (states), by achieving the maximum operation parallelism [2]. The source ADA code is transformed into the Intermediate Tables Format (ITF)<sup>2</sup> [3], using compiler-compiler techniques [4]. The integrated PARCS (Parallel, Abstract Resource – Constrained Scheduler) optimizer utilizes formal logic programming relations [5] and scheduling algorithms [6].

The next section presents existing work on HLS techniques. Section III explains the custom options of the author's prototype hardware synthesis tool. Section IV describes the case study of a custom processor synthesis from an ADA specification of a cryptographic RSA application. Modeling and verification issues are analyzed in Section V. Section VI discusses synthesis results from a number of selected benchmarks. The last section, draws useful conclusions and proposes future work on the developed HLS methodology.

## II. EXISTING WORK AND BACKGROUND

In [7], C programs using pointers and the functions malloc and free are mapped onto hardware, producing implementations that instantiate custom hardware memory allocators. Every allocator is coupled with the specific memory architecture. The SpC tool [7] transforms C functions with complex data structures into Verilog models, and the tool is implemented using the SUIF compiler environment [8]. Memory locations are mapped onto variables and arrays in the generated Verilog modules which are synthesized using the Synopsys's Behavioral Compiler.

A scheduling heuristic optimises behavioral specifications with a lot of conditional control flow [9]. The heuristic uses an intermediate design representation that supports chaining and multi-cycling, conditional resource sharing and speculative execution, and thus is suitable for scheduling conditional code. This intermediate representation is called hierarchical conditional dependency graph (HCDG).

Integrated coarse-grain and fine-grain parallelizing transformations are applied on the input design in [10]. These transformations execute both during a pre-synthesis phase and during scheduling, improving the implementation quality. The SPARK HLS tool transforms a small subset of C into RTL

<sup>1</sup> The CCC ESL hardware compiler method is patented with patent number: 1005308, 5/10/2006, from the Greek Industrial Property Organization (OBI)

<sup>2</sup> The intermediate tables format is patented with patent number: 1006354, 15/4/2009, from the Greek Industrial Property Organization

VHDL hardware models [10]. However, there are serious restrictions on the accepted by SPARK subset of the C language, such as inability to accept design hierarchy modules (e.g. subprograms) and of “while” type of loops. Three large examples evaluate SPARK in [10]: MPEG-1, MPEG-2 and the GIMP image processing algorithm.

Scheduling, resource allocation, module binding, module selection, register binding and clock selection are executed simultaneously in [11] so as to achieve better optimization in design energy, power and area. Resource constraints drive the scheduling algorithm, which enforces concurrent loop optimization and multi-cycling on the implementations [11].

Incremental behavioral and physical optimization are combined in an incremental floorplanner in [12]. These optimisations are integrated into the existing interconnect-aware ISCALP synthesiser [13].

Beginning with a behavioral C description of the system, the methodology in [14] applies behavioral profiling in order to extract simulation statistics of computations and references of array data. This creates footprints which contain the accessed array locations and the frequency of their occurrence. This synthesis approach [14] is suitable for the design of distributed logic and memory architectures and is implemented into an industrial tool called Cyber [15].

The system specifications in [16] consist of communicating processes and the operation scheduling is considered globally, in the system critical path (instead of the individual process critical path), in contrast to the conventional HLS approach that synthesises each concurrent process separately.

Memory access management is integrated in a HLS methodology in [17]. It mainly targets digital signal processing (DSP) and streaming systems, with specific performance constraints. The synthesis transformations are performed on the extended data-flow graph (EDFG) which is based on the signal flow graph. EDFG models the access and data computations, the transfers of data, and the condition statements for addressing, computation and data transfers respectively. Mutually exclusive scheduling methods are implemented with the EDFG [18], [19]. Dynamic address computation operations are moved from the datapath unit onto the sequencer, based on a set of criteria [17], and this process is called address computation balancing. This improves the overall system performance and graph which is in turn passed on to the GAUT HLS tool [20], to perform operator selection and allocation, scheduling and binding.

There are a few more HLS approaches reported in the bibliography, but extensive review of them is not the purpose of this paper, since they fall in one or more of the above categories. Moreover, the focus of this work is on custom options that apply on the formal HLS hardware compiler, developed by the author of this paper. The significant differentiation of this work is the formality of the synthesis transformations, and the flexibility of including this method in any existing industrial design flows, using the various custom options that are available to the user of the CCC methodology.

### III. THE CCC HLS CUSTOM OPTIONS

The CCC HLS flow is implemented with the frontend and the backend compiler, which are both developed using formal techniques, such as compiler-compilers and logic programming predicate relations. These two compilation phases communicate with each other via the formal ITF format [13]. ITF captures all the information of the input ADA programs, in a formal manner, which is readable by the backend compiler transformations. ITF follows the format of the logic predicate facts [5], and these facts are loaded into the backend inference engine, which produces “formal conclusions” via a number of optimizing transformations including the generation of the targeted HDL language RTL models. Every subprogram in the system specification code is coded in ADA, and it produces one, functionally-equivalent custom processor which is modeled in technology-independent RTL module. Every such RTL module includes the FSM and the datapath of the custom processor.

A number of custom options can be selected for the generation of the custom processors from the input ADA system specification. Large data objects can be located either on chip as register file inside the custom processor, or in the system’s main (shared) memory. If location on external memories is desired, then a file of memory communication options must be constructed by the designer, and given to the backend compiler to configure the translation flow. In this case, all the necessary memory ports, and communication protocols are automatically generated by the CCC tool and are embedded into the total operation schedule of the processor. In this way, an improved, integrated custom processing optimization is achieved, as opposed to separate core and interface optimizations.

Other custom options involve the resource constraints that are used to drive the embedded PARCS scheduler<sup>3</sup>. PARCS is an aggressive optimizer that compresses the length of the initial state schedule (the one that comes out directly from the analysis of the ADA programs), and parallelizes the operations into states, as far as data and control dependencies allow. PARCS will always attempt to parallelize as many operations as possible into the same control state, but when resource constraints are provided, either at the command-line or by means of a constraint file, then PARCS will go as far as the resource constraints determine. For example, a global constraint of 4 adders can be specified, in which case PARCS will stop at the 4 parallel addition into the same control step of the generated FSM. Moreover, if there is ADA program hierarchy and there are 5 subprograms that contain addition operations then each subprogram can be individually constrained with 4, 3, 6, 6, and 8 maximum parallel adders for each subroutine respectively. Of course, as already mentioned, each such subprogram will be optimized into one standalone custom processor that executes the functions of the specification subprogram. Moreover, a combination of global and local resource constraints can be provided, by means of a command-line option (for all operators) and a constraint file respectively. Then, the maximum constraint value will be

<sup>3</sup> The method of the CCC scheduler is patented with patent number: 1006609, 25/11/2009, from the Greek Industrial Property Organization (OBI)

applied on the PARCS transformations. The user of the CCC toolset, can use the resource constraints as a way to draw cost/efficiency trade-offs, and therefore, to rapidly arrive at the desired balance for the intended type of implementation.

The type of the targeted micro-architecture can also be selected by a different custom command-line option. By default, massively parallel implementations are enabled. With this choice the parallelized operations are directly embedded into the state definitions of the state machine (FSM). The direct impact of this will be simple state command wires and fast execution of the operations without complicated data multiplexers. Therefore, short clock cycles will be achieved. The side-effect of this, is a high degree of resource redundancy since the operators and functional units that are scheduled into inactive states will be idle for a long period of time, and until the respective state is active again. Another choice, specified as another command line is the conventional FSM+datapath architecture. This choice will deliver more economical results since now operators are shared between different states, the resource redundancy is kept low, but maybe (depending on the implementation technology) longer clock cycles will be imposed. Therefore, this option is another means to draw cost/efficiency trade-offs and adapt to different technology requirements such as large ASICs or small FPGAs.

The targeted hardware description language (HDL) can be selected by another command-line option. By default, VHDL is chosen, which leads to VHDL RTL code that models the generated, optimized implementation. However, if desired, Verilog HDL can be specified, which will result into Verilog RTL models. Both VHDL and Verilog code models are technology-independent and tool vendor – independent. Therefore, the generated custom processor descriptions can be synthesized with any RTL synthesizer, into any available ASIC or FPGA technology. These features were tested and confirmed with a large number of test applications that were compiled with the CCC hardware compiler.

The interfaces of the custom processors that are automatically generated by the backend compiler, consist of a hierarchical, simple, synchronous handshake with the computing environment of the processor. A pair of I/Os *START/BUSY* synchronize the beginning and activation of the processor, after the input data are given to it, and the I/O pair *DONE/RESULTS\_READ* synchronize the completion of the custom processor's function and the delivering of its result data to the host environment (e.g. a main system processor).

The input ADA subprogram hierarchy as well as the control flow structures are mapped onto an optimized but nevertheless, one-to-one manner in the generated HDL modules. This means that every separate ADA subprogram is translated into a separate, standalone custom processor in the RTL code. Moreover, when if controlling subroutine calls a controlled subroutine in the ADA code, then by default, these calls generate interface events between the controlling processor and the controlled processor respectively<sup>4</sup>. By default, the calling and the called module are standalone and they can be

<sup>4</sup> The hierarchical coprocessor interface is patented with patent number: 1005968, 4/7/2008 from the Greek Industrial Property Organization (OBI)

synthesized into hardware alone. However, when simulation is used to verify the functionality of the generated HDL code, both modules need to be instantiated into the verification testbench. However, certain ADA subroutines may model custom hardware blocks, using Boolean logic, or other pre-verified and tested functional units, that the designer doesn't want to be modified throughout the CCC compilation. Such custom subroutines can be directly translated into HDL routines and synthesized into the target technology using RTL synthesizers. These subroutines are in turn called within the state description logic of the custom processor FSM. The custom subroutines must be marked as such in a provided by the designer, custom block options file that is in turn read by the backend compiler.

#### IV. A HIERARCHICAL DESIGN EXAMPLE: THE RSA PROCESSOR

Some of the above custom options are explained here with a hierarchical set of subroutines that constitute the RSA cryptography processor, with hierarchy as in Fig. 1.

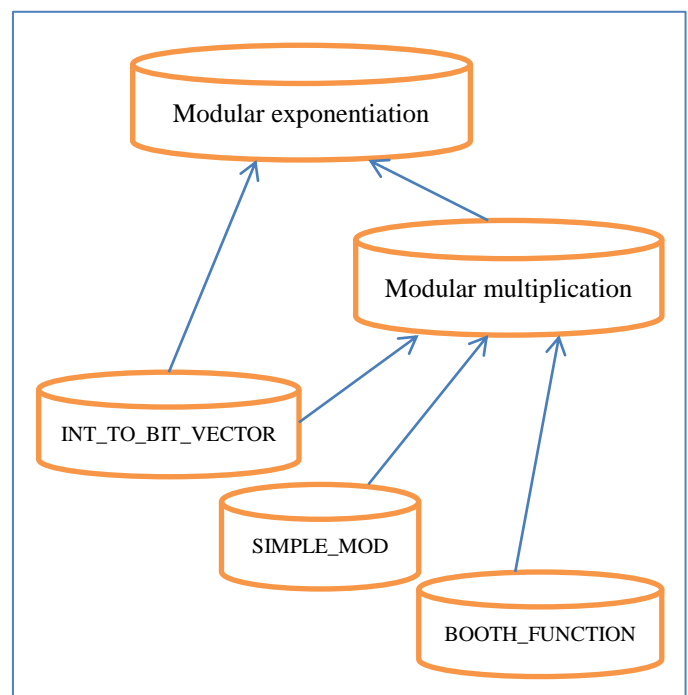


Figure 1. ADA code hierarchy of the RSA processor

In Fig. 1, the blue arrows denote hierarchical relations between two subroutines, by means of a function call relationships. For example subroutine *INT\_TO\_BIT\_VECTOR* is called by subroutine *Modular multiplication* as well as by *Modular exponentiation*. It is obvious from the drawing of Fig. 1 that the top-level routine, hierarchically, is *Modular exponentiation*. If the CCC synthesizer is executed with no custom options, one VHDL module (custom processor) will be generated from each of Fig. 1 subroutines. However, because in the computer engineering practice, subroutines *BOOTH\_FUNCTION*, *SIMPLE\_MOD*, and *INT\_TO\_BIT\_VECTOR* are desired to be treated as Boolean logic blocks, they are marked as custom blocks in a custom blocks file, provided by the user and with contents as follows:

```
combo(1,"int_to_bit_vector", 1)
combo(2,"simple_mod", 1)
combo(3,"booth_function", 1)
```

This custom options file marks the respective subroutines as custom combinatorial blocks, and they will be treated as such throughout the CCC compilation, into hardware custom processors. Therefore, using these options, the CCC compiler will generate for example the following VHDL subroutine:

```
PROCEDURE simple_mod(
    VARIABLE a : IN std_logic_vector;
    VARIABLE n : IN std_logic_vector;
    simple_mod_function : OUT std_logic_vector
) IS

    VARIABLE mm : std_logic_vector(31 DOWNT0 0);
    CONSTANT const1 : std_logic_vector(31 DOWNT0 0) :=
        std_logic_vector(conv_unsigned(0, 32)); -- integer constants are
        converted into std_logic
    VARIABLE var1 : boolean;
    BEGIN
        var1 := a >= const1;
        IF var1 THEN
            mm := a - n;
        ELSE
            mm := a + n;
        END IF;
        simple_mod_function := mm;
    END simple_mod;
```

Figure 2. Generated VHDL custom block for use in the multiplier

This subroutine will be treated as custom combinatorial block by RTL synthesis, since it is called for example in the FSM state definition (in the same RTL code module) of Fig.3 :

```
...
WHEN state_21 =>
    state <= state_22;

    ----- this is a call to custom block : simple_mod -----
    simple_mod_a_var := r ;
    simple_mod_n_var := n ;
    simple_mod(simple_mod_a_var,
                simple_mod_n_var,
                simple_mod_simple_mod_var);
    r <= simple_mod_simple_mod_var; -- default function output
...
```

Figure 3. Function call of the custom block inside the VHDL FSM

This is representative of the way that custom blocks are instantiated in the above manner in the generated custom processors. In this way, predesigned and tested library subroutines can add functionality in new processor definitions, captured in ADA subroutines.

## V. MODELLING AND VERIFICATION

All the processed benchmarks were rapidly modeled in ADA, using programming semantics that are common amongst many imperative programming languages including all complex expressions, subroutines, code hierarchy and complex

control flow with if-then-else, for-loops, while-loops, case-structures, etc.

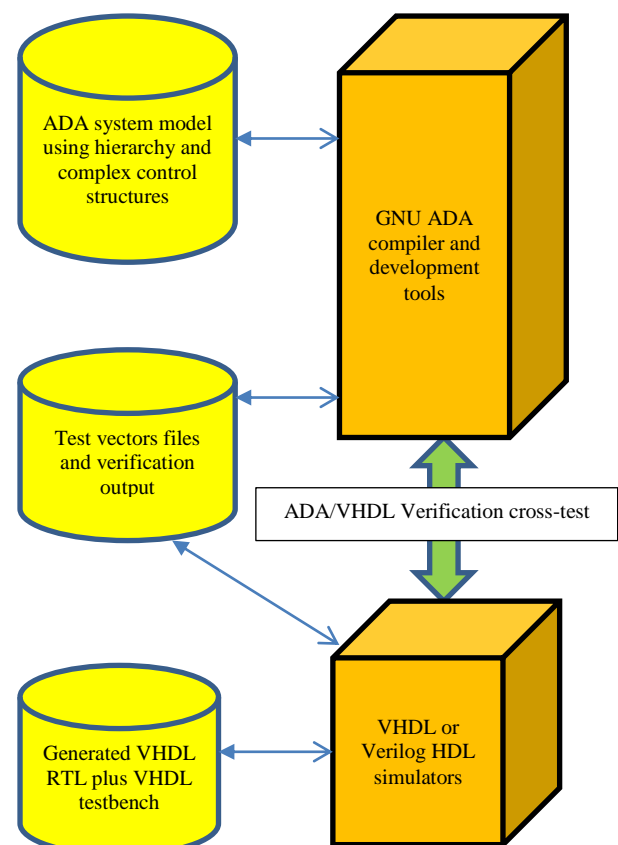


Figure 4. ADA and VHDL cross-verification flow

The verification flow in the CCC methodology is shown in Fig. 4. All the tests were verified using rapid ADA modeling and compile-and-execute using the GNU ADA development tools and compiler.

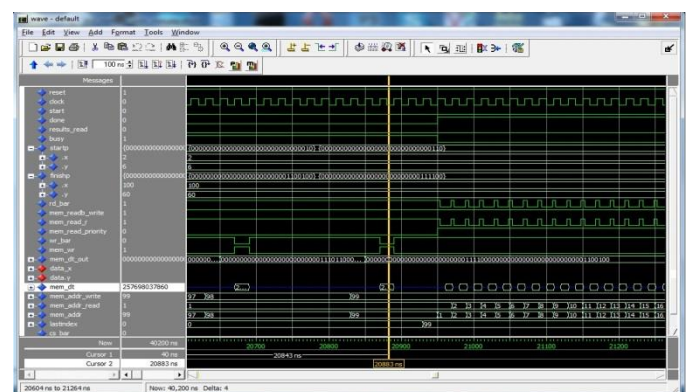


Figure 5. Simulation of a generated line-drawing processor

This type of verification is orders-of-magnitude faster than typical VHDL RTL/gate-netlist simulations, as experience and theory have shown. Due to the formal nature of the CCC synthesizer, there is no requirement for simulation of the

provably-correct generated RTL code, nevertheless RTL simulations were run on all the benchmarks to prove the principle of the above argument. The outputs of the VHDL testbench were loaded back on the ADA testbench for automatic match and comparison. All the tests were passed successfully through the cross-verification test.

Fig. 5 shows the simulation of a generated line-drawing algorithm using the CCC synthesizer. It demonstrates the memory read/writes of the automatically generated memory protocols that were embedded in the optimized custom processor, from custom memory options, provided by the user.

## VI. SYNTHESIS STATISTICS

Four benchmarks from the area of high-level hardware synthesis were run through the CCC hardware synthesizer, in order to evaluate the presented synthesis flow of this work. The programs were executed on a Pentium-4 platform running the MS-Windows-XP-SP2 operating system. The four design benchmarks include a DSP FIR filter, a RSA crypto-processor from cryptography applications, an application that uses two level nested for-loops, and a large MPEG video compression engine. The third benchmark includes subroutines with two-dimensional data arrays stored in external memories. These data arrays are processed within the bodies of 2-level nested loops.

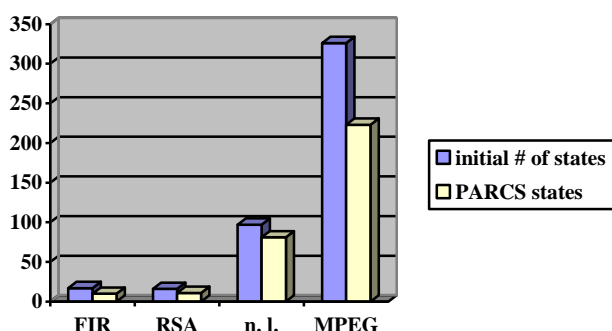


Figure 6. State reduction from the initial schedule to the PARCS shedule

Fig. 6 shows graphically the state reduction from the initial schedule to the one optimized by the PARCS scheduler. The reduction reaches up to 40% for the MPEG algorithm, and this was done in a rapid manner using the automatic generation of the optimized output of the backend compiler. Moreover, the number of states increases significantly for complex applications such as the MPEG engine, where it almost reaches 350 control states. It is well known in the engineering community that for such high-number of control steps, manual optimization and verification of such schedules are practically impossible to be completed on time for the products to enter quickly the market window.

All of the above tests were synthesized into target Xilinx FPGA and ASIC technologies and were simulated to prove the principle of this contribution which is the formality of the utilized synthesis transformations. All simulations proved that the generated custom processors using custom options, are functionally equivalent with their ADA specification.

Moreover, the fact that the ADA specification is executable, contributes significantly to the rapid nature of the CCC design and development approach.

## VII. CONCLUSIONS AND FUTURE WORK

The main contribution of this work is the formal synthesis of custom processors from executable specifications in ADA, using custom options, such as memory configuration, custom blocks, target HDL, and target micro-architecture. The presented design flow is rapid, formal and easy to get acquainted with, even for not very experiences programmers.

A high number of tests were synthesized and verified using the presented methods, and all of them proved the high quality of the evaluated CCC design flow. The generated processor models are easily synthesized with any RTL synthesizer and they are mapped to any of the available FPGA or ASIC technologies.

Future work includes the integration of more than one-cycle custom functions, and enhancement of the employed optimizing scheduler, with advanced transformations such as aggressive code motion techniques. Furthermore, there are ongoing developments of more input language frontends, such as ANSI-C, C++, Java and UML, as well as more output language writers such as cycle-accurate C and System-C, for fast, cycle-accurate verification.

## ACKNOWLEDGMENT

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# SECTION 18.

*Energy*

# SECTION 19.

*Industrial and Civil Engineering*

# Flapwise bending vibration of rotating Euler-Bernoulli beam with non-uniform tapers

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**Abstract—** In this work the dynamic behavior of beams with variable section rotating around an axis is analysed. The natural frequency of the flapwise bending vibration is investigated for the rotating beam. The model used is respectful of the Euler-Bernoulli hypotheses and obtains the natural frequencies and modes according to the rotation speed. Using the Boundary Characteristic Orthogonal Polynomial method is proposed to solve the natural frequency of rotating tapered beam at high angular velocity. Numerous numerical examples are proposed for the calculation of the free frequencies of vibration to vary some parameter of taper of the beams. In the end the results are compared with those reported by other authors.

**Keywords:** *Hamilton principle, vibration beams, centrifugal force, Rayleigh-Ritz method.*

## I. INTRODUCTION

Rotating beam-like structures are widely used in various engineering fields, such as helicopter blades, robotic manipulators, wind turbines and turbo-machinery. The free vibration frequencies and mode shapes of such structures have been a topic of interest, and hence have received considerable attention [1-3]. A rotating beam differs from a non-rotating beam in having additional centrifugal stiffness and Coriolis effects on its dynamics. These previous studies usually have been based on Euler-Bernoulli beam theory and various approximate solution techniques have been used to obtain the dynamic characteristics of such rotating beams. In order to investigate the effect of centrifugal force Yoo and al. [4] used a modal formulation to obtain the natural frequencies.

A number of methods based on the power series solution have been developed for determination of natural frequencies of rotating tapered beams. The differential equation with variable coefficients is solved by means of the Frobenius series. Following this approach, Wright et al. [2] and Wang et al. [6] obtained the free vibrations of uniformly tapered beams according to the numbers of the terms of the series. The accuracy of the exact solution depends on the number of terms included in the Frobenius function and it goes up with higher modes, taper, and rotation speed.

Some researchers have also used the Dynamic Stiffness Method (DSM), to solve the natural frequencies of rotating beams. Benerjee et al. [7] studied the free vibration frequencies for tapered beams with various boundary conditions. The structure is discretized with beam elements of constant section, therefore the considered stiffness is lower than the real one. Ozgumus and al. [8] obtained the free vibrations of rotating

beams by the method of differentiation (DTM), [15]. Gunda et al. [10] used the linear combination of terms of the functions derived from the exact solution of the governing static differential equation of a stiff-string and that of a non-rotating beam. They proposed these new hybrid-type functions to determine the free frequencies in both case, without rotation and with rotation.

In this work, flapwise bending vibration of a rotating tapered Bernoulli-Euler beam is studied by using the approximate Ritz method. The partial differential equations are obtained through the Hamilton energy principle written in the test functions space. Further, minimizing the Rayleigh quotient, the frequencies equation is also obtained. Worth mentioning that the exposed procedure gives upper bounds values of the free frequencies. The results of the parametric analysis have been compared with those known in literature and reported in bibliography. The purpose of this paper is to perform the modal analysis of rotating cantilever beams based on the modeling method.

## II. MATHEMATICAL FORMULATIONS

Consider a tapered Euler-Bernoulli beam rotating around the  $z_1$  axis with a constant speed,  $\Omega$ , as shown in Fig. 1. It is assumed that, the cross profile of the beam is symmetric. This implies that the locus of the centroids and shear centers coincide along the span of the beam hence nullifying any bending and torsion coupling effects. The material properties of the beam are isotropic and homogeneous,

At steady state, the system can be considered conservative and its dynamic behavior can be obtained through the *Hamilton principle*;

$$\delta \int_{t_1}^{t_2} L dt = 0 \quad (1)$$

where  $L = T - V$ , and  $T$ ,  $V$  are respectively the kinetic and the potential energy. In the Euler-Bernoulli assumptions their explicit forms are given as follows:

$$T = \frac{1}{2} \int_0^L m(x) \dot{w}^2 dx \quad (2)$$

$$V = \frac{1}{2} E \int_0^L I(x) w_{,xx}^2 dx + \frac{1}{2} \int_0^L F(x) w_{,x}^2 + \bar{F}, \quad (3)$$

where  $E$  and  $I(x)$  are respectively the Young modulus and the inertia of the section referred to the  $x$  axis and  $m(x)$  is the mass distribution. The derivatives with respect to the coordinates are defined with the related subscript while the time derivatives are defined with a dot.

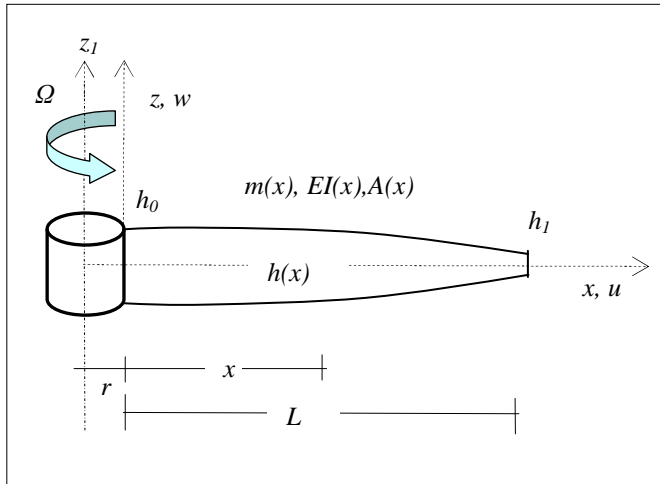


Figure 1. Configuration of a rotating, non-uniform, cantilever beam.

The term

$$F(x) = \frac{1}{2} \int_x^L m(x) \Omega^2 (r+x) dx + \bar{F} \quad (4)$$

is the centrifugal force acting on the beam at a distance from the origin and is due to the effect of the spin around the axis  $z$ . The term  $\bar{F}$  is constant and related to the static inertia, in dynamic conditions its contribution is zero.

Thus potential energy is made of two different terms: one due to bending deformation and the other due to centrifugal force deformation.

In the hypothesis of separation of variables, the transverse displacements  $w(x,t)$  can be written as follows

$$w(x,t) = W(x) \cos \omega t, \quad (5)$$

where  $W(x)$  represents the amplitude of the displacements  $w(x,t)$ . So, the maximum kinetic energy is

$$T_{\max} = \frac{\omega^2}{2} \int_0^L \rho A(x) W^2(x) dx, \quad (6)$$

where  $\rho$  is the mass density and  $A(x)$  is the cross-sectional area. Therefore, the maximum potential energy can be written as:

$$V_{\max} = \frac{1}{2} E \int_0^L I(x) W_{,xx}^2 dx + \frac{1}{2} \int_0^L F(x) W_{,x}^2 + \bar{F}. \quad (7)$$

Equating  $T_{\max}$  with  $V_{\max}$ , by means of the *Rayleigh* quotient, the natural frequencies can be obtained by the following

$$\omega^2 = \frac{V_{\max}}{T_{\max}}. \quad (8)$$

Because the maximum amplitude for the displacements has been assumed, the frequencies obtained in (8) are higher than the exact ones. From a theoretical point of view this means that a constraint has been added with the obvious consequence of an increase of the global stiffness of the system. Obviously upper bound values will be obtained.

In the approximate formulation the transversal displacements are assumed to be linear combination of  $n$  independent functions which satisfy the boundary equations. If functions  $\phi_i$  are chosen respecting the geometrical constraints the displacements can be written

$$W(x) = \sum_{j=1}^n q_j \phi_j(x) = \Phi^T \mathbf{q}, \quad j=1, \dots, n, \quad (9)$$

where  $\phi_i(x)$ , are orthogonal functions and  $\mathbf{q}$  is the generalized displacements vector. Substituting (9) in eq. (8), the *Rayleigh* ratio has the following form

$$R(\omega) = \frac{\int_0^L I(x) [(\Phi_{,xx}^T \mathbf{q})^T \Phi_{,xx}^T \mathbf{q}] dx + \int_0^L F(x) [(\Phi_{,x}^T \mathbf{q})^T \Phi_{,x}^T \mathbf{q}] + \bar{F}}{\int_0^L \rho A(x) [(\Phi^T \mathbf{q})^T \Phi^T \mathbf{q}] dx}$$

Imposing the stationary conditions (1) with respect to the  $q_i$ , the homogeneous system in the unknown  $q_j$  is obtained

$$\frac{\partial R[\omega]}{\partial q_j} = 0, \quad j=1, \dots, n, \quad (10)$$

and consequently the eigenvalue problem :

$$(K_{ij} - \omega_i^2 M_{ij}) q_i = 0, \quad (11)$$

where  $K_{ij}$  and  $M_{ij}$  are given as

$$K_{ij} = E \int_0^L I(x) \phi_{i,xx} \phi_{j,xx} dx + \int_0^L F(x) \phi_{i,x} \phi_{j,x} dx \quad (12)$$

$$M_{ij} = \int_0^L \rho A(x) \phi_i \phi_j dx. \quad (13)$$

### III. ADIMENSIONAL ANALYSIS

In order to compare the results with those reported in the literature it is useful to introduce the functions  $G(x)$  and  $H(x)$  that define, in general terms, the geometric characteristics of the structure

$$A(x) = A_0 G(x), \quad I(x) = I_0 H(x), \quad (14,15)$$

where  $A_0$  and  $I_0$ , are respectively the area and moment of inertia of the section at  $x = 0$ .

Applying the following non-dimensional parameters

$$\xi = \frac{x}{L}, \quad \delta = \frac{r}{L}, \quad \gamma^2 = \rho \frac{A_0 \Omega L^4}{E I_0}, \quad \lambda_i^2 = \alpha_i^2 \frac{\rho A_0 L^4}{E I_0}, \quad (16)$$

the terms in (12) and (13) can be rewritten as

$$\bar{K}_{ij} = \int_0^1 H(\xi) \varphi_{i,\xi\xi} \varphi_{j,\xi\xi} d\xi + \gamma^2 \int_0^1 F(\xi) \varphi_{i,\xi} \varphi_{j,\xi} d\xi \quad (17)$$

$$\bar{M}_{ij} = \int_0^1 G(\xi) \varphi_i \varphi_j d\xi. \quad (18)$$

Therefore the eigenvalue problem can be placed in the following non-dimensional form

$$(\bar{K}_{ij} - \lambda_i^4 \bar{M}_{ij}) q_i = 0. \quad (19)$$

As well known, the polynomial functions are chosen respecting both essential and normality conditions. The geometric conditions are:

#### Cantilever beam

$$W = 0, \quad \frac{\partial W}{\partial \xi} = 0, \quad \text{at } \xi = 0, \quad (20)$$

The first polynomial  $\varphi_1$  can be obtained. After, by means of the Gram-Schmidt normalization, all the other requested functions can be obtained by *Mathematica* program.

As shown before, the weak formulation of the problem contains implicitly the so called natural conditions. Obviously all natural and essential conditions can be considered in the test functions but in this case these functions will be polynomials of higher degree. As consequence, the computer time requested for the integrals in (17-18) would increase without having an appreciable higher precision.

#### IV. FREE VIBRATION RESULTS

Geometry of the structure is given through the introduction of two functions  $G(\xi)$  and  $H(\xi)$  which supply the tapering laws:

$$\begin{aligned} A(\xi) &= A_0 G(\xi) \\ I(\xi) &= I_0 H(\xi). \end{aligned} \quad (21)$$

If the tapering is defined by a linear variation of both the height and the thickness of the beam the geometric functions, are

$$h(\xi) = h_0 (1 - \alpha \xi), \quad b(\xi) = b_0 (1 - \beta \xi), \quad (22)$$

Consequently the area and the inertia assume the form

$$\begin{aligned} A(\xi) &= A_0 (1 - \alpha \xi)(1 - \beta \xi) = A_0 G(\xi) \\ I(\xi) &= I_0 (1 - \alpha \xi)^3 (1 - \beta \xi) = I_0 H(\xi). \end{aligned} \quad (23)$$

To varying of  $\alpha$  and  $\beta$ , the various geometric conditions reported in bibliography can be compared. In particular, for  $\alpha = \beta$ , the geometric distribution is given by

$$\begin{aligned} A(\xi) &= A_0 (1 - \alpha \xi)^n \\ I(\xi) &= I_0 (1 - \alpha \xi)^{n+2}, \end{aligned} \quad (24)$$

where  $\alpha$  is the tapering coefficient and  $n$  is respectively, 1 or 2.

TABLE I. COMPARISON OF FIRST FIVE NATURAL FREQUENCIES; UNIFORM BEAM.

$\alpha=0$					$\alpha=0$				
$\delta=0$	$\gamma=5$	$\lambda_1$	6.44950		$\delta=1$	$\gamma=5$	$\lambda_1$	8.9403	
		$\lambda_2$	25.4461				$\lambda_2$	29.3528	
		$\lambda_3$	65.2050				$\lambda_3$	69.7607	
		$\lambda_4$	124.5660				$\lambda_4$	129.5800	
		$\lambda_5$	203.6220				$\lambda_5$	208.9110	
	$\gamma=12$	$\lambda_1$	13.17020			$\gamma=12$	$\lambda_1$	19.72150	
		$\lambda_2$	37.6031				$\lambda_2$	51.0701	
		$\lambda_3$	79.6145				$\lambda_3$	98.5268	
		$\lambda_4$	140.5340				$\lambda_4$	163.7240	
		$\lambda_5$	220.5360				$\lambda_5$	246.7160	
$\delta=2$	$\gamma=5$	$\lambda_1$	10.8616		$\delta=5$	$\gamma=5$	$\lambda_1$	15.2012	
		$\lambda_2$	32.7642				$\lambda_2$	41.2249	
		$\lambda_3$	73.9844				$\lambda_3$	85.1837	
		$\lambda_4$	134.3660				$\lambda_4$	147.5860	
		$\lambda_5$	214.0410				$\lambda_5$	228.5820	
	$\gamma=12$	$\lambda_1$	24.54910			$\gamma=12$	$\lambda_1$	35.2082	
		$\lambda_2$	6.4464				$\lambda_2$	84.9141	
		$\lambda_3$	113.7890				$\lambda_3$	149.7830	
		$\lambda_4$	183.3260				$\lambda_4$	230.2920	
		$\lambda_5$	269.7410				$\lambda_5$	326.9570	

#### Uniform beam

Assuming  $\alpha = 0$ , the simplest case of the constant section

beam is recovered. Free frequencies are obtained using respectively 8 polynomial functions. With  $N = 8$  the procedure supplies frequencies in full agreement with the exact solution. Comparing the values obtained a really small difference on the first frequency can be observed. The results, for cantilever beam, reported in Tab. I and compared with the free vibration calculated by Wang and Wereley [6], Hodges and Rutkowski [1]. As usual, the differences gradually increase for the higher frequencies. This depends from the rotational parameters too, in particular from the angular speed that is related to  $\gamma$ . For  $\gamma=12$ ,  $\delta=0$  values are exactly identical to those calculated in [6] and [1]. For  $\delta=5$  and  $\gamma=12$ , the differences on the first five frequencies are under the 2%.

The flapwise bending natural frequencies variation are shown in Figure 2. The lower three natural frequencies are plotted for three case of hub radius ratio,  $\delta$ . The dimensionless natural frequencies increase as the angular speed ( $\gamma$ ) increase, and the increasing rates becomes larger as the hub radius ratio ( $\delta$ ) becomes larger. This results from the centrifugal inertia force which increases as the angular speed and the hub radius increase.

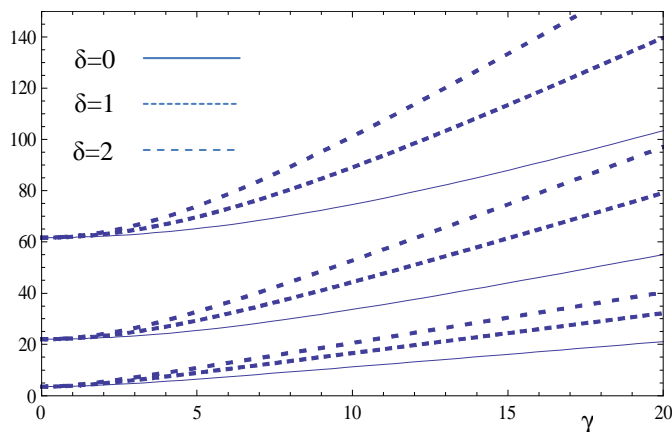
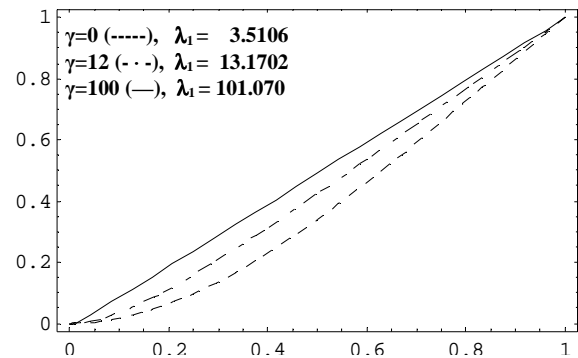


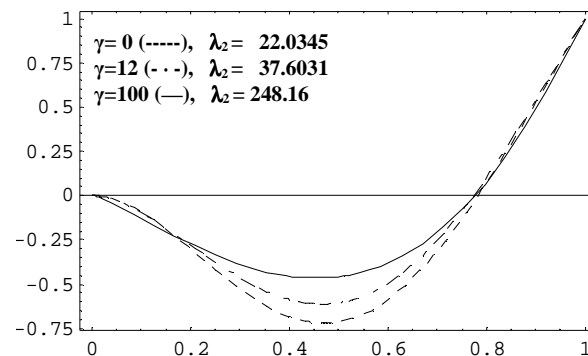
Figure 2. Flapwise bending natural frequency variation.

In order to show the relevance of the rotary displacements, the first three modes, for  $\delta=0$ , are reported in Fig. 3, respectively for  $\gamma = 0$ ,  $\gamma=12$  and  $\gamma=100$ . As can be seen the dashed lines represent the mode shapes of the beam with no rotational motion while the dot-dashed line and the solid line represent those of the beam with rotational motion. Noticeable difference exists between the three sets of lines. If speed increases, the effect of centrifugal force becomes more evident. In this case, an increase of the positive tension and a reduction of the vibration period can be observed. The tension term will increase and consequently become dominant at very high rotation speed.

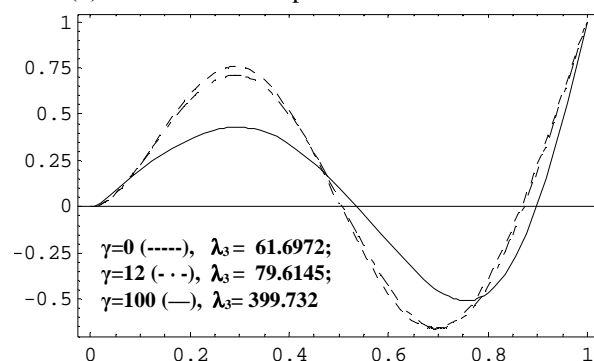
Noticeable difference exists between the third sets of lines. Information about mode shapes variation (e.g. position of nodal points) may be utilized usefully for the control of a rotating beam.



(a) First mode shapes



(b) Second mode shapes



(c) Third mode shapes

Figure 3. Flapwise bending mode shape variation due to rotation; uniform beam.

#### - Double Tapered beam $\alpha = \beta$

This is the case of a beam that tapers linearly in one plane according to the relation in (23). For  $\alpha = 0.5$  and  $\delta=0$  variation of the natural frequencies with respect to the rotational speed parameter  $\gamma$  have been reported. The results have been compared with those obtained using the Dynamic Stiffness Method (DSM); Banerjee et al. [7].

In Tab.II, assuming  $\alpha = 0.5$ , free frequencies were reported for both  $n = 1$  "wedge beam" and  $n = 2$  "cone beam".

The values are then compared with the solution proposed in [7].

TABLE II. COMPARISON OF FIRST FIVE NATURAL FREQUENCIES.

$\delta=0$	$\alpha=0.5$	$n=1$		$n=2$	
		Present	[7]	Present	[7]
$\gamma=1$	$\lambda_1$	3.98662	3.98662	4.76405	4.76405
	$\lambda_2$	18.4740	18.4740	19.6803	19.6803
	$\lambda_3$	47.4173	47.4173	48.7073	48.7073
	$\lambda_4$	90.6039	90.6039	91.9409	91.9409
	$\lambda_5$	148.1560	148.1560	149.5180	149.5180
$\gamma=4$	$\lambda_1$	5.87876	5.87877	6.47262	6.47262
	$\lambda_2$	20.6852	20.6851	21.5749	21.5749
	$\lambda_3$	49.6456	49.6456	50.5939	50.5938
	$\lambda_4$	92.8730	92.8730	93.8415	93.8415
	$\lambda_5$	150.4540	150.4540	151.4310	151.4310
$\gamma=10$	$\lambda_1$	11.5015	11.5015	11.9415	11.9415
	$\lambda_2$	30.1827	30.1827	30.0299	30.0299
	$\lambda_3$	60.5639	60.5639	60.0399	60.0399
	$\lambda_4$	104.6120	104.6120	103.8100	103.8100
	$\lambda_5$	162.6770	162.6770	161.7010	161.7010
$\gamma=100$	$\lambda_1$	101.3890		101.793	
	$\lambda_2$	232.9540		220.319	
	$\lambda_3$	368.1380		344.948	
	$\lambda_4$	509.3910		475.396	
	$\lambda_5$	659.1540		613.529	

The Tab.III provides frequencies to varying of both angular velocity of rotation  $\gamma$  and hub radius ratio ( $\delta$ ).

TABLE III. COMPARISON OF FIRST FIVE NATURAL FREQUENCIES; TAPERED BEAM.

$\alpha=1$	$\delta=0$	$\delta=5$	
		$n=1$	$n=2$
$\gamma=0$	$\lambda_1$	5.31510	8.71930
	$\lambda_2$	15.2072	21.1457
	$\lambda_3$	30.0198	38.4538
	$\lambda_4$	49.7633	60.6801
	$\lambda_5$	74.4400	87.8340
$\gamma=12$	$\lambda_1$	12.5846	14.7417
	$\lambda_2$	27.0213	29.8678
	$\lambda_3$	44.3132	48.4782
	$\lambda_4$	65.5339	71.4349
	$\lambda_5$	91.1435	99.0363
$\gamma=100$	$\lambda_1$	102.4330	104.243
	$\lambda_2$	208.0900	194.746
	$\lambda_3$	308.6180	278.455
	$\lambda_4$	408.4140	360.997
	$\lambda_5$	508.5510	443.885

- Beam with parabolic thickness variation

This section is concerned with the transverse vibration of

the non-uniform beam shown in Fig. 4, a beam of constant breadth and depth proportional to the square of the axial co-ordinate.

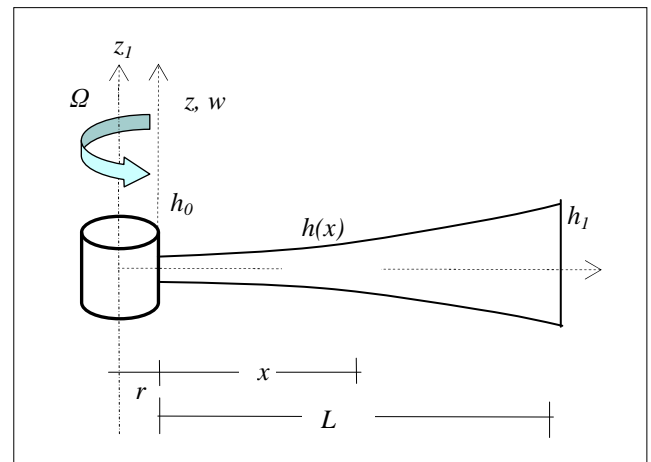


Figure 4. Non-uniform beam; parabolic thickness variation.

In particular, the geometry of the structure is given:

$$h(\xi) = h_0 (1 + (\alpha - 1) \xi^2), \quad b(\xi) = b_0, \quad (25)$$

the area and the inertia assume the form

$$A(\xi) = A_0 (1 + (\alpha - 1) \xi^2) \quad (26)$$

$$I(\xi) = I_0 (1 + \xi^2 (\alpha - 1))^3.$$

TABLE IV. COMPARISON OF FIRST FIVE NATURAL FREQUENCIES; PARABOLIC THICKNESS VARIATION.

$\alpha=5$		$\delta=0$		$\delta=5$	
		$n=1$	$n=2$	$n=1$	$n=2$
$\gamma=0$	$\lambda_1$	2.2608			
	$\lambda_2$	30.0559			
	$\lambda_3$	110.7650			
	$\lambda_4$	230.4959			
	$\lambda_5$	395.3289			
$\gamma=12$	$\lambda_1$	12.5806	33.4471		
	$\lambda_2$	50.0796	106.4972		
	$\lambda_3$	137.4859	234.4189		
	$\lambda_4$	260.9709	397.4638		
	$\lambda_5$	428.5189	605.8781		
$\gamma=100$	$\lambda_1$	100.9850	276.5721		
	$\lambda_2$	301.1600	769.3038		
	$\lambda_3$	550.2041	1320.2100		
	$\lambda_4$	854.6310	1968.2940		
	$\lambda_5$	1223.8710	2735.9000		

In Tab IV, the first five natural frequencies for rotating parabolic non-uniform beam,  $\alpha=5$ , are presented for various

angular speed,  $\gamma$  and hub ratios,  $\delta$ .

If  $\delta = 0$  as  $\gamma$  increases the first natural frequency of the beam tends to the angular velocity ( $\omega \equiv \gamma$ ), causing the phenomenon of resonance, which is usually referred to as "angular speed turner". An increase of parameter  $\delta$  results in an increase in the fundamental frequency of the beam for which the phenomenon of "turner angular speed" doesn't occur.

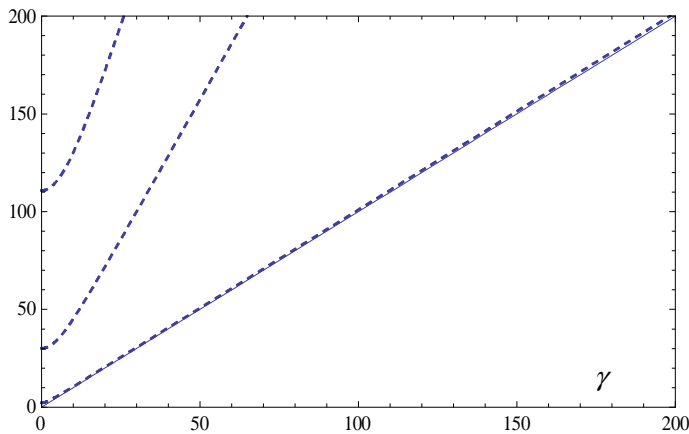


Figure 5. Angular speed and flapwise bending;  $\alpha=5$ ,  $r=0$ .

The effect of the parameter  $\alpha$ , has a deep impact even on the free frequencies results. For values of  $\gamma \neq 0$ , the centrifugal force influences the dynamic behavior of beam: the free frequencies increase to increase, for increasing values of the rotation,  $\gamma$ . From a practical point of view, greater values of the angular velocity lead to greater centrifugal forces, and in turn to stiffer beams. By increasing the extensional deformation, one gets increasing values of the natural frequencies of vibration.

#### V. CONCLUDING REMARKS

The Hamilton principle is used to solve the free vibration problem of a rotating non-uniform beam based on the Euler beam theory. The effects of angular speed,  $\gamma$  and hub radius,  $\delta$ , parameters are discussed in detail. The natural frequencies increase for increasing angular speed. That is due to the increase of the beam stiffness, and it is due to the increase of centrifugal force. In particular, the effect is evident on higher mode shapes. The advantage of the procedure used is the generality of polynomial functions which only need to satisfy the essential conditions. The numerical examples have been

completely carried through by means of the powerful symbolic software.

Also, it is demonstrated in the numerical routines that, the use of the Boundary Characteristic Orthogonal Polynomial technique is quite simple and converges quickly to the exact solution with very minimal computation effort and resources. This investigation is also intended to form the foundation for the application of the Euler theory to other rotating beam problems.

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# An Evaluation of Critical Success Factors for Construction Projects using Expert Judgment

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**Abstract**—Construction is a risky business and the possibility of failure always exists, so construction companies have to consider the factors that can have a direct effect to their success in construction project performance. The purpose of this study is to identify and to rank the critical success factors of construction projects in Lithuania. A survey with 71 critical success factors was distributed among to 15 construction professionals and experts from 5 construction companies who have projects management knowledge and related experience. The data were processed by expert judgment. Based on the results ten factors including experience of project management, project value, experience of project manager, technical capabilities of project manager, experience of contractor, project size, competence of project team members, clear and realistic goals, decision making effectiveness of projects management and technical capability of project management were determined as the most important success factors for construction projects.

**Keywords**-critical success factors; construction projects; expert judgment; Lithuania

## I. INTRODUCTION

The construction industry is a very competitive high-risk business. Increasing uncertainties in technology, budgets and development processes create a dynamic construction industry. Construction projects are now much more complex and difficult and the construction project team faces unprecedented changes. The study of project success and critical success factors is means of understanding and thereby improving the effectiveness of construction projects. However the concept of project success remains ambiguously defined in the mind of construction professionals. There is no an industry-accepted or standardized definition of project success because the fact is that individual project teams find themselves in unique situations, implying that their definition of success will differ from that of another project team. Project success is a topic that is frequently discussed and yet rarely agreed upon.

The concept of project success has remained ambiguously defined in the construction industry. Project success is almost the ultimate goal for every project [1]. Achieving success is a highly critical issue for the companies to survive in a competitive business environment. The construction industry is also an area where there is strong competition due to a large number of construction contractors [2]. Measuring a project's success is more than making sure it's completed.

Traditionally, success is defined as the degree to which project goals and expectations are met [3]. It should be viewed

from different perspectives of individuals and the goals related to a variety of elements, including technical, financial, education, social, and professional issues. Indeed, measuring project success is a complex task since success is intangible and can hardly be agreed upon. Such a phenomenon also exists in the construction industry where different parties are involved, including the client, the architect, the contractor, and various surveyors and engineers. Each project participant will have his or her own view of success.

According to Al-Tmeemy et al. [4] project success is a strategic management concept where project efforts must be aligned with both short and long-term goals of the company. Lehtiranta et al. [5] stated that construction project success depends on the multi-firm project organizations involved working together satisfactorily. Project success, therefore, should be examined from a more holistic perspective than the traditional measures in terms of budget, schedule and specifications.

The success of construction projects is a fundamental issue for most governments, users and communities. In the literature that deals with construction project success and causes of time and cost overruns in the construction industry, there is some literature that highlights the role of the contractors in project success. Construction projects and their success are closely related to contractors [6].

Project success can be achieved through the good performance of project managers in the project. Various researchers have all mentioned that human factors played an important role in determining the success of a project [7-11]. Furthermore, the importance of stakeholder management in the success of the projects was recognized by many scholars [12-14]. Performance and productivity of a project has always been an important issue in the construction industry [15-17].

There is considerable debate in project management research practice about what determines project success. While the topic has been discussed for a long period of time, an agreement has not been reached. In addition, when it comes to a definition of project success, there is no single list that is totally comprehensive.

The performance of a construction project is influenced by a multitude of inter-related factors some of which are referred to in the literature as critical success factors (CSF) [18]. Such an identification of success factors could well formulate

effective strategies for minimizing construction conflicts and improving project performance.

However, the concept of critical success factors presents a smarter way to identify certain factors which when present or absent in a project are likely to make the project successful [6].

Critical Success Factors is known as a tool for measuring performance in an organization to achieve their mission [19]. In building maintenance, CSF is becoming very important as it could identify the cause of failure as well as improving the system. The success of maintenance management initiatives depends on many factors. Zawawia et al. [19] categorized critical success factors into five primary categories: leadership, culture, structure, roles and responsibilities, system infrastructure, measurement. These five categories were based on the objective of the organization. According to the researchers, it is also essential to identify the constraint of the critical success factors. In understanding the constraints, critical success factors defense measures can be derived. Knowing the constraints will eliminate predicted work which can bring about greater risks to the company's success. Knowing critical success factors in the operation of the business can strengthen management strategy. Risk management process can be more focused and many issues will be corrected and probability of failure is greatly reduced. Every single activity within the organization will be directed towards achieving the overall success of the company [19].

The adversarial relationship between owners and construction contractors creates an environment which jeopardizes the success of the construction industry as a whole. So, the partnership between these groups is very important. Partnering is a complex, dynamic process, and attention to how the different activities and elements interact to influence project success is needed. Successful partnering reduces building costs while at the same time increasing the profit margins of participating companies [20]. Chen et al. [21] explored success variables in construction partnering. They identified 19 success variables. Research results showed that four successful factors (collaborative team culture, long-term quality perspective, consistent objectives, and resource sharing) have a significant influence on the success of construction partnering. Partnering creates both a win-win situation and more synergy in team work [22].

Alzahrani and Emsley [6] studied the impact of contractors' attributes on project success from a post construction evaluation perspective and identified what critical success factors (CSFs) have greatly impact to the success of project. Authors selected 35 CSFs, which were categorized into nine groups: safety and quality; past performance; environment; management and technical aspects; resource; organization; experience; size/type of previous projects; finance. Factors such as turnover history, quality policy and adequacy of labor and plant resources, waste disposal and size of past projects

completed, and company image are the most significant factors affecting projects success [6].

Al-Tmeemy et al. [4] identified 13 critical success factors for building projects in Malaysia from the contractors' perspective. These criteria included: cost, time, quality, safety, achieving scope, customer satisfaction, technical specifications, functional requirements, market share, competitive advantage, reputation, revenue and profits, and benefit to stakeholder.

Pakseresht and Asgari [23] in their study identified 26 critical success factors in construction projects of Pars Garma Company. They grouped them into 6 groups. The research findings indicated that the critical success factors in construction projects have different priorities and weights. Also, considering the importance, the critical success factors are respectively: technical and economic assessment of the project required resources, experience and executive records of project manager, project strategic planning and executive experiences of contractor team about the project subject.

Ribeiro et al. [24] explored success factors of Portugal construction industry. Several factors were identified which are currently considered in the evaluation of project success, as found in the literature review. The results showed that the traditional factors, often referred to as the "Atkinson elements triangle" (cost, time and quality), are still the most relevant for evaluating the success of a project, but others, such as customer involvement and acceptance, have gained importance in recent years [24].

Mbachu and Nkado [25] identified two groups of factors constraining successful building project implementation in South Africa. These were controllable (project characteristics, service providers' influences, client organizational influences) and uncontrollable (socio-cultural issues, unforeseen circumstances, economic and global dynamics, governmental/statutory controls) factors, depending on the extent to which they could be controlled by clients and project teams.

Saqib et al. [26] grouped critical success factors under seven main categories: project management factors, procurement-related factors, client-related factors, design team-related factors, contractor-related factors, project manager-related factors, business and work environment-related factors.

Based on an analysis of the literature that has been outlined earlier, it has become apparent that there is a plenty of factors with the potential to affect the project success. A conceptual critical success factors model based on identified comprehensive list of critical success factors of construction projects in Lithuania is presented in Fig. 1 [27, 28]. This paper aims to rank critical success factors contributing to the successful implementation of construction projects in Lithuanian construction companies based upon the respondents' perceptions.

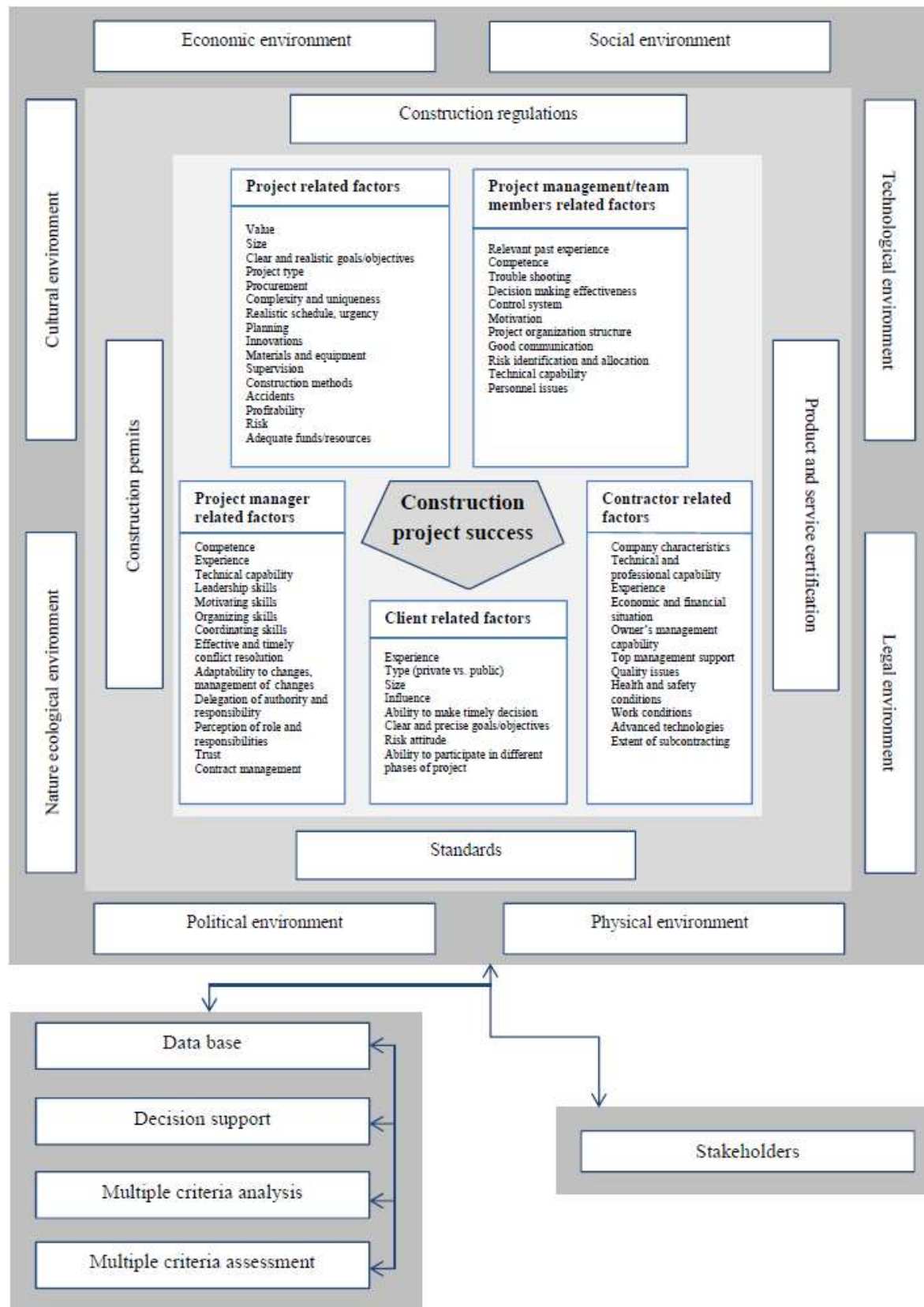


Figure 1. Critical success factors model for construction projects [27, 28]

## II. RESEARCH METHODOLOGY

A questionnaire survey was designed by incorporating the applicable 71 factors affecting or enabling successful construction project performance. For the purposes of the study, the success factors were further classified into 7 groups: external factors, institutional factors, project related factors, project management/team members related factors, project manager related factors, client related factors, and contractor related factors. The questionnaire was divided into two parts. The first part comprised background questions about the respondents' individual and organizational information. In the second part the experts were asked to rank factors groups and factors in each group according to their importance. In the survey, the proposed success factors were rated by construction professionals and experts who have project management knowledge and related experience. The questionnaire of survey was distributed either personally or via e-mail to 15 members of top and middle management in 5 construction companies. A sample of 15 practitioners received the questionnaire and 15 valid questionnaires were returned for analysis. The calculation of the evaluation factors weights is carried out in 5 steps with the use of expert judgment method [29, 30].

Step 1. An average rank is defined as:

$$\bar{t}_j = \frac{\sum_{k=1}^r t_{jk}}{r} \quad (1)$$

where:  $t_{jk}$  –  $k$  expert's index  $j$  evaluation ( $k = 1, 2, \dots, r$ );  $r$  – number of the expert's.

Step 2. The importance of the factor is defined as:

$$q_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (2)$$

where:  $n$  – the number of evaluation factors.

Step 3. Kendall's  $W$  is defined as:

$$W = \frac{12S}{r^2(n^3 - n)} \quad (3)$$

where:  $S$  is the sum of squared deviations.

If the test statistic  $W$  is 1, then all the judges or survey respondents have been unanimous, and each judge or respondent has assigned the same order to the list of objects or concerns. If  $W$  is 0, then there is no overall trend of agreement among the respondents, and their responses may be regarded as essentially random. Intermediate values of  $W$  indicate a greater

or lesser degree of unanimity among the various judges or respondents.

Step 4. The sum of squared deviations,  $S$ , is defined as:

$$S = \sum_{j=1}^n \left[ \sum_{k=1}^r t_{jk} - \frac{1}{n} \sum_{j=1}^n \sum_{k=1}^r t_{jk} \right]^2 \quad (4)$$

where:  $t_{jk}$  – the rank conferred by the  $k$  expert to the  $j$  factor.

Step 5. The significance of the concordance coefficient is defined as:

$$\chi^2 = \frac{12S}{rn(n+1)} \quad (5)$$

This value must be greater than  $\chi^2_{\alpha, v}$ , which depends on the number of degrees of freedom and the chosen significance level, then considered the opinion of expert's agreed. Otherwise, the  $\chi^2 > \chi^2_{\alpha, v}$  states that the unmatched expert's opinions.

## III. RESULTS

At first the experts ranked the groups of critical success factors. A 7-point scale was adopted, where 1 represented "very important" and 7 "not important at all". Table I shows how the seven groups of critical success factors were ranked.

TABLE I. THE RESULTS OF RANKING OF CRITICAL SUCCESS FACTORS GROUPS

Experts	Critical Success Factors Groups						
	X1	X2	X3	X4	X5	X6	X7
E1	1	2	5	3	7	6	4
E2	6	7	3	1	2	5	4
E3	6	7	5	1	2	4	5
E4	6	7	4	2	3	5	1
E5	7	1	2	4	3	5	6
E6	1	5	6	3	7	4	2
E7	7	5	2	1	3	6	4
E8	4	7	2	1	3	5	6
E9	7	6	5	2	1	3	4
E10	5	7	4	1	3	6	2
E11	4	7	6	3	2	5	1
E12	6	7	2	1	3	5	4
E13	5	7	2	1	3	6	4
E14	7	5	1	2	4	6	3
E15	4	5	2	1	3	7	6

Experts	Critical Success Factors Groups						
	X1	X2	X3	X4	X5	X6	X7
Sum of ranks	76	85	51	27	49	78	56
Average rank	5,07	5,67	3,40	1,80	3,27	5,20	3,73
Weight	0,137	0,133	0,146	0,156	0,147	0,135	0,144
Priority	5	7	3	1	2	6	4

Among the 7 critical success factors groups affecting construction projects, the project management/team members related factors were found as the most important group with  $q_4 = 0.156$ , as can be seen in Table I. The institutional factors were found as the least important group with  $q_2 = 0.133$ .

The respondents agree as regards the critical success factors groups, what can be judged by values  $W = 0.399$ ;  $\chi^2 = 35.877$  ( $\alpha = 0.01$ ).

The same calculations were done with each group of critical success factors.

In the external factors group the economic environment was found as the most important factor with  $q_1 = 0.137$ . The cultural and nature ecological environments were found as the least important factors with  $q_7 = 0.116$  and  $q_8 = 0.117$ . The concordance coefficient is equal to 0.579, so the experts are in agreement.

In the institutional factors group the most important factors was construction permits with  $q_1 = 0.286$ , the least important factor – product and service certification with  $q_3 = 0.217$ .

The project value was the most important factors under the project related factors group with  $q_1 = 0.066$ . The next two important factors were project size and clear and realistic goals. The accidents was the least important factor under this group with  $q_{13} = 0.059$ .

The experience was the most important factor under the other four groups: project management/team related factors with  $q_1 = 0.098$ , project manager related factors with  $q_1 = 0.0818$ , client related factors with  $q_1 = 0.138$  and contractor related factors with  $q_3 = 0.097$ .

The concordance coefficient  $W$  of each group is shown in Table II.

TABLE II. THE CONCORDANCE VALUES OF EACH GROUP

	Critical Success Factors Groups						
	X1	X2	X3	X4	X5	X6	X7
W	0.579	0.531	0.517	0.504	0.659	0.497	0.678

Based on the experts defined importance of factors groups and factors under the groups the factors significances were calculated in the overall row. Based on the results calculated by expert method ten factors were determined as the most important factors for construction projects in Lithuania. The results are shown in Table III.

TABLE III. THE TOP TEN CRITICAL SUCCESS FACTORS IDENTIFIED

No.	Critical Success Factors of Construction Projects
1	Experience of project management (of team)
2	Project value
3	Experience of project manager
4	Technical capabilities of project manager
5	Experience of contractor
6	Project size
7	Competence of project team members
8	Clear and realistic goals
9	Decision making effectiveness of projects management
10	Technical capability of project management

#### IV. CONCLUSIONS

There is no single answer to the question of what determines the success of construction projects. Success factors are varying depending on the country, the type of project, scope, size, complexity, using of methods, materials, projects team and other factors. This study identifies and prioritizes critical success factors for the successful implementation of construction projects in Lithuania. A survey with 71 critical success factors was distributed among to construction professionals and experts who have projects management knowledge and related experience. Due to the large number of factors the significances were determined by ranking and using expert judgment method. Among the 7 critical success factors groups affecting construction projects, the project management/team members related factors were found as the most important group. The institutional factors were found as the least important group. Based on the results ten factors including experience of project management, project value, experience of project manager, technical capabilities of project manager, experience of contractor, project size, competence of project team members, clear and realistic goals, decision making effectiveness of projects management and technical capability of project management were determined as the most important success factors for construction projects. The experience of management, manager, client and contractors leads better to plan, execute, manage and control the project to its successful completion.

A further research steps will be the involvement of more experts and validation of the critical success factors model by selecting the most successful project to implement.

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# The position and the procedure for checking the features of high voltage contact systems

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**Abstract**—Contact assemblies of electric apparatuses belong to the most burdened elements of current circuits. They should be designed, made and exploited in order to acceptable restrictions to their technical parameters, resulting from adequate rules and norms, weren't crossed.

**Keywords**- features of conducting materials, contact assemblies of electric apparatuses

## I. INTRODUCTION

Current circuits and contact systems enable to conduct specific working currents, whereas contact systems of electrical connectors are used to effect join in electric circuits. The main elements of current circuits, containing contact systems are also electrical conductors. Electrical conductors are cords of modules in the form of stiff current circuits in general close in the shared casing, about the appropriately designed length, the shape and the diameter arranged into sequences put together, assembled in length of routes marked out - from the switchgear (of electrical connectors) to receivers. Basic group of discussed connector apparatuses, links are determining contact systems devices. The main elements of links conducting the electric current are connectors and contact systems, creating the team consisting of individual joints, springing elements and the casing in general [1]. They are very important building blocks of switchgears and electrical power engineering stations and are co-deciding on his availability and the reliability [2]. By the contact system we are calling the part of the current circuit, in which the flow of the electricity is enabled thanks to the contact of two guides. Due to performed functions in the current circuit, we are distinguishing the following types of contact assemblies: contact assemblies which are joined (separate) and those which can be separate or inseparable. This one can be also movable or motionless [3]. Join contact assemblies (separate) are applied in pin connecting areas and enable to attach and to switch off the electricity in the given circumference. We are dividing them on closing contacts (closed in the movable joint) and break contacts (opened in this location). Closed contacts can act as basic contact assemblies (universal) or team. We divide closed contacts on basic and arcing is essential in structures of current circuits contact assemblies. Basic and arcing contact assembly, connected parallel are creating the contact assembly team, cooperating in the performance of join activities so that the arc appears exclusively on arcing joints made of special composite materials [4]. Contact systems inseparable, movable, are

creating the merger, of which joints can freely move towards themselves, not losing the patch. They are rolling or sliding connections between detachable and motionless parts of path of the current circuit of connector or the contact assembly of the inseparable switch [5]. Contact assemblies, separated, movable are those, which joints can not only move towards oneself, but also gather and divide, deciding in this way on the lock or the opening of the circuit. However they aren't intended for the performance of connectors activities [6]. Service wire clamps of apparatuses belong to the group of contact assemblies, separated, motionless, however roller or sliding contact assemblies belong to the group of contact assemblies, separated, movable [7]. Contact assemblies of electric apparatuses belong to elements the most burdened of current circuits. They should be designed, made and exploited, in order to acceptable restrictions to their technical parameters, resulting from adequate rules and norms, weren't crossed. For determining the procedure of the sample to indicate SPPW and SPPL. Samples were made in skeletal, powder technology and electric copper.

## II. MARKINGS, YARD OF MATERIAL, ONOMASTICS OF SAMPLES

Fastening them together is main threats to contact assemblies oneself and the lack of the resistance to the arc. Resistance to getting locked together of joints depends from their area and the force of pressure, according to the pattern (1):

$$\frac{F_k}{n \cdot \pi \cdot r_p^2} = \alpha \cdot HB = \sigma_0 \quad (1)$$

where:

n - number of the area of the contact,  
 $r_p$  - ray (substitute) of wheeled plain of the contact,  
 HB - hardness of material of joints according to Brinell or Vickers,

$\alpha$  - rate of the pin hardness of material, he depends on the microstructure of the area of the contact, in practical calculations it is possible to accept  $\alpha = 0.5 \div 0.7$ . The contact assembly Rz resistance is a basic parameter of the contact assembly deciding on his load capacity with constant and short-circuit electricity, as well as of the entire electrical conductor. Generally it is possible for itself to depict her as resistance compound of three elements:

- resistance of material of joints forming the contact assembly, treated as the solid team  $R_1$ ,
- of resistance of the narrowing (of shape) of diameter for the flow of the electricity, of the area associated with the microstructure of the contact  $R_{p1}$ ;
- of resistance of outside layers (bust) being found in surfaces encountering oneself of joints, especially at the smaller force of pressure of joints,  $R_n$

The resistance to the effect of the arc of joints is important in extinction arrangements in which extinguishing the arc is appearing. In order to increase this resistance covers pin, made of resistant material for the bow are applicable. These are configurations of different kind of copper or tungsten. For examinations to mark taken samples in pairs, always the flat joint and the other joints spot or linear, creating the spot or linear contact assembly appropriately. Samples marked appropriately:

a) in case of the research on the electricity of fastening together:

SPPW 1,2,3... n - flat joint spot tungstic

SPLW 1,2,3... n - flat joint linear tungstic

b) in case of the measurement of the electrical conductivity: randomly bar/inserts were being picked up tungstic-copper

c) in case of the examination of arc resistance:

SPPL 1,2,3... n - flat joint spot arched

SPLL 1,2,3... n - flat joint linear arched

The way of preparing samples for analysis was presented in figure 1.



Figure 1. Way of preparing test samples.

To differentiate in examinations to mark samples by SPPW and SPPL. both types of samples were carried out in the skeletal and powder technology. To comparative purposes joints carried out of electric copper were also examined.

### III. DESCRIPTION OF THE RESEARCH

#### 1. Equipment of the research position

For assessments of the current of clipping contact assemblies together and arc resistance 3 types of examinations were conducted:

- measurement of electricities of fastening together,
- measurement of the electrical conductivity of material (in the destination of getting the influence of tungsten on the resistance of material),
- examination of arc resistance of material.

a) examining the electricity of clipping contact assemblies together:

For conducting research to perform the post with the following equipment:

- handle for fixing joints,
- copper, flexible connecting to supplying the electricity,
- special ring with stuck sphygmomanometer-s for the measurement of the force of pressure ( $F_{doc}$ ) and power of breaking ( $F_{roz}$ ),
- the knob and the arrangement of tracks for adjusting the value of the force of pressure ( $F_{doc}$ )

b) Measurement of the electrical conductivity of material

- with technical method

c) Examination of arc resistance:

For conducting research a post was performed with the following equipment:

- handle for fixing joints,
- copper, flexible connecting to supplying the electricity,
- guide ( $\phi$  0.5 wire) enabling to generate the arc between joints,

2. Schematic diagram of the test arrangement for studying currents of fastening joints together was presented in picture 2.

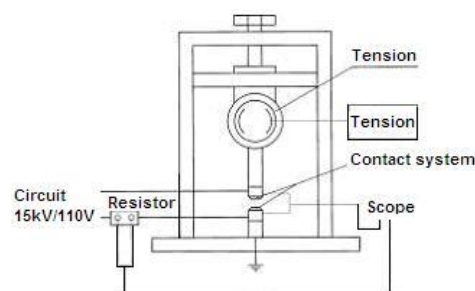


Figure 2. Schematic diagram of the test arrangement for studying currents of fastening joints together.

Flow diagram of the high electrical short circuit arrangement of 15 kV/ 110 V was presented in picture 3.

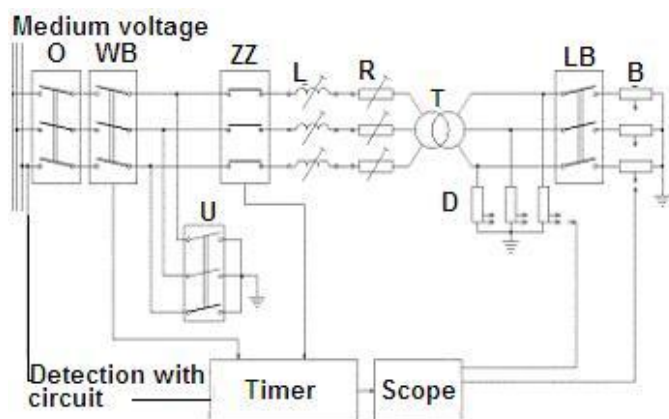


Figure 3. Flow diagram of the short-circuit arrangement, O - switch, WB - safety cut-out switch, U – grounding switch, ZZ - short-circuit attachment, L - tubules for setting the value of the electricity, R - resistors for setting the value  $\cos \phi$  of the circumference, T - short-circuit transformer, D - divisors for the measurement of the tension, B - shunts for the measurement of the value of the electricity, LB - studied hyphen, WF - detection system of the zero.

#### IV. COURSE OF ATTEMPTS

##### Measuring equipment:

A) examining the electricity of clipping contact assemblies together:

- To measure the force of pressure of joints and tearing the contact assembly clipped together with the small tensometrical sternum and with digital voltmeter.

- Recording of the electricity and the voltage drop on the contact assembly, to make with the digital recorder, at using the probe with protecting diodes.

- Measurement of the resistance of the contact assembly, before and after the attempt, to measure with the special small sternum for the measurement of the resistance.

B) Measurement of the electrical conductivity of material:

- With technical method.

C) Examination of arc resistance:

- Examinations of arc resistance to carry initiating the arc between joints.

#### V. WAY OF CONDUCTING AN EXPERIMENT

Procedure of conducting an examination:

a) Examining the electricity of clipping contact assemblies together:

Measurement of the electricity of fastening together:

- To fasten the examined pair of joints, next with knob a desirable  $F_{doc}$  force of pressure was adjusted (with the tensometrical sensor).

- To measure the resistance of the contact assembly and to connect wires to the measurement of the voltage drop on the contact assembly during the flow of the electricity.

- To use the power-driven arrangement and ran electric current through the contact assembly, about the determined intensity and to record courses on the recorder.

- After the attempt, to cause the measurement of the resistance of the contact assembly and power of tearing (if necessary) of contact assembly.

- Make an inspection of joint, if necessary, photograph some joints.

- In order to get the effect of fastening joints together, one should carry the sequence of attempts out. The attempt is being conducted adjusting the value of the amperage or the value of the force of pressure. It should be mentioned that every another trial is held on new (or additionally cleaned) pair of joints.

b) Measurement of the electrical conductivity of material:

- In order to appoint the electrical conductivity we should use following relations (2):

$$\gamma = \frac{1}{\delta} \left[ \frac{\Omega \cdot mm^2}{m} \right] \quad (2)$$

c) Examination of arc resistance:

- Before putting samples to the arrangement measuring we should exactly weigh every contact assembly (consisting of two joints),

- At using the conducting material we are initiating the arc,

- After examining again we are measuring mass of the same contact assembly and we are estimating the loss in weight (percentage).

2) Examining the electrical conductivity

To conduct research with technical method at the sample length  $l \approx 1$  m, diameter  $S \phi 19$  mm, source of the direct current 20-100 A. Result is a conductivity  $> 10 \left[ \frac{\Omega \cdot mm^2}{m} \right]$ .

#### VI. SUMMARY

Due to character of attempts the most essential criterion is criterion of arc resistance. Of point of view of using of the sinter of copper and tungsten at the technique of high voltages and electric apparatuses, the most essential criterion is a criterion of arc resistance. This criterion explicitly shows that in the practical application it is necessary to use the sinter of copper and tungsten.

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# Comparative analysis of contact versus contactless methods of three-dimensional digitization of objects

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**Abstract**— Strong development and progress in the field of information technologies (IT) and manufacturing technologies, in the last decade, has provided performance and implementation of many activities that involve an interdisciplinary approach in solving of specific problems. By this way through synergy effect, based on achievements in various scientific fields, existing problems can be overcome, but it also opens the doors to new applications in different areas of human activities. Three-dimensional (3D) digitalization of physical objects is a multidisciplinary scientific-research area that combines a series of knowledge and practical skills in engineering and computer science. Result of 3D digitalization process is digital 3D CAD model with acceptable accuracy.

**Keywords**- formatting; three-dimensional (3D) digitalisation, contact method, contactless method, cloud of points, CAD inspection

## I. INTRODUCTION

Three-dimensional digitalization is the initial step in implementation of contemporary approaches, based on usage of information technology in the manufacture of castings when as an input parameter of process the specimen was used. In cases when there is no the technical documentation of part that should pour off most often is foundry delivered samples of part, which requires making the appropriate technical documentation delivered of sample [1,2]. Unlike to conventional approaches where is this operation performed with conventional measuring equipment, approach based on modern methods of three-dimensional digitalization ensures creation of almost absolutely accurate copy of scanned part. In the framework of process of three-dimensional digitalization collecting of data with an area of the physical object, as well as their transformation in digital form is carried out, and because of that comes the term three-dimensional (3D) digitalization [10]. The result of three-dimensional digitalization is the set of points, defined over the spatial coordinates and because of the shape that occupies in the space are generally well known in a literature as a term "cloud of points". There are a several methods that perform a three-

dimensional digitalization of geometric characteristics of objects, and depending on surface structure and complexity of part the appropriate method for three-dimensional digitalization is selected. In a case when the parts are made from materials with elastic properties application of contact methods for three-dimensional digitization is not appropriate [3]. Of course, if there is possibility of implementing contactless method of three-dimensional digitalization, it represents better choice because it provides generation of "cloud of points" with a large number of points scanned from a part in a very short period of time, with great accuracy of collected points. Generated "cloud of points" saved in a file represents a real physical description of the scanned object in three-dimensional virtual space [4,8,9].

## II. PROCESS OF CAD INSPECTION (CONTACT METHOD)

To determine the qualitative difference between „raw“ cloud of points versus generated 3D volume model of cross members of scraper conveyor obtained by contact method of 3D digitalization and pointed to the necessity of processing of „raw“ data presented in a cloud of points, CAD inspection of above mentioned data sets that generate the geometrical shape of the considered object was done. Phases of the CAD inspection process and its results are presented on Figure 1 and in table 1 [1]. When analyzing of critical cross section

(Figure 1c) performed by CAD inspection (table 2) it can be concluded that the total number of points on the observed cross section is 334, from that 96 points deviate from the nominal value, and that the critical point with maximal distance (5.611 mm) from nominal value is located at the point of maximum radius (Figure 1d). Possible reason for the maximum deviation at the point of maximum radius is due to

"slipping" of probe of tactile scanner on a circular surface and therefore collected points have significant deviation from the rest of sample [5,6].

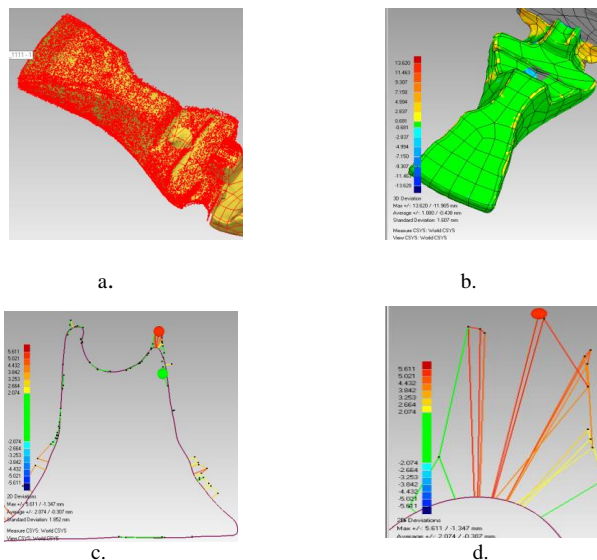


Figure 1. a) overlapping points, b) results of CAD inspection, c) critical cross section, d) most critical location at the cross section

TABLE I. DISPLAY THE RESULTS OF 3D-COMPARISON

3D Comparison	
Reference model	„Raw“ cloud of points, method of contact
Test model	CAD-model
The total number of points	47973
The points that deviate	11993
	3D deviation
Measure	mm
The maximum critical	13.620
The maximum nominal	0.681
The minimum nominal	-0.681
The minimum critical	-13.620
Deviation	
Maximum upper deviation	13.620
The least deviation	-11.965
The mean deviation	1.080/-0.438

Analysis of the statistical distribution of errors in CAD inspection of two observed models (Figure 2) indicates that the highest number of points has a deviation of 0,681 mm, respectively, about 75% of total number of points [1].

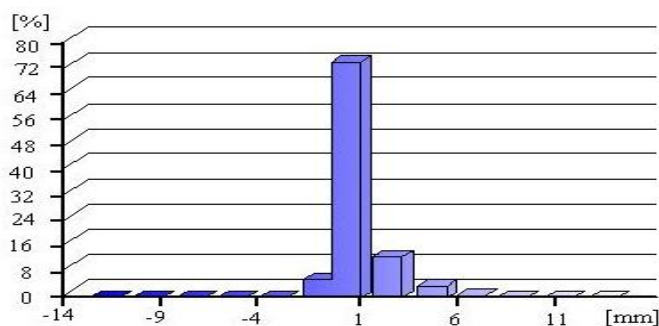


Figure 2. Graphical representation of deviation

TABLE II. RESULTS CAD INSPECTION OF COMPARING

2D Comparison	
Reference model	„Raw“ cloud of points
Test model	CAD-model
The total number of points	334
The points that deviate	96
	2D deviation
Measure	mm
The maximum critical	5.611
The maximum nominal	2.074
The minimum nominal	-2.074
The minimum critical	-5.611
Deviation	
Maximum upper deviation	5.611
The least deviation	-1.347
The mean deviation	1.080/-0.438
The standard deviation	1.852

### III. PROCESS OF CAD INSPECTION (CONTACTLESS METHOD)

Identically as in the previous case in order to determine qualitative difference between "raw" cloud of points versus generated 3D CAD virtual model of cross members of scraper conveyor, and to point on necessary processing of „row“ data presented through a cloud of points access to with CAD inspection. Each phase of the CAD inspection and its results are presented on Figure 3 and table 3 [1,5,6,7].

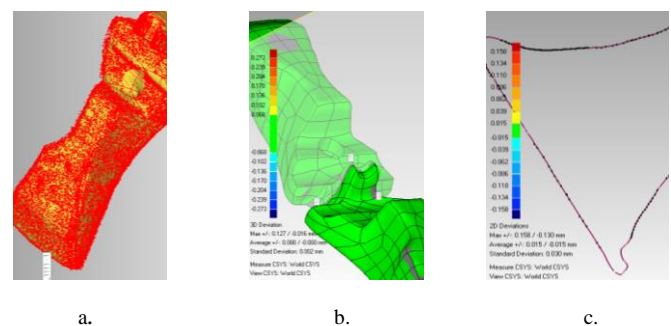


Figure 3. a) overlapping of cloud of points and 3D CAD solid model, b) representation of the results of CAD inspection, c) critical cross section

Analysis of the results indicates that the total number of points of two overlapping models is 191860, from that in 724 points there are some variations (table 3). Maximum deviation from nominal value is 0,273 mm in critical point. Analysis of the critical cross section (table 4) indicated that the total number of observed points in cross section is 526, from that 276 points deviates from the nominal value, and the is maximum deviation is in critical point with distance of 0.158 mm from the nominal value [1].

TABLE III. RESULTS OF CAD INSPECTION

3D Comparison	
Reference model	„Raw“ cloud of points,
Test model	CAD-model
The total number of points	191860
The points that deviate	724
3D deviation	
Measure	mm
The maximum critical	0.273
The maximum nominal	0.068
The minimum nominal	-0.068
The minimum critical	-0.273
Deviation	
Maximum upper deviation	0.127
The least deviation	-0.016
The mean deviation	0.000/-0.000
The standard deviation	0.007

TABLE IV. RESULTS CAD INSPECTION OF COMPARING CROSS-SECTIONAL OBSERVED MODEL

2D Comparison	
Reference model	„Raw“ cloud of points
Test model	CAD-model
The total number of points	526
The points that deviate	276
2D deviation	
Measure	mm
The max. critical	0.158
The maximum nominal	0.015
The maximum nominal	-0.015
The min. critical	-0.158
Deviation	
Max. upper deviation	0.158
The least deviation	-0.130
The standard deviation	0.030

#### IV. COMPARATIVE ANALYSIS OF THE RESULTS OF 3D DIGITIZATION

Once completed of partial analysis of „raw“ clouds of points (before processing) versus generated three-dimensional CAD virtual model of cross members of scraper conveyor obtained by contact and contactless methods of three-dimensional digitalisation a comparative analysis of the results was performed table 5. Based on the results presented on table 5, it can be concluded that by usage of contact digitalisation method maximal upper deviation from nominal value is 13,620 mm, while by usage of the contactless digitalisation method for the same model maximal upper deviation from nominal value 0,127 mm was obtained. The superiority of application of contactless method for 3D digitization in comparison to the applied contact method for

3D digitization can be viewed in comparative analysis of observed critical cross-section of the analyzed models (table 6) [1].

TABLE V. COMPARISON OF RESULTS OF THE CAD INSPECTION

3D Comparison		
Reference model	„Raw“ cloud of points, (method of contact)	„Raw „cloud of points, (contactless method)
Test model	CAD model	CAD model
The total number of points	47973	191860
The points that deviate	32	724
3D deviation		3D deviation
Measure	mm	mm
The max. critical	13.620	0.273
The max. nominal	0.681	0.068
The max. nominal	-0.681	-0.068
The min. critical	-13.620	-0.273
Deviation		
max.upper devia.	13.620	0.127
max. least mdevia.	-11.965	-0.016
mean deviation	1.0/-0.4	0.001/-0.002
standard deviation	1.607	0.007

TABLE VI. COMPARISON OF THE RESULTS OF CARRY OUT CAD INSPECTION IN THE CROSS SECTION

2D Comparison		
Reference model	„Raw“ cloud of points, (method of contact)	„Raw „cloud of points, contactless method
Test model	CAD model	CAD model
The total num. of points	334	526
The points that deviate	96	276
2D devia.		2D deviation
Measure	mm	mm
The max. critical	5.611	0.158
max. nominal	2.074	0.015
max. nominal	-2.074	-0.015
The min. critical	-5.611	-0.158
Deviation		
max. upper devi.	5.611	0.158
max. least devia.	-1.347	-0.130
mean deviation	1.0/-0.438	0.001/-0.002
standard deviati.	1.852	0.030

#### V. CONCLUSIONS

In this paper a comparative analysis of three-dimensional digitization of objects using contact and contactless methods was carried out. Although it is generally known that the process of contactless scanning results in better data quality i.e. obtaining better data on the one hand, the cost of these systems is much higher than the systems based on the contact approach. Finding the optimal scope of contact (tactile) and contactless (optical) methods of three-dimensional digitization usage is a goal of carried out analysis. In accordance with the derived measurements it is possible to conclude that tactile methods of three-dimensional digitization are less accurate at the circular crossing points on the sample, at the openings, at the uneven surfaces, in the

case of improper management of a probe, accuracy is a function of wear probe, etc. but application of contact methods is possible and justified in cases when the scan of geometrically simple surfaces is needed. On the other hand optical methods of three-dimensional digitalization have better accuracy due to the positioning of the sample for scanning, it is possible to collect more points than by tactile methods, quality of collected data is better, etc., but it is unreasonable to use those methods in the cases when the scan performs simple geometric surface (flat surface, without holes, Mitre etc.) [1].

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# CONSTRUCTION COST ESTIMATES FOR RESIDENCES IN SPAIN: practical application of the Pcr.5n model

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**Abstract.** The construction cost estimation systems in Spain are undeveloped and, hence, infrequently used by technicians and professionals in the building sector. However, estimation of an approximate real cost prior to the execution of the work is compulsory under current legal regulations (Technical Building Code). Therefore, the development of research projects on construction cost estimation models such as the one described and demonstrated in this talk is extremely interesting.

The objectives of the present research are to establish a construction cost estimation system for the residential building sphere in Spain, and to demonstrate the practical application of a quick and precise model for estimating the construction costs by contract.

This model is referred to as Pcr.5n (Cost estimation with 5 levels of process design) it makes it possible to formulate a cost estimate that is implemented in the stages prior to the conceptualization of the architectural project, namely during the process of carrying out preliminary studies, drafting and the basic project.

At each level of calculation, the model adjusts the estimate in accordance with how the definition of the project advances (successive approximations at finite intervals). The final objective and hypothesis of the model is the achievement of at least 90% accuracy with regard to the final cost estimation of the work.

The cost calculation for material execution is structured using functional three-dimensional cubic parameters for the planned space, and constructive two-dimensional metric parameters for the surface that envelopes around the facade and the building's footprint on the plot of land. These functional and constructive parameters are considered in each stage of the calculation process along with other thematic/specific parameters having to do with the management, design and execution of the exact building project, the cost of which has been estimated for the planned works, according to contract.

**Keywords:** Building, cost, estimation, housing, model, project.

## I. HISTORIC PRECEDENTS

In the introduction to his "Ten Books on Architecture", Vitruvius Polion (Vitruvio, 1787), makes reference to an old law stipulating that the architect is obliged to calculate the "true estimate" of a project's final cost. Once the budget had been accepted and approved, all of the architect's properties were mortgaged by the government administration behind the project in question, until its ultimate financial settlement.

If the work was settled with a cost increase that did not exceed "*more than a quarter part*" of the approved budget, it was paid for using public funds, and the architect was not "*...subject to any penalty*". But if the project's final cost exceeded the original estimate by more than a quarter part, this excess was defrayed with the architect's own mortgaged property. When the originally approved financial forecasts had been met, the architect's property was released from the mortgage and he received fees in recognition of this fact.

This demonstrates that in 1 BC, there was already awareness about methods of final cost estimation for building projects, with penalties in effect for architects that strayed from financial previsions by more than 25% over the initial cost estimate for the construction project.

## II. PLANNED OBJECTIVES AND FORMULATED HYPOTHESES

The research has two basic goals. On the one hand, to describe the current situation in Spain with regard to construction cost estimation techniques for residences, and on the other, to explain the concept of the Pcr.5n cost estimation model for architectural projects using preliminary studies of the project to be executed.

The goal is to obtain a useful working tool for students, technicians and professionals in the building sector that enables the calculation of the actual cost of the planned work, and to demonstrate with a simple practical application a reasonable and feasible technical calculation that is easy to use.

The objective focuses on achieving a reasonable level of precision in the estimation of final construction costs for a project, insuring that the deviations remain below the 10% permitted by the EU with regard to the project's initially approved budget. This deviation can also be considered the maximum in terms of what is reasonable from a perspective of financial security and the initial viability of the development, both on a public and private level. Thus, by applying the developed model, the objective is to obtain deviations of less than 10% of the actual cost of the finished work. These deviations will be measured at the following intervals, arranged from lowest to highest in terms of the project's level of definition: at level 1, initial development valuation (+/- 25%, a quarter part according to Vitruvius' *Ten Books*); at level 2, corresponding to preliminary studies (+/- 20%, maximum margin of error allowed by Law 3/2011 on Contracts for the Spanish Public Sector); at level 3, drafting (+/- 15% of the admissible maximum margin of error); and at levels 4 and 5, corresponding to the basic project, deviations of less than 10%. This is the legally allowed percentage for the financial acceptance of the work through an increment in the project's final mediation, with respect to the initial mediation state of the executed project.

Therefore, the calculation stages or levels contemplated in the Pcr.5m model, prior to the execution stage of the project are:

1. Initial development: Construction costs calculation based on initial sale price
2. Preliminary studies: Estimation of construction costs based on total cubic meters
3. Drafting: Estimation of construction costs based on the external envelope, the interior volume and the footprint on the ground
4. Basic Project: Estimation of construction costs based on square meters built, with wheighted average parameters of management, project and development
5. Basic development: Costs construction calculation based on basic sale price

Figure 1 shows the trend in percentage of deviation of costs estimates from the initial stages nr. 1 (10% deviation) to the Basic development nr. 5 (5% deviation)

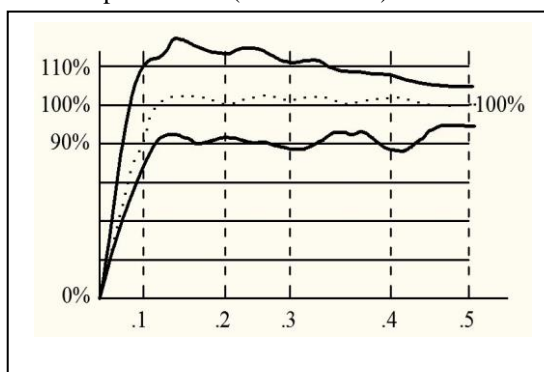


Figure 1. Estimated calculation process by level

Source: the authors

The purpose of these objectives is to provide a positive response to four hypotheses, formulated as follows:

1. The first hypothesis is based on the fact that estimated cost calculations for residential architectural projects result in maximum deviations of 10% over the project's final cost, which is to say, half of the maximum margin of error permitted by Law 3/2011, Law of Contracts for the Public Sector, in which articles 311 and 312 stipulate that the maximum deviation is 20%, in order to ensure that the planning technician is not subject to penalties over the actual construction cost.

2. The second hypothesis asks that, in addition to being accurate, the model in development must be fast, with easy practical application. This supports the objective of introducing it into everyday construction cost estimates in the building sector of our country, through the approximate calculation based on two-dimensional (m2) and three-dimensional parameters (M3), which is a common approach in countries such Germany (BKI, 2012), United States (Cox & William, 1996) and Australia (Cheung, 2005).

3. The third hypothesis intends that the model go beyond the methodology that is usually found in cost estimation methods, which are based on an estimation of costs per square meter. To this end, the proposed cost estimation model is structured around building systems and functional spaces, costs that are gradually defined and estimated during the design process (successive approximations at finite intervals).

4. The fourth hypothesis is that history supports this model, both in its conceptual origins and in its methodological development: Vitruvius (beauty + utility + solidity) versus the Pcr Model: (exterior envelope + interior space + foundation footprint).

### III. STATE OF THE MATTER: COST ESTIMATION IN SPAIN

In Spain there have been very few treatises published on construction cost estimation. Only two (Paricio, 1971) and (Carvajal, 1992) have explored this issue in-depth. Additionally, there are only two commercial construction cost estimation programs available in the Spanish market, Presto (Soft) and Arquímedes (Cype).

However, the current Technical Building Laws stipulate that the basic project include at least one approximate budget by chapter (Anejo I.2.V). This budgetary estimation should be calculated using cost estimation models, since this planning stage does not include detailed documents or highly developed plans that correspond to the executed project. Therefore, the need exists for the specification and development of construction cost estimation models.

### IV. RESEARCH METHODOLOGY

The methodology used to obtain the intended results for the development of the Pcr.5n model and to respond to the established hypotheses, has been structured into the three following stages:

#### 1st Stage: INTRODUCTION

During this initial phase, the origin and justification of the research is set out, based on the requirements stipulated by current legislation on construction cost estimation and its

possible penalties when deviations occur in the actual costs of the work in question.

The proposed objectives and formulated hypothesis are specified and designed, as well as the advisability and advantages of the developed cost estimation model.

## 2<sup>nd</sup> Stage: ANALYSIS. EVALUATION

This second phase involves the development of the internal calculations made using traditional analytical methodology on projects and real building costs (Pina, 1989, 1991 and 2004), thereby obtaining the minimal functional unit costs (half-bath, bedroom, kitchen, washroom, living room), the costs of the building systems for the exterior envelopes (roof and facades), and the cost of the building's footprint on the plot of land (preparation of the land, foundation, basements). Also, an estimate is made of the percentages by which management, planning and construction parameters increase the calculated cost of the planned work, beyond the contractor's general costs and profits.

As a result of the research have been obtained with statistics costs performed by the software SPSS (Statistical Package of the Social Sciences) (Figure 2).

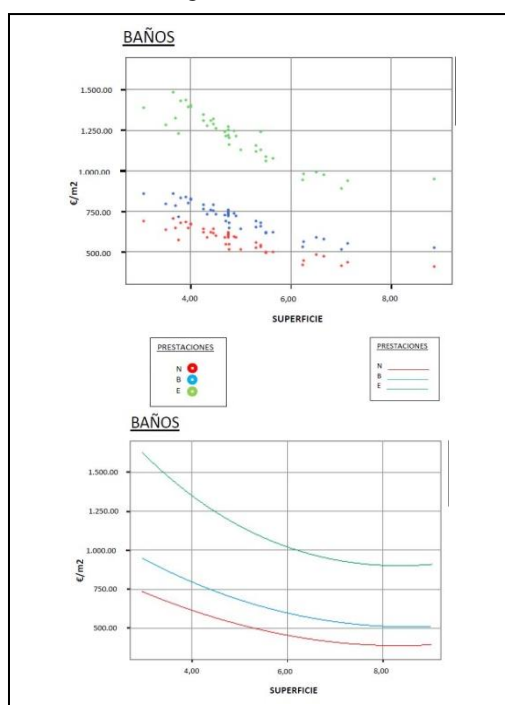


Figure 2. Analytical cost/surface area calculations in use (SPSS)

Source: the authors

Finally, the internal, theoretical results of the model are analyzed through information that is structured using tables which make it possible to contrast and validate these results against the external calculations and evaluations of the actual final construction costs.

Subsequently, the external analysis and evaluation of the Pcr.5n model (Estimation of reference costs using 5 calculation levels) is carried out, and the theoretical model is applied to 240 completed building projects, whose real and final construction

costs are known. This contrasting and evaluation process makes it possible to reconcile the results and definitively validate compliance with the four original hypotheses:

- (1) Errors / deviations less than 10% over the final construction cost.
- (2) A model that is fast with an easy practical application.
- (3) Spatial / volumetric calculations (from 2D to 3D).
- (4) (Beauty + utility + solidity) versus (exterior envelope + interior space + foundation footprint).

Finally, this stage involves the synthesizing of the theoretical and practical conclusions.

In summary, the methodology developed for the current research project has centered on the theoretical and practical development of the synthetic calculation procedure, in order to achieve compliance with the four hypotheses detailed in items (1), (2), (3) and (4), above.

And lastly, the Pcr.5n model incorporates and integrates the commonly applied methods in our country that are based on specifications for constructed surface areas by floor, the cubic method for constructed volume, and the "Storey" box method that takes into account floors and facades and their corresponding heights (Cheung, 2005). This results in an integrated model with fewer errors and deviations than those results obtained using the independent application of the aforementioned methods.

Figure 3 graphically displays the five levels of calculation developed by the Pcr.5n model.

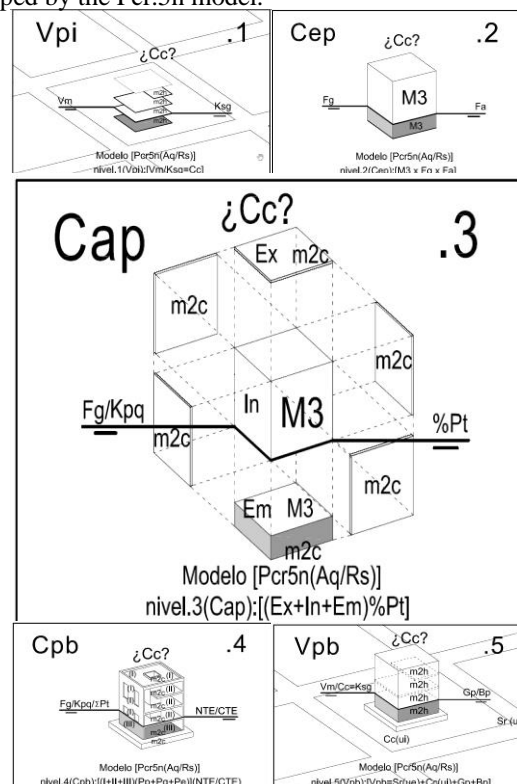


Figure 3. — General cost estimation model.

Figure 4 shows one of the 240 factsheets type of the projects database. The zoomed area includes the detailed data of the project. The down part and the upper right includes the two-dimensional and three-dimensional graphics references.


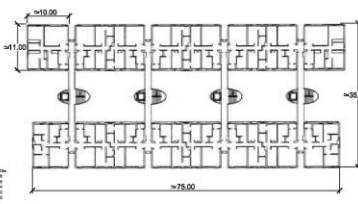
<p>Situación: Fuenlabrada (Madrid) Denominación: Vlv.colectiva Calle Miguel de Cervantes 3 Tipología: B1/ Cb- Colectiva bloque Arquitecto: Antonio Ruiz Barbarin Promotor: Sociedad Cooperativa Artículo 47 Fecha proyecto/inicio/obra: 1995/1996/1998 Duración estimada de obra: 2.1 años m2 construidos: 11.389m2 /Coste de contrata: 3.995.252€ M3 edificados: 31.890m3 /Coste de contrata: 125€/ M3e Altura: 7 Plantas + 1 Sótano Total coste construcción por contrata final de obra: 3.995.252€ Exterior: Fábrica de ladrillo visto Fuente: Costes+Datos de Edificación-SOFT, Archivo_VIC280033</p> <p>USO/TIPOLOGÍA: RESIDENCIAL/COLECTIVA BLOQUE TOTAL M3 PROYECTADOS: [ 28.700 / 35.075 ].....M3p DENOMINACIÓN DEL PROYECTO: ..... SITUACIÓN DE LA OBRA: ..... AÑO PREVISTO FINAL DE OBRA: ..... (Fg) Factor geográfico=Fg(.....): Fg(Madrid)=..... (Fa) Factor actualización = Fa(.....): Fa(1998)=..... (Cc.2) Coste construcción= (Fg)(Fa) x Cc (Coste contrata final)= = (.....)x(.....)x3.995.252€=.....€ : 31.890M3= = [.....€/M3 actualizados ] x [.....M3 proyectados ]= Cc.2 = [.....€/M3 actualizados ] x [.....M3 proyectados ] = .....€</p> <p>Predimensionado coste construcción por contrata final de obra: (Cc.2) = .....€(iva no incluido)=Aq/Rs/Cb/ 042 /.....</p>	<p>Aq/Rs/Cb/042/1998 Ccp Cc? .2</p> <p>Módulo: Por Sici/Aq/Rs/ Rs: 2 Cc(042)gR</p> <p>Coste estudios previos?</p> 	<p>Situación: Fuenlabrada (Madrid) Denominación: Vlv.colectiva Calle Miguel de Cervantes 3 Tipología: B1/ Cb- Colectiva bloque Arquitecto: Antonio Ruiz Barbarin Promotor: Sociedad Cooperativa Artículo 47 Constructor: Bouygues Construcciones España S.A. Fecha proyecto/inicio/obra: 1995/1996/1998 Duración estimada de obra: 2.1 años m2 construidos: 11.389m2 /Coste de contrata: 3.995.252€ M3 edificados: 31.890m3 /Coste de contrata: 125€/ M3e Altura: 7 Plantas + 1 Sótano Total coste construcción por contrata final de obra: 3.995.252€ Exterior: Fábrica de ladrillo visto Fuente: Costes+Datos de Edificación-SOFT, Archivo_VIC280033</p>
 <p>TEBB DOCTORALIZO: DESARROLLO DE UN MODELO DE PREDIMENSIONADO DE COSTES DE CONSTRUCCIÓN EN EL PROYECTO-ARQUITECTÓNICO ESCUELA TÉCNICA SUPERIOR DE ARQUITECTURA Y DISEÑO UNIVERSIDAD POLITÉCNICA DE MADRID AUTOR: PEDRO PARRA RUIZ - ARQUITECTO</p> <p>B1/Cb 042</p>	<p>USO/TIPOLOGÍA: RESIDENCIAL/COLECTIVA BLOQUE TOTAL M3 PROYECTADOS: [ 28.700 / 35.075 ].....M3p DENOMINACIÓN DEL PROYECTO: ..... SITUACIÓN DE LA OBRA: ..... AÑO PREVISTO FINAL DE OBRA: ..... (Fg) Factor geográfico=Fg(.....): Fg(Madrid)=..... (Fa) Factor actualización = Fa(.....): Fa(1998)=..... (Cc.2) Coste construcción= (Fg)(Fa) x Cc (Coste contrata final)= = (.....)x(.....)x3.995.252€=.....€ : 31.890M3= = [.....€/M3 actualizados ] x [.....M3 proyectados ]= Cc.2 = [.....€/M3 actualizados ] x [.....M3 proyectados ] = .....€</p> <p>Predimensionado coste construcción por contrata final de obra: (Cc.2) = .....€(iva no incluido)=Aq/Rs/Cb/ 042 /.....</p>	

Figure 4. type of data sheet found in the Pcr.5n model database.

Source: the authors.

Figure 5 shows the apartment building of 159 units whose costs construction and percentage deviations are estimated.

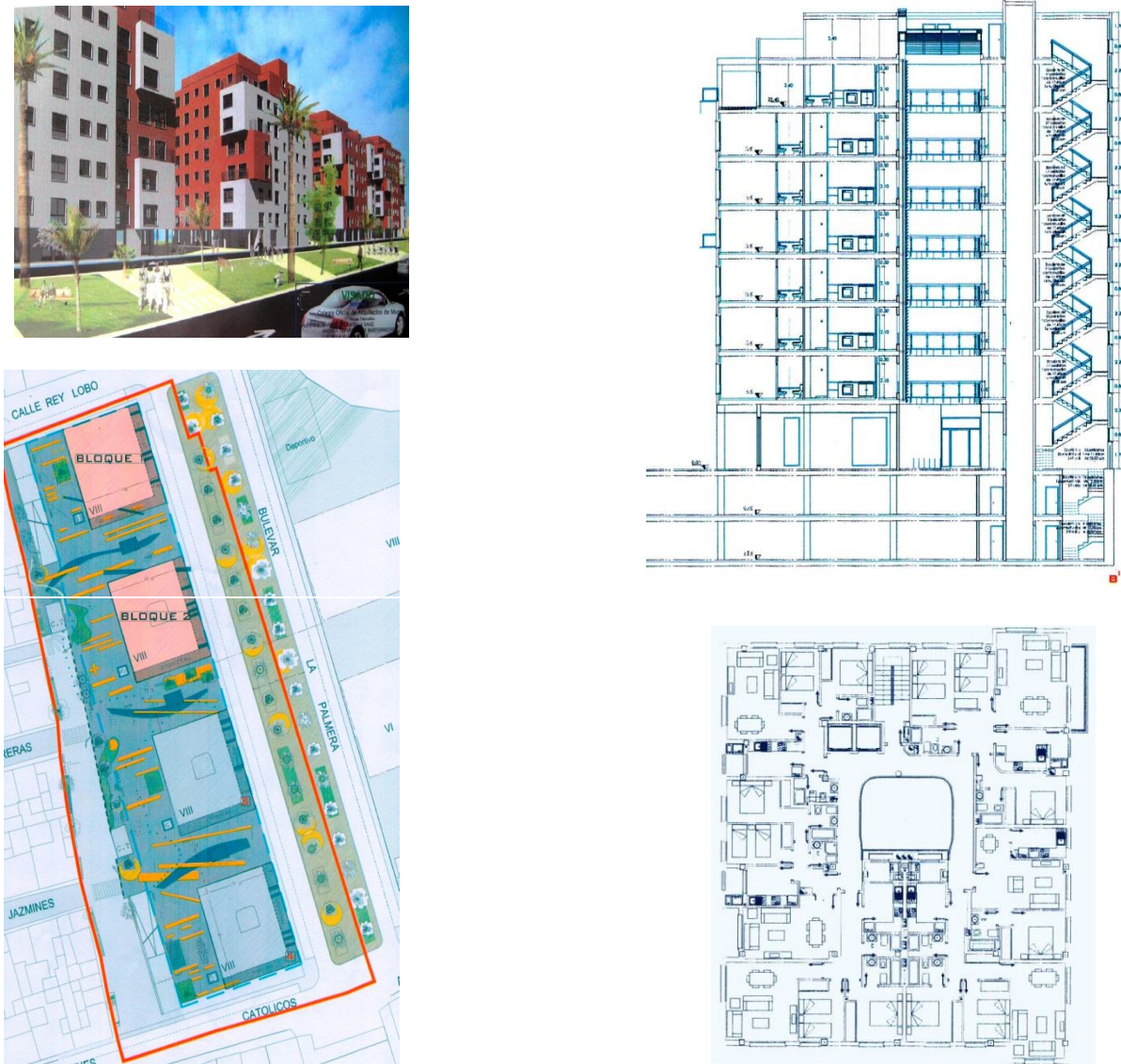


Figure 5. **Figure 5:** Perspective, floor plans and sections of 159 residences, retail spaces, parking garages and storage units

Source: Mariano y Luz de la Villa-Arquitectos- Murcia - Spain

## V. DATA ANALYSIS, DISCUSSION AND SUMMARY OF RESULTS

For an example of the practical application of the specified model, we chose a project consisting of 159 residences, retail spaces, parking garages and storage units in Murcia (Spain).

The project consists of four blocks of community housing with a square floor plan, that are each 8 stories high with 2 basement garages.

**Table 1**, contains a selection of 12 projects excerpted from the Pcr.5n model database, which were selected using criteria related to the volume of the construction and its overall typology.

The sample size is sufficiently representative for the cost estimation of a similar project (BKI, 2012).

TABLE I. SELECTED PROJECTS FROM THE OF THE Pcr.5n MODEL DATABASE (COLLECTIVE HOUSING/B1Cb: 159 RESIDENCES)

Code number	Designation	Location	Year construction finalized	Contracted cost	m2	M3	Cost €/m2	Cost €/M3
B1/Cb/027	56 Subsidized housing	Madrid	1993	1.952.154	7.305	21.501	267	91
B1/Cb/031	Collective housing	Malaga	1998	2.339.259	8.242	22.686	284	103
B1/Cb/034	53 Subsidized housing	Madrid	2003	3.409.352	8.497	26.004	401	131
B1/Cb/035	85 Subsidized housing	Murcia	1987	1.878.808	9.000	27.000	209	70
<b>B1/Cb/041</b>	<b>128 Residences</b> ✓	Madrid	2003	3.847.334	10.492	31.476	<b>367</b>	<b>122</b> ✓
<b>B1/Cb/042</b>	<b>Collective housing</b> ✓	Madrid	1998	3.995.252	11.389	31.890	<b>351</b>	<b>125</b> ✓
<b>B1/Cb/054</b>	<b>96 Subsidized housing</b> ✓	S.Sebastian	2001	5.080.000	13.116	44.980	<b>387</b>	<b>113</b> ✓
<b>B1/Cb/060</b>	<b>155 Residences</b> ✓	Madrid	1995	5.629.053	18.847	55.081	<b>299</b>	<b>102</b> ✓
B1/Cb/062	45+48 Residences	Madrid	2000	4.640.414	15.308	58.407	303	79
<b>B1/Cb/063</b>	<b>Building with 174 Residences</b> ✓	Seville	2002	7.283.420	21.479	62.431	<b>339</b>	<b>117</b> ✓
<b>B1/Cb/064</b>	<b>168 Subsidized housing</b> ✓	Vitoria	2002	7.420.037	23.086	67.345	<b>321</b>	<b>99</b> ✓
B1/Cb/067	156 Residences for young people	Madrid	2007	12.187.375	28.237	75.500	432	161

Source: the authors

**Table 2** depicts a selection of six projects that are comparable to the project being evaluated, with specific design-type criteria and similar in features and quality to the group of planned projects. This criteria (graphically displayed on figure 6) is supported by the Spanish Order/805/2003 ECO, regarding the rules for valuing real estate assets and which defines the fees for certain financial purposes. We obtain certain average unitary costs of 548€/m2 and **189 €/m3** (2013) weighting the cost per square meter (€/m2c) and cubic meter (€/M3e) to a restatement factor (Fa) and to a geographical factor (Fg).

TABLE II. CONTROL/COMPARABLE SIMILARITIES TO THE PLANNED PROJECT (COLLECTIVE HOUSING/B1/Cb: 159 RESIDENCES)

Code number	Designation	Location	Cost €/m2c	Cost €/M3e	Fa 2013/.....	Fg Murcia/.....	Cost 2013 €/m2	Cost 2013 €/M3
<b>B1/Cb/041</b>	<b>128 Residences</b> ✓	Madrid	<b>367</b>	<b>122</b>	172/115	100/112	<b>488</b>	<b>162</b> ✓
<b>B1/Cb/042</b>	<b>Collective housing</b> ✓	Madrid	<b>351</b>	<b>125</b>	172/86	100/112	<b>625</b>	<b>222</b> ✓
B1/Cb/054	96 Subsidized housing	S.Sebastian	387	113	172/104	100/110	580	169
B1/Cb/060	155 Residences	Madrid	299	102	172/75	100/112	610	208
<b>B1/Cb/063</b>	<b>Building with 174 Residences</b> ✓	Seville	<b>339</b>	<b>117</b>	172/108	100/101	<b>532</b>	<b>184</b> ✓
B1/Cb/064	168 Subsidized housing	Vitoria	321	99	172/108	100/110	465	144
<b>B1/Cb/XXX</b>	<b>159 Residences (2013)</b>	Murcia	.....				<b>548</b>	<b>189</b>

Source: the authors

**Table 3** contains specific calculations for the planned building of 159 residences, retail spaces, parking garages and storage units, along with the five calculation levels of the Pcr.5n model, numerically developing the formulas and concepts summarized in Figure 4, as described below:

Stage 1. At this first level of the initial development, construction costs are calculated by multiplying the homogenized surface area by the selling price per square metre of the finished building divided by the coefficient (Ksg), whose value is a function of the cost of the land and the costs and benefits of the construction company.

Stage 2. At this second initial study level, the construction costs are calculated by multiplying the mean unitary cost per cubic metre of projects of similar characteristics by the cubic metres projected.

Stage 3. In this third level of the draft project, the construction costs are estimated by the product of the georeferenced material cost of construction (Cg), comprising the roof, façade, interior volume and “footprint” of the building (all increased by the thematic parameter (Pt) which takes into consideration general costs and the benefits of the construction company.

Stage 4. At this fourth level of the basic project estimation, basic plans and specifications are already available, and the predimensioning of the construction cost can be broken down into three chapters: (I) roof and façade, (II) interior functional uses and (III) foundations and basements. The result of the above calculation is then weighted by the parameters management, project and execution (Pg + Pp + Pe), which provides the closed estimate of the projected work.

Stage 5. At this level, the calculation is based on the selling value minus the cost of the land, promotion costs and benefits of the construction company, giving the construction costs of the project as “remainder”.

The results represent construction costs with a deviation range of [4.79% - 9.52%] over the actual costs. This error is less than the 10% maximum that was originally proposed as the objective and hypothesis of this study.

Table 3 reveals that the further one advances through the model's calculation levels, the better the approximation of the estimated value to the real and final cost of the planned construction. In short, Level 1 (market evaluation of the initial project) provides a greater deviation than Level 5 (market evaluation of the basic project) [+ 6.93 compared with + 4.79 %]. Level 2 (Construction costs in previous study phase) gives a higher deviation than the subsequent phases of calculating construction costs, Level 3 (pre-project) and Level 4 (basic project) [+ 9.52 % compared with + 6.55 % and + 5.46 %, respectively] .

TABLE III. COST ESTIMATES PLANNED BUILDING (B1/Cb/XXX:159 RESIDENCES) AND CALCULATION OF DEVIATION % OVER REAL COST

Calculation level	REAL FINAL COST (2013) OF BUILDING B1/Cb/XXX=159 Residences (Murcia/Spain: 13.609.803€) CALCULATIONS FOR ESTIMATING CONSTRUCTION COSTS BY CONTRACT (without taxes)	% error deviation
	<b>Stage 1: Valuation of initial development (Vpi): [Cc= Vm/Ksg]</b> Total constructed surface area = 24.310m <sup>2</sup> Homogenized surface area of "entire residence" =(433 m <sup>2</sup> .Ex1,214)+ +(13.861 m <sup>2</sup> Vx1,000)+(1.098 m <sup>2</sup> .Lx0,435) + +(8.214 m <sup>2</sup> .Gx0,565)+(704 m <sup>2</sup> .Tx0,649)= <u>Sh=19.974 m<sup>2</sup>h.V</u> $Cc.1 = Cc.0 \times Sh = \frac{Vm}{Ksg} \times m2h.V = 2.550€/m2c : 3,50 \times 19.974 = \mathbf{14.552.486 €}$	<b>+6,93%</b>
	<b>Stage 2: Preliminary cost studies (Cep): [M3xFgxFa]</b> Total projected volume= 78.865M3e; €/M3e (2013)= <u>189 €/M3 updated (Table 2)</u> $Cc.2 = \frac{€/M3 \text{ real}}{€/M3 \text{ projected}} \times M3e \text{ projected} = 189€/M3 \text{ real} \times 78.865 M3 \text{ projected} = \mathbf{14.905.485 €}$	<b>+9,52%</b>
	<b>Stage 3: Drafting cost (Cap): [(Ex + In + Em)%Pt]</b> Cg = Cost material execution x F location $Cc.3 = \frac{(Cg) \text{ Cost M.E. location}}{€Pt \text{ specific parameter}} = [(1.976m2Q \times 172€/m2Q) + (10.852m2Fx152€/m2F) + (8 UdA \times 36.600€/UdA) + (1.461M3E \times 134€/M3E) + (45.741M3V \times 134€/M3V) + (4.941M3L \times 58€/M3L) + (2.112M3T \times 87€/M3T) + (24.642M3G \times 76€/M3G) + (8.661m2H \times 119€/m2H)] \times x[Fg = Murcia = 1,000] + [23\% \text{ over } (Cg)] = Cc.3 = \mathbf{14.733.913€}$	<b>+6,55%</b>
	<b>Stage 4: Cost basic project (Cpb): [(I+II+III)x(Pg+Pp+Pe)] (NTE/CTE)</b> $Cc.4 = \frac{(Cg) \text{ Cost M.E. location}}{€Pt \text{ specific parameter}} = [(I) \text{ Exterior} + (II) \text{ Interior} + (III) \text{ Built-in}] \times [Fg] \times [Pg + Pp + Pe]$ $(I) \text{ Exterior} = [(1.976 m2Q \times 172 €/m2Q) + (8.580 m2 Fm \times 110€/m2 Fm) + (2.262m2 Fh \times 365 €/m2Fh)] = \mathbf{2.109.302€ EXTERIOR}$ $(II) \text{ Interior} = [(8 UdA \times 27.200€/UdA) + (443m2 \times E \times 420 €/m2E) + (620m2 B1 \times 1.495 €/m2B1) + (803m2 B2 \times 1.346 €/m2B2) + (1.515m2Cx 592€/m2C) + (1.604m2V \times 506€/m2V) + (461m2L \times 413€/m2L) + (2.120m2D1 \times 357 €/m2D1) + (2.450m2D2 \times 319€/m2D2) + (4.287m2S \times 295 €/m2S) + (1.098m2L \times 159€/m2L) = \mathbf{7.287.932€ INTERIOR}$ $(III) \text{ Built-in} = (8UdA \times 9.100 UdA) + (8.214m2S \times 328€/m2S) + (8.661m2H \times 119m2H) = \mathbf{2.976.251 € BUILT-IN}$ $€ Pt = Pg+Pp+Pe = 6\% + 4\% + 6\% = 16\% \text{ sobre } (I) + (II) + (III). Cc.4 = [(I) + (II) + (III) \times Fg \times 1,16 (€Pt)] = (2.109.302€ + 7.287.932+2.976.251€) \times 1,000 \times 1,16 = \mathbf{14.353.243 €}$	<b>+5,46%</b>
	<b>Stage 5: Valuation basic development (Vpb): Vm= Sr (ue) + Cc(ui) + Gp + Bp; [Cc(ui) = Vm - Sr(ue) - Gp - Bp]</b> $Cc.5 = \frac{Cc(ui)}{m2h.V} \times m2h.V = [Vm - Sr(ue) - Gp - Bp] \times m2h.V =$ $Cc.5 = [2.550€/m2c - (35\% \text{ sobre } 2.550) - (37\% \text{ sobre } 2.550)] \times 19.974m2h.V = \mathbf{14.261.436 €}$	<b>+4,79%</b>

Source: the authors

## VI. CONCLUSION

The construction cost estimation systems used in Spain are very underdeveloped, thanks to their general disuse by technicians and professionals from the construction sector. At the same time, the Spanish regulatory framework establishes the need to specify a cost for the project during the design stage (Technical Building Code).

Therefore, the value of this research lies in the importance of specifying cost-approximation models that can be used as useful tools for construction work and the development of building projects.

The model is conceptually based on the three pillars of architecture as described by Vitruvius in his "Ten Books on Architecture": beauty (exterior envelope) + utility (interior functional space) + solidity (footprint on the land).

Our conclusion with regard to the practical application of the Pcr.5n model is that it has fulfilled both its original objectives and formulated hypotheses, achieving a level of precision in estimating costs that is better than 90%. Specifically, the resulting deviations are less than 10%, and range from 4.8% to 9.5% in the analyzed control group.

Additionally, the practical application of this model is fast and simple throughout its five levels of implementation.

This model incorporates the innovative features of volumetric calculation and the box method, neither of which is habitually used in Spain, but whose application is common throughout as another countries like Germany, United States and Australia. The incorporation of these tools is of particular interest given that they result in a significant reduction in margins of error.

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# Optimization of energy consumption for the drying process with pre-heating of the material

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**Abstract-**The known method of increasing the drying process intensity is a pre-heating of the material. The effectiveness of this technology is based on the acceptance that the increase in the average material temperature before drying increases the coefficient of internal moisture diffusion, which determines the overall process duration.

However, in practice, there are no recommendations on the selection of the modes for preheating of the drying material which analyze energy consumption. Obviously, the preliminary increase in temperature of the material, on one hand, reduces the duration of the subsequent drying process, but on the other hand, requires a lot of the overall energy cost to the whole process.

This paper presents the theoretical and experimental studies to determine the rational modes for pre-heating edible raw materials in order to reduce overall energy costs for the drying process.

To estimate the energy efficiency new index is proposed: the ratio of dryer performance by moisture evaporation to drying process energy costs ratio.

It is shown that there exists an optimal duration of the preliminary material pre-heating process at which the total energy consumption for the drying process with pre-heating is minimal.

Based on the example of grape pomace drying in heat Mass Transfer module with conductive heat supply it is shown that dryer energy efficiency increases 25...45% when pre-heating duration is optimal.

**Keywords-**foodstuffs, kinetics of drying, structure of moisture, transport phenomena

## I. INTRODUCTION

Well-known method of increasing the intensity of the drying process is preheating of the material [1]. The effectiveness of this technological method is based on the fact that the increase of average temperature of the material before drying increases the internal mass transfer coefficient, and it determines the overall duration of the process.

However, grounded recommendations about the choice of conditions of preheating of drying material on the base of power inputs analysis are absent in the literature. It is obviously, that the increase of average temperature of the material on one side reduces duration of the next drying process, but on the other hand, requires longer duration of

heating, and therefore more total power inputs for the entire drying process.

In connection with this the object of the research paper is the definition of rational conditions of preheating under conductive heat admission to the material in order to reduce overall power inputs for the drying process.

In this connection it is of practical interest to research the possibility of additional increase of power efficiency through the use of preheating of the material. For this end, we propose to pre-heat of material with conductive heat increase from the heater is located on the lower surface of the drying material.

It is necessary to obtain the analytical dependences which link the total duration of the drying process with parameters of the material preheating for solving this problem, it would plan the search for rational conditions of the food material preheating.

Physical model of the process is formulated as follows. The material in the form of plates of finite size is heated. On one plane heat brings through the wall at constant temperature of the heater, another plane of material is in contact with the channel, where drying agent at constant temperature is located. Thermal properties are taken constant and equal to the average values during heating.

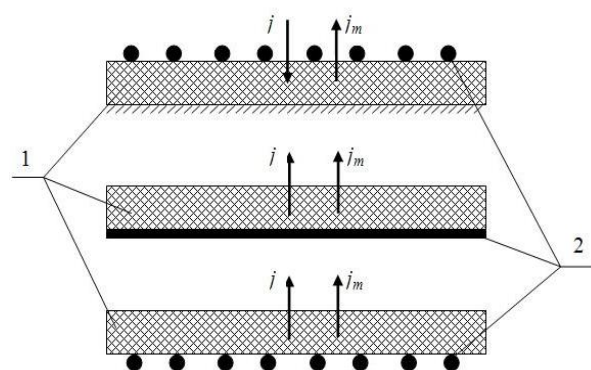


Figure 1. The scheme of conductive dryer: 1 – raw material; 2 – heater;  $j$  – flow of heat;  $j_m$  – mass flow

We use the approximate method of the solution of the thermal conductivity equation which is described in the research paper for obtaining the temperature field according to thickness of HMEM during the heating by internal heater [3]. The thermal conductivity equation is solved in quasiregular, quasionedimensional approximation under the assumption that

the rate of heating is proportional to the current temperature gradients by volume, which, in turn, is proportional to the gradient of the lowest geometric body size. The thermal conductivity equation in this approximation is written as follows:

$$\frac{d\theta}{dFo} = \Gamma_2 \frac{d^2\theta}{d\xi^2}, \quad (1)$$

where  $\theta = \frac{T-T_0}{T_2-T_1}$  - dimensionless material temperature;

$T_2$  - the temperature of internal heater, K;

$T_1$  - the temperature of drying agent, K;

$T_0$  - the initial material temperature, K

$\xi = x/R_x$  - dimensionless coordinate ( $0 \leq \xi \leq 1$ );

$\frac{d\theta}{dFo}$  - dimensionless rate of change of temperature;

$$\Gamma_2 = 1 + \left(\frac{R_x}{R_y}\right)^2 + \left(\frac{R_x}{R_z}\right)^2 - \text{quadratic coefficient of form;}$$

- number of Fourier;

$$Fo = a\tau/R_x^2$$

$a$  - coefficient of material thermal diffusivity,  $m^2/s$ ;

$R_x, R_y, R_z$  - feature body size according to the coordinates,  $2R_x$  - Plate thickness of the body.

Boundary conditions on the surface contacting with the channel of drying agent

$$-\lambda \frac{\Gamma_2}{\Gamma_1} \frac{\partial \theta}{\partial \xi} \Big|_{\xi=1} = \alpha \cdot (\theta - \theta_1), \quad (2)$$

where  $\lambda$  - coefficient of thermal conductivity of the body,  $W/(m \cdot K)$

$$\Gamma_1 = 1 + \frac{R_x}{R_y} + \frac{R_x}{R_z} - \text{coefficient of form,}$$

$\theta = \frac{T-T_0}{T_2-T_1}$  - dimensionless temperature in the channel of drying agent;

$\delta$  - wall thickness of HMEM, m;

$\lambda_\delta$  - thermal conductivity coefficient of HMEM wall thickness,  $W/(m \cdot K)$

$\alpha$  - heat exchange coefficient to drying agent  $W/(m^2 \cdot K)$ ;

Boundary conditions on the surface of HMEM contacting with the internal heater

$$-\lambda \frac{\Gamma_2}{\Gamma_1} \frac{\partial \theta}{\partial \xi} \Big|_{\xi=1} = k_2 \cdot (\theta_2 - \theta), \quad (3)$$

where  $\theta_2 = \frac{T_2-T_0}{T_2-T_1}$  - dimensionless temperature of the heater;

$k_2$  - thermal transmission coefficient,  $W/(m^2 \cdot K)$ ;  $k_2 = \frac{\lambda_\delta}{\delta}$ .

The solution of the equation (1) relative to temperature field  $\theta(\xi)$  under condition  $\frac{d\theta}{dFo} = const$  with boundary conditions (2, 3) takes the form

$$\theta(\xi) = -\left(\frac{d\theta}{dFo}\right) \cdot \left(\frac{1}{2} \cdot \frac{1}{\Gamma_2}\right) \cdot \frac{1}{K(\xi)} - \theta_{\max}(\xi), \quad (4)$$

where

$$\theta_{\max}(\xi) = \left[ \theta_2 - \frac{B_1 \cdot (B_2 \cdot \xi + 1)}{(B_2 + B_1 \cdot B_2 + B_1)} \right];$$

$$K(\xi) = \left[ \left[ \frac{2+B_1}{1+B_1+\frac{B_1}{B_2}} \cdot \left( \xi + \frac{1}{B_2} \right) - \xi^2 \right] \cdot \left( \frac{1}{2} \cdot \frac{1}{\Gamma_2} \right) \right]^{-1}$$

$$B_1 = \left( \frac{\alpha \cdot R_x}{\lambda} \cdot \frac{\Gamma_1}{\Gamma_2} \right);$$

$$B_2 = \frac{\lambda_\delta}{\lambda} \cdot \left( \frac{R_x}{\delta} \cdot \frac{\Gamma_1}{\Gamma_2} \right).$$

Solution of differential equation (4) relative to temperature with dimensionless time  $Fo$  with the initial condition of equal temperature distribution  $\theta(\xi)|_{Fo=0} = 0$  takes the form

$$\theta(\xi, Fo) = \theta_{\max}(\xi) \cdot \left( 1 - e^{-K(\xi) \cdot Fo} \right) \quad (5)$$

The resulting equation (5) allows calculating the temperature field by the thickness of the plate material by heating it on constant temperature of the internal heater and temperature in the channel of drying agent.

Calculate the kinetic of average volume temperature of the material on the base of the equation.

$$\bar{\theta} = \int_0^1 \theta_{\max}(\xi) \cdot \left( 1 - e^{-K(\xi) \cdot Fo} \right) d\xi \quad (6)$$

Next step is the calculating of the drying period, depending on the average temperature of the material. For this we use the results are published in the monograph [3], where, the following formula for determination of the duration of the drying process:

$$\tau = \ln \left( \frac{A_b}{u_k} \right) \cdot \frac{R_x^2}{a_{m0}} \cdot \left( \frac{T_0}{\bar{T}} \right)^n \quad (7)$$

where  $\tau$  – duration of the drying process, s;

$$u_k = \frac{w_k - w_p}{w_0 - w_p} \text{ - dimensionless final moisture content;}$$

$A_b$  - he proportion of free moisture in the material;

$a_{m0}$  - diffusion moisture coefficient at temperature  $T_0$ ,  $m^2/s$ ;

$\bar{T}$  - average temperature of the material during the drying whole period, K;

According to data [3] for food materials of vegetable origin under conditions of convective drying at temperatures of drying agent 40...120 °C  $a_{m0}=10^{-8}...10^{-11} m^2/c$  at  $n=7...13$ .

Will present the drying period (7) in dimensionless form in accordance with the above notation

$$Fo_{II} = \frac{1}{Lu} \cdot \ln \left( \frac{A_b}{u_k} \right) \cdot \left( \frac{1}{1 + \Theta_2} \right)^n \quad (8)$$

where  $Lu = a_{m0}/a$  – number of Lykov;

$$\Theta_2 = (T_2 - T_1)/T_0.$$

The total duration of the preheating and drying processes is:

$$Fo = Fo_I(\bar{\theta}) + Fo_{II}(\bar{\theta}) \quad (9)$$

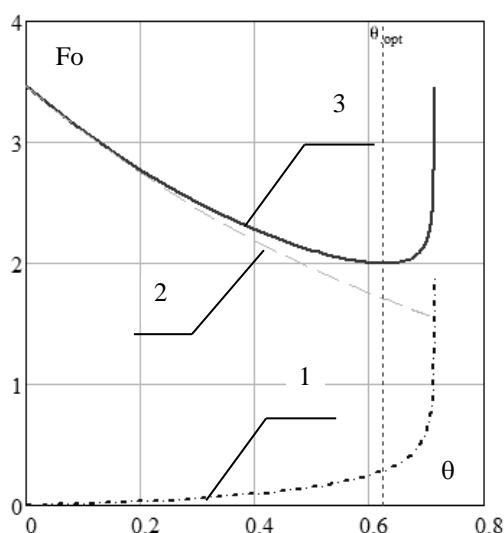


Figure 2. Heating duration (1), drying duration (2), total duration of the process (3) depending on average temperature of the material.

The fig. 2 shows the nature of changes in the duration of preheating  $Fo_I$  and drying  $Fo_{II}$  processes depending on the average temperature of the material  $\bar{\theta}$ , the relation of total duration of two phases  $Fo_I + Fo_{II}$  of the average temperature of the material (the average temperature at the end of the first phase) is constructed there. It is obvious that the average temperature of the material increases with increasing of preheating process duration and, consequently, the duration of the second phase of drying reduces. The total duration of the drying process with preheating is minimal at the optimal temperature of the material at the end of the first phase (optimal duration of the phase  $\theta_{opt}$ ).

The optimal duration of preheating process is determined from the condition of minimum total duration of two phases. We write on the based of equations (6), (8) and (9):

$$\frac{d}{dFo} \left[ Fo + \frac{1}{Lu} \cdot \ln \left( \frac{A_b}{u_k} \right) \cdot \left( \frac{1}{1 + \Theta_2 \cdot \int_0^1 \theta_{max}(\xi) \cdot (1 - e^{-K(\xi) \cdot Fo}) d\xi} \right)^n \right] = 0 \quad (10)$$

The last equation is solved only by numerical methods, however, it is possible to get its analytical solution under the following simplifications: the surface temperature and the material on one side, and the material of drying agent channel on the other hand differ in hundreds times corresponding to the inequality  $B_2 \gg B_1$ ; at low duration of the first phase (Fourier numbers  $Fo < 1$ ), we replace  $\exp(-K(\xi) \cdot Fo)$  by its expansion and it is limited by linear term. The analytic expression for the optimal duration of preheating phase of material is obtained under these assumptions. Calculations show that the deviation of the approximate solution (11) of the exact order is 30% under values  $Fo < 0,5$  and  $Lu < 0,1$ .

$$Fo_{opt} = \frac{\left[ \frac{n}{Lu} \cdot \ln \left( \frac{A_b}{u_k} \right) \cdot \left( 1 - \frac{1}{B_2} \right) \times \left( 1 - \frac{1}{B_2} \right) \times \left( \ln(2 \cdot B_2) - \frac{1}{2 \cdot B_2} \right) \cdot \Theta_0 \cdot \Gamma_2 \right]^{\frac{1}{n+1}} - 1}{\left( \ln(2 \cdot B_2) - \frac{1}{2 \cdot B_2} \right) \cdot \Theta_0 \cdot \Gamma_2} \quad (11)$$

where  $\Theta_0 = (T_2 - T_0)/T_0$ .

As it can be seen from the last expression, the optimal duration of heating process period  $Fo_{opt}$  depends primarily on the number of Lykov and the temperature difference  $\Theta_0$  between the heater and the channel of drying agent. The dependences of the total duration of the drying process with preheating process of the material of the duration of the first phase for typical range of values of  $Lu$  and  $\Theta_0$  under the drying are shown on fig. 2 and fig. 3.

The dotted lines show the optimal duration of the heating process phase of the material, which are calculated from the equation (10).

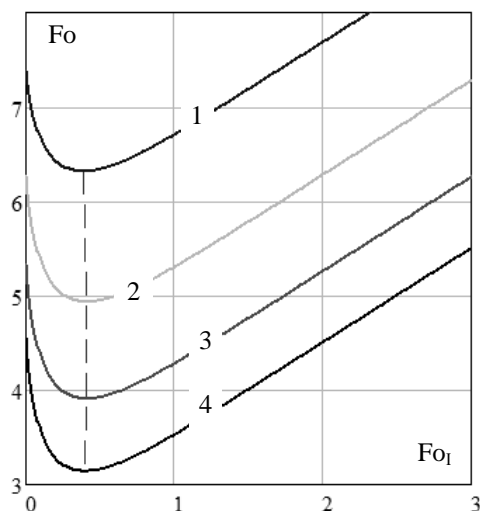


Figure 3. The effect of duration of heating process phase on the total duration of the process under changing the characteristic temperature: 1 -  $\Theta_0 = 0,1$ ; 2 -  $\Theta_0 = 0,15$ ; 3 -  $\Theta_0 = 0,20$ ; 4 -  $\Theta_0 = 0,25$  by  $Lu = 0,1$

The data of the fig. 3 show that the changing of the characteristic temperature of the process  $\Theta_0$  in 2 times ( $T_2 = 50 \dots 95^\circ\text{C}$ ) leads to the decrease of the total duration of the process on 14 ... 30% (from  $Fo = 6,3$  до  $Fo = 3,1$ ) under almost constant the optimal duration of heating process phase  $Fo_{opt} \approx 0,4$ .

Number of Lykov provides the key effect on the optimal duration of the process, which shows the relationship between the rate of change of moisture content and temperature fields (fig. 4).

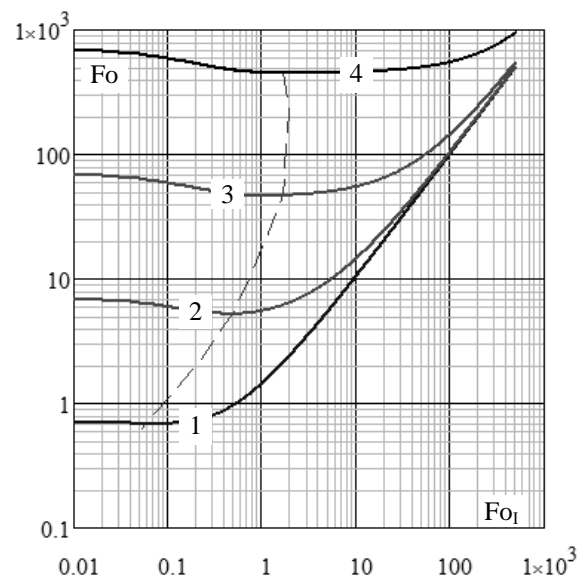


Figure 4. The effect of duration of material heating phase on the total duration of the process by changing the number of Lykov: 1 -  $Lu = 1$ ; 2 -  $Lu = 0,1$ ; 3 -  $Lu = 0,01$ ; 4 -  $Lu = 0,001$  by  $\Theta_0 = 0,1$

The optimal duration of preheating phase increases more than in 20 times (from  $Fo_{opt} \approx 0,07$  to  $Fo_{opt} \approx 1,7$ ) with decreasing of Lykov's number from 1 to  $10^{-3}$ . This is due to the fact that smaller Lykov's number slows down the process of drying and it is necessary to prolong material heating process for increasing its average temperature and thus to increase the ratio of mass transfer for intensification of drying process.

The experiments of husks of grapes drying with preheating phase were conducted with the aim of verifying obtained results. The experiment was conducted with different types of heaters: internal flat heater (IFH), surface flat heater (SFT), internal tubular heater (ITH) at temperature of its surface  $70^\circ\text{C}$ , which was maintained constant throughout the period of heating and drying. Temperature was controlled by using thermocouple and was regulated by changing the voltage supplied to the heater.

The investigation of the kinetics of drying was carried in containers with overall sizes  $200 \times 120$  mm. Kinetics of moisture content was measured by direct method directly during the drying process, for this drying chamber with the container filled with husks of grapes was put on electronic scales.

In this series of experiments the speed of drying agent was 5 m/s, the temperature of drying agent was equal to ambient temperature (heating wasn't conducted), the container with thickness of 60 mm was used. Husks of grapes with equal weight were loaded in the container; it allowed avoiding the effect of initial moisture content on the results of experiments.

The experiment was conducted in such way: grape marc in it's the container was placed in the drying chamber after downloading of husks of grapes and the internal heater was switched on. Pre-heating is carried at constant temperature from 5 to 30 minutes with 5 minutes time step. Then ventilator

was switched on the drying process was held to the same final mass, which was corresponded to 10% moisture content.

The dependences of the total duration of the drying process ( $\tau_s$ ) at the duration of the preheating phase ( $\tau_n$ ) of husks of grapes for different types of heaters are shown on fig. 5.

As it can be seen, under these conditions of drying the reducing of the total duration from 15 min. for ITH to 27 min. for SFH takes place that is 13 ... 23% of the duration of drying without preheating process of the material. The optimal duration of preheating process phase is 10 min. for IFH and ITH and 12,5 min. for SFH. The latter result can be explained by the fact that in the case of surface heater using, the intensity of the drying process is lower than when using internal heaters, since in the first case heat and moisture fluxes are directed in opposite directions. Therefore the material warms up slowly and optimal time shifts toward larger values.

The second important result is that preheating process does the greatest impact in the case of traditional thermal admission during drying (from the surface to the center of the material). The highest reduction of drying duration from 115 min. to 85 min. is recorded for SFH, it is also explained by the negative effect of cross directivity of heat and moisture flows during the drying process. Therefore, the increasing of internal mass transfer coefficient by preheating process in this case has greater effect than in the case of internal heaters.

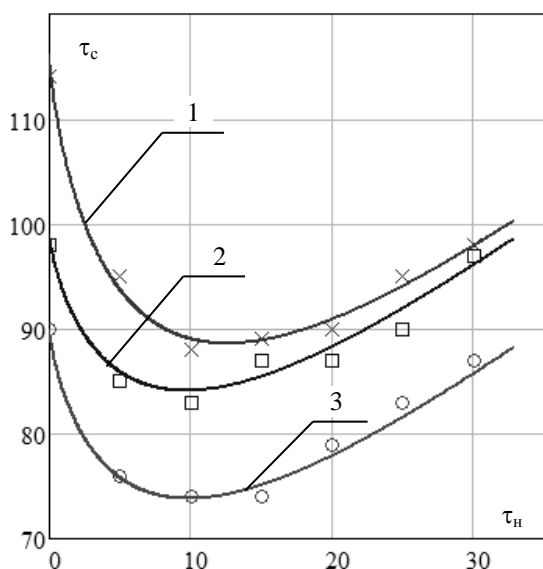


Figure 5. The change of the total duration of the drying process during under the preheating process of husks of grapes for different types of internal heaters: 1 – SFH, 2 – ITH, 3 – IFH.

For evaluation the use of energy efficiency during drying process with preheating by the heater the coefficient of power efficient proposed by us earlier is used [3].

$$E\Phi = \frac{\Pi}{q}, \quad (11)$$

where  $\Pi = m/\tau_c$  - productivity of the dryer in evaporated moisture, kg/s;

$q = Q/m$  - specific power inputs on the process of evaporation of moisture, J/kg.

$m$  – amount of evaporated moisture, kg;

$\tau_c$  – drying duration, s;

$Q$  – total power inputs for the drying process, J.

The physical meaning of this coefficient is that the numerator of expression (11) reflects primarily the properties of raw material that determine the kinetics of its drying; the denominator takes into account the design of the dryer. Using this parameter it is possible to make comparisons of different methods of drying for different types of dryers, because in the technical indices of dryers usually data on their productivity and specific power inputs are only given.

The equation will be presented (11) in another form for easy analysis:

$$E\Phi = \frac{(m/\tau_c)^2}{p_k + p_\theta + p_{no} + p_{nc}}, \quad (12)$$

where  $p_k$  – power is consumed on moisture evaporation and material heating, W;

$p_\theta$  – ventilator power, W;

$p_{no}$  – power of the heat loss through the barrier, W;

$p_{nc}$  – power of the heat loss with emission of drying agent, W.

For aggregate calculation of dryer between capacities which are included in the equation (12) the following relations are adopted [3]:  $p_\theta = 0,1p_k$ ;  $p_{no} = 0,08p_k$ ;  $p_{nc} = 0,05p_k$ .

Including this fact the power efficiency coefficient  $E_{\phi 1}$  for dryer with convective thermal admission is equal:

$$E_{\phi 1} = \frac{(m/\tau_c)^2}{1,23p_k}, \quad (13)$$

Dryers with conductive thermal admission from internal heater at the same amount of evaporated moisture  $m$  demand the same power for evaporation of moisture and heating of material  $p_k$ . Consumed power of ventilator is reduced by the value of the coefficient of its work  $k_\theta$  (the ratio of duration of drying with preheating to drying without it) with taking into account the application of preheating conditions. According to the above experimental results, the minimum duration of the ventilator work is 65 min. (for IFH) and the maximum duration of the drying process without preheating and thermal admission from the surface for SFH is 115 min. For these conditions of drying –  $k_\theta = 0,57$ .

The magnitude of losses through barrier and with drying agent under the use of conductive thermal admission with internal heater reduces, as in this case, drying agent has lower temperature and it is heated only by heat losses. The heat losses under aggregate calculation are proportional to the relation  $(T_c - T_0)/T_0$  ( $T_c$  – temperature of the drying agent, K,  $T_0$  – the ambient temperature, K). For the dryer with convective thermal

admission this value is  $50/293 = 0.17$ , then for dryer with conductive thermal admission from internal heater, this value is  $20/293 = 0.07$ . Thus, the coefficient of reduction of heat losses is  $k_{no}=k_{nc}=0.41$ . Including this fact for total power consumption of drying with conductive thermal admission we obtain:

$$p_K + k_{\theta} p_{\theta} + k_{no} p_{no} + k_{nc} p_{nc} = 1,11 p_K. (14)$$

Then we take into account that the use of preheating process of material the duration of the process is reduced. According to data of fig. 5 the coefficient of reducing the duration of the drying process is  $k_{\tau}=0,65$  ( $\tau_3=75$  min. for drying with preheating by internal tubular heater and  $\tau_3=115$  min. for drying without preheating by SFH). Including this fact and the equation (14) we obtain the power efficiency coefficient  $E_{\phi 2}$  for drying in HMEM with internal heater:

$$E_{\phi 2} = \frac{(m/0,65\tau_c)^2}{1,11 p_K}, \quad (15)$$

The increasing of the value of power efficiency coefficient is:  $E_{\phi 2} / E_{\phi 1} = 2,6$  for IFH. Similar calculations are for ITH:  $E_{\phi 2} / E_{\phi 1} = 2,0$ .

## II. CONCLUSIONS

Thus, the researches allow making the following conclusions. The existence of optimal duration of preheating process of the material under which the duration of the drying process at these conditions is minimal is theoretically grounded. It is shown that Lykov's number makes the main effect on the optimal duration of the process it shows the relationship between the rates of change of moisture content and temperature fields in the dried material. The existence of optimum conditions of preheating process on the example of conductive drying of husks of grapes with different internal heaters was experimentally confirmed. It is shown that the use of such conditions increases the power efficiency coefficient in 2...2.6 times compared with the drying with convection heat admission.

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# The theoretical model of calculation of the power during viscous mediums mixing

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**Abstract**-The new structural design of screw mixer for viscous mediums mixing (e.g. for fruit puree) during the boiling process was elaborated. Viscous non-Newtonian fluids are abnormal, their viscosity under the influence of shear stress changes. That is why of interest is the modeling of the power consumption including the changes of the rheological parameters of the fluid.

The model of the power calculation for non-Newtonian fluids mixing is proposed in the research paper. Mixer agitators are considered as the main elements the motion of which takes the power consumption. In turn the power is represented as the sum of the forces of hydraulic resistance and friction acting on the element of the agitator area.

As the result the criterion equation of Euler which allows making rational calculations of mixing equipment is obtained. The modified criteria of Reynolds, Euler, Newton, under the calculations of which taking into account the rheological characteristics of viscous fluid, namely shear stress, the viscosity of the non-deformed structure, the consistency coefficient were offered. These rheological parameters are obtained according to the graph of the complete rheological curve of non-Newtonian fluid.

**Keywords**-viscosity, non-Newtonian fluids, mixer agitators, power, interfusion of viscous fluids

## I. INTRODUCTION

The technology of production of new high viscosity products – paste-like concentrates of drinks (PCD) was developed in the department of the processes, machines and automation of food production of KSUFTT (Kharkiv State University of Food Technology and Trade). The basis of their receipt is boiling of vegetable puree under vacuum with use of new scraper mixer [1]. The mixing process accompanies all technological stages of getting the final product.

It should be noted that the main question in the study of the mixing process in the liquid medium is the power consumption during the process. The question of the power consumption for mixing in Newtonian medium is studied adequately, while the optimal calculation of power consumption for mixing of non-Newtonian mediums does not exist [2-4]. This is explained by abnormality of the viscosity of non-Newtonian mediums. The change of the viscosity depends on several factors: the shear rate, changes of temperature and pressure. That is why the purpose of this research paper is studying the effect of mixing by the proposed scraper mixer on power consumption.

The main structural elements of elaborated scraper mixer are agitators and roller scrapers [1].

Let's examine the agitator of the mixer as the main element the motion of which takes power consumption.

Two forces – the forces of hydrodynamic resistance and friction act on each agitator of the mixer during the rheological fluid mixing, so the required power for motion of the agitator can be calculated

$$N = \int v(dF_r + dF_{fr}), \quad (1)$$

where  $N$  – supplied power, W;  $v$  – conveying speed of rheological fluid, m/s;  $dF_r$  – resistance force, acting on infinitesimal element of area of the agitator, N;  $dF_{fr}$  – friction force, acting on infinitesimal element of area of the agitator, N.

The hydrodynamic resistance force is equal to

$$dF_r = \lambda_1 \frac{\rho v^2}{2} dS, \quad (2)$$

where  $dS$  – the element of the agitator area, m<sup>2</sup>;  $\rho$  – fluid density, kg/m<sup>3</sup>;  $\lambda_1$  – dimensionless resistance coefficient, which takes into account the nature of the fluid flow around the agitator.

The friction force can be calculated on the base of the well-known equation of Herschel [2]:

$$dF_{fr} = (\sigma_0 + k\gamma^{1-m})dS, \quad (3)$$

where  $\sigma_0$  – shear ultimate strength, Pa, that is, the strength at which the system begins to deform, PA;  $k$  – consistency index;  $m$  – rate of the structure destruction;  $\gamma$  – shear rate, s<sup>-1</sup>.

Consistency index according to [2]

$$k = B_0 \gamma^m, \quad (4)$$

where  $B_0$  – the effective viscosity at a single shear rate, Pa·s; in the physical sense it is close to the viscosity of the intact structure.

Then the equation (3) takes the form

$$dF_{fr} = (\sigma_0 + B_0\gamma) dS, \quad (5)$$

Area element of the agitator is equal to

$$dS = h \cdot dx, \quad (6)$$

where  $h$  - agitator height, m;  $dx$  - infinitesimal element of length of the agitator, m (fig. 1).

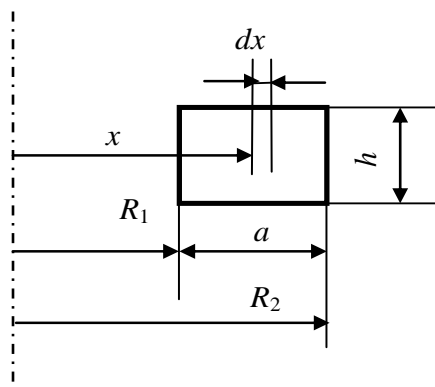


Figure 1. Calculated geometry of the agitator:  $R_1$  – the radius of the inner frame of the mixer,  $R_2$  – radius of the outer frame of the mixer,  $a, h$  – width and height of the agitator, respectively,  $dx$  – infinitesimal element of length of the agitator,  $x$  – distance from the axis of rotation of the mixer to the element of the agitator  $dx$

We consider that the linear and angular velocities of the fluid migration are related by this equation

$$v = 2\pi n x, \quad (7)$$

where  $n$  - rotation rate of the mixer,  $s^{-1}$ ,  $x$  – distance from the axis of rotation of the mixer to the element of the agitator  $dx$ , m (fig. 1).

Shear rate is proportional to the rotation rate of the mixer that is why we rewrite the equation (5) as follows

$$dF_{fr} = (\sigma_0 + \lambda_2 B_0 n) dS, \quad (8)$$

where  $\lambda_2$  – dimensionless friction coefficient, which takes into account the nature of the fluid flow around the agitator.

In view of this the expression (1) for calculation of the drive power of the mixer takes the form

$$N = \int_{R_1}^{R_2} 2\pi n x \left[ \lambda_1 \frac{\rho(2\pi n x)^2}{2} + \sigma_0 + \lambda_2 B_0 n \right] h dx. \quad (9)$$

We obtain by integrating this expression

$$N = \pi^3 \lambda_1 \rho n^3 h (R_2^4 - R_1^4) + 2\pi^2 \lambda_2 B_0 n^2 h (R_2^2 - R_1^2) + \pi \sigma_0 n h (R_2^2 - R_1^2) \quad (10)$$

Taking into account that

$$(R_2^2 - R_1^2) = (R_2 - R_1)(R_2 + R_1) \approx 2aR, \quad (11)$$

where  $R$  - the mean radius of the mixer, m;  $a$  - agitator width, m;

and, also lowering in (10) the numerical constants we obtain following equation

$$N = \lambda_1 \rho n^3 h a R^3 + \lambda_2 B_0 n^2 h a R + \sigma_0 n h a R. \quad (12)$$

We rewrite it in dimensionless form

$$Eu^* = \lambda_1 + \lambda_2 Re_1^* + Ne^*, \quad (13)$$

where  $Eu^* = \frac{N}{\rho n^3 h a R^3}$  - modified Euler criterion;

$Re_1^* = \frac{B_0}{\rho n R^2}$  - modified Reynolds criterion;

$Ne^* = \frac{\sigma_0}{\rho R^2 n^2}$  - modified Newton criterion.

The resistance coefficients  $\lambda_1, \lambda_2$  depend on the flow hydrodynamics of the agitator, they are functions of Reynolds criterion

$$\lambda_1 = A_1 Re_2^{\alpha_1}, \quad \lambda_2 = A_2 Re_2^{\alpha_2}, \quad (14)$$

where  $Re_2 = \frac{n R h \rho}{B_0}$  - modified Reynolds criterion.

Thus, using equalities (14) and substituting them into (13), we finally obtain the criterion equation of calculation of the drive power of the developed mixer

$$Eu^* = A_1 Re_2^{\alpha_1} + A_2 Re_2^{\alpha_2} \cdot Re_1^* + Ne^*, \quad (15)$$

where the coefficients  $A_1, A_2, \alpha_1, \alpha_2$  are determined from the experimental relationships of drive power of the mixer from rotation rate.

Appropriate regression equation corresponding to the variable rotation rate which is derived on the basis of (15) can be rewritten thus

$$Y = C_1 n^{\alpha_1} + C_2 n^{\alpha_2 - 1}, \quad (16)$$

where  $Y = Eu^* - Ne^*$ ;

$$C_1 = A_1 \left( \frac{Rh\rho}{B_0} \right)^{\alpha_1};$$

$$C_2 = A_2 \frac{B_0}{\rho R^2} \left( \frac{Rh\rho}{B_0} \right)^{\alpha_1}.$$

Table 1 shows the experimental data of the relationship of the drive power of the developed scraper mixer from the rotation rate.

TABLE I. THE EXPERIMENTAL DATA OF THE RELATIONSHIP OF THE DRIVE POWER OF THE SCRAPER MIXER FROM THE ROTATION RATE

$n, s^{-1}$	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0
$N, kW$	0,2	0,5	0,8	1,1	1,4	1,8	2,4	3,2

Fig. 2 indicates the approximation of the experimental data by the equation (16) under the following values of the physical quantities entering into these equations:  $\sigma_0=230$  PA;  $B_0=295$  PA·s;  $\rho=1250$  kg/m<sup>3</sup>;  $a=0,1$  m;  $R=0,35$  m;  $h=0,087$  m.

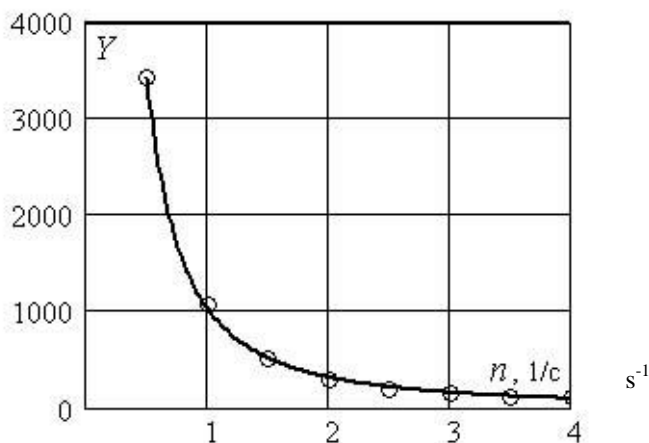


Figure 2. The results of approximation of the experimental data by the equation (16)

After processing the experimental data in the MathCAD package, the following values of regression coefficients were obtained  $A_1=13,7$ ,  $A_2=67,7$ ,  $\alpha_1=-1,72$ ,  $\alpha_2=-0,73$ .

Relationships of resistance coefficients for developed scraper mixer in relation to the modified Reynolds criterion (according to (14)) are presented on the fig. 3.

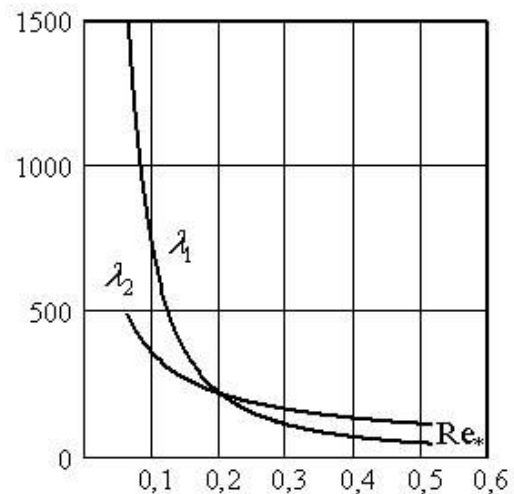


Figure 3. The relationship of the resistance coefficient  $\lambda_1$ , friction  $\lambda_2$  from modified Reynolds criterion

## II. CONCLUSIONS

Thus the theoretical model of calculation of power consumption during the mixing of viscous mediums by developed scraper mixer was proposed. This model can be used for the design and calculation of the equipment for viscous products. The modified criteria of Reynolds, Euler, Newton, under the calculations of which taking into account the rheological characteristics of viscous fluid, namely shear stress, the viscosity of the non-destroyed structure, the consistency coefficient were offered.

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# Methodological principles of energy efficiency upgrading of microwave treatment of food semi-products

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**Abstract-**The article is devoted to the development of the principles of energy efficiency upgrading of microwave (VHF) treatment of food semi-product by investigating electromagnetic field strength. While solving the practical problem of heat exchange concerning (VHF) microwave heating of spicy raw material, influence of certain factors on variation of electromagnetic field strength was determined and recommendations on electromagnetic energy efficiency upgrading were laid down.

**Key words:** *electromagnetic field, strength, microwave generator, heat power, mixture of finely-chopped spicy vegetables.*

## LITERATURE REVIEW

Microwave (VHF) treatment is widely used in producing a wide range of food products, particularly in defrosting, boiling, drying, pasteurizing, sterilizing etc. It is characterized by high speed of heating, short duration, great efficiency of energy utilization when transforming into heat as well as relatively low temperature of the process that provides high storage quality of useful substances and vitamins.

VHF-heating of food products is realized by means of converting energy of alternating magnetic field of super high frequency into heat energy that is generated all over the size of the product. Electromagnetic field can penetrate the processed product at a considerable depth irrespective of thermal conductivity [1]. The main reason of the beginning of the internal heating is polarizing that is displacement of bound charges under the action of electrical field. When a product is placed in the electrical field of alternative current polar molecules are affected by the forces that try to shift them according to the change of direction of the field in consequence of which in the course of molecules dragging heat is released and heating up takes place all over the size [2].

### A. Research objectives defined:

Review of the literature sources concerning the theory of dielectric heating and its practical application did not allow finding out generalized scientific information that makes it possible to have descriptive model of interrelation of the whole complex of determining factors while VHF-processing: at the stages of VHF-energy generation, its transmission through the environment, penetration inside the product and transformation into heat. An evident consequence of it is constricted directivity of the existent scientifically grounded approaches

concerning improvement of the process of VHF-treatment with the aim of supporting its intensification and energy efficiency and obtaining high quality products with allowance for change of properties of raw material during heating. In the context of integrated researches of VHF-concentration and drying spicy vegetables (in the form of finely-chopped mixtures of roots and greenery) in vacuum [3, 4] that are conducted by the authors of the work, schematic representation of system interrelation of determining factors will allow to broaden the idea about possible options of improvement of the process of VHF-treatment.

**The objective of the research** is to develop methodological principles of energy efficiency upgrading of microwave treatment of food semi-products by calculating electromagnetic field strength.

**The main tasks** are systemization of scientific information concerning generation of electromagnetic energy, its transfer and transformation into heat energy; conceptual scheme of system interrelation of determining factors during VHF-heating; substantiation of possibility of adaptation of methods of determining of electromagnetic field strength for solving practical problems of heat exchange concerning VHF-heating of food semi-products with prescribed thermo physical and dielectric properties; determining influence of certain factors on the change of capacity of the internal sources of heat; defining recommendations concerning energy efficiency upgrading in terms of microwave treatment of spicy vegetables.

**Research methodology.** Development of the conceptual scheme of system interrelation of determining factors of VHF-heating is based on their analysis at different stages, particularly VHF-energy generation, its transmission through the environment, penetration inside the product and transformation into heat.

Current frequency and power output are two determining factors that are the most significant for VHF-generator. Current frequency is constant and, as a rule, it is chosen from the frequencies allowed for industrial use and with account of the depth of penetration of electromagnetic waves into the product. Frequency of 2450 MHz is mainly used for processing of food products.

During the work of VHF-generator electromagnetic field, strength of which depends on power output, is developed in the environment. Strength characterizes electromagnetic field at a

specified coordinate at a given time and it influences volume energy that transfers in the environment at a specific speed. Value of energy density that reaches the surface of food semi-product depends on the above mentioned factors.

Electromagnetic field strength is not constant, it depends on the value of coordinate and it changes over a distance that is why a significant factor is also the distance between VHF-generator and the surface of food semi-product as well as its thickness.

In its turn food semi-product has a set of properties – thermophysical, dielectric that to a great degree depend on moisture capacity of a product. Increase in quantity of water molecules that move around the specified space causes increase in the degree of dielectric loss angle and consequently more active heating. Dehydration of a product in the process of heating is followed by nonuniformity of moisture by volume. Whereby wetter sections obtain more quantity of energy but in consequence of moisture movement its concentration equalizes. Gradual decrease in moisture content results in decrease of dielectric loss angle and consequently decrease of thermal capacitance that is released in the product.

Thus, a set of thermophysical and dielectric properties determines resistance for transferring electromagnetic field, depth of penetration of electromagnetic field and attenuation ratio. Penetrating the product electromagnetic field strength is attenuated that results in decrease in thermal capacity and decrease in heating rate of a product. As a rule, to maintain massive heating at above mentioned frequency products of thickness not more than 30...50mm should be processed in most cases.

Thermal capacity that is released in the product provides dielectric heating during which at the same time moisture evaporation takes place. When heating the product during specified period of time relevant changes of constituents are realized that provides obtaining final food products with specified properties. It should be mentioned that increase in thermal capacity, on the one hand, results in increase in speed of moisture evulsion and, on the other hand, in increase in temperature that is one of the hazards for a food product if duration of processing exceeds certain limit.

VHF-treatment in vacuum can be conducted at different values of pressure and temperature and total energy consumption depends on thermal capacitance of a product, quantity of evaporated moisture and evaporation heat at specified parameters of pressure.

Thus, to ensure efficient work of VHF-generator and obtain high quality products it is necessary to determine rational values of capacity with regard to change of electromagnetic field strength depending on the distance to the surface of the product and its properties that determine the depth of penetration of electromagnetic field, speed of heating and moisture transfer.

Thermal capacity that is released in the product during VHF-heating, on the one hand, depends on electric parameters of the field (current frequency and squared of strength) and, on the other hand, on dielectric parameters of a product (dielectric

loss angle and relative dielectric constant) and it is determined by the known formula

$$P_{\text{нвт}} = 2\pi f \varepsilon_0 \varepsilon' \text{tg} \delta E^2, \quad (1)$$

where

$\varepsilon_0$  – electric constant ( $\varepsilon_0 = 8,85 \cdot 10^{-12}$  F/m);  
 $f$  – frequency of electromagnetic oscillation,  $f$ , Hz  
 $\varepsilon'$  – relative dielectric constant;  
 $\text{tg} \delta$  – dielectric loss factor;  
 $E$  – electric field strength, V/m;

Among the above mentioned factors electromagnetic field strength that can be regulated during VHF-treatment has priority significance.

Let's consider the task as a part of which it is necessary to determine electromagnetic field strength that is formed by VHF-generator on the surface and inner layers of a food semi-product.

During its solving for the first stage – determining electromagnetic field on the surface of a food semi-product, the following well-known electrodynamics equation [2] is used.

Energy density of electromagnetic field  $\omega_e$  that is accumulated in a unit of volume of environment is determined by formula:

$$\omega = \varepsilon_0 \varepsilon' E^2, \quad (2)$$

Specific power  $\Pi$  (W/m<sup>2</sup>) that is transferred by electromagnetic wave in the environment is determined by formula

$$\Pi = \nu \omega = \nu \varepsilon_0 \varepsilon' E^2, \quad (3)$$

where  $\nu = \frac{c}{\sqrt{\varepsilon \mu}}$ , – light velocity in the environment, m/s,

where  $c$  – light velocity in vacuum ( $c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ ).

where  $\mu_0$  – magnetic constant ( $\mu_0 = 4\pi \cdot 10^{-7}$  H/m);  
 $\mu$  – relative magnetic permeability.

In the working volume of VHF-oven electromagnetic wave transfers practically at light velocity in vacuum because dielectric and magnetic conductivity for air equals one ( $\varepsilon' = \mu = 1$ ). That is why specific power (3) that is transferred from the VHF-generator to the product equals

$$\Pi = c \varepsilon_0 E_0^2. \quad (4)$$

де  $E_0$  – electric field strength in the VHF-oven, V/m;

On the other hand, specific power of electromagnetic wave on the surface of a product can be determined as ratio of VHF-generator power to surface area of a product, that is

$$\Pi = \frac{P}{S}. \quad (5)$$

where  $P$  – power of VHF-generator, W;  
 $S$  – surface area of a product,  $m^2$ .

Setting equal right parts of the expressions (4) and (5) we can obtain an expression for determining electromagnetic field strength on the surface of a product

$$E_0 = \sqrt{\frac{P}{\varepsilon_0 c S}} \quad (6)$$

The next step is to determine electromagnetic field strength that occurs in the product itself because it differs from the strength on the border of product – environment of VHF-oven in consequence of dependability of electromagnetic wave transfer rate on dielectric properties of environments (3). If consider that all the energy of electromagnetic wave is absorbed by the product then it is possible to write down on the base of (3) and (4)

$$v\varepsilon'\varepsilon_0 E^2 = c\varepsilon_0 E_0^2. \quad (7)$$

From which with regard of expression for light velocity in the environment we obtain

$$E^2 = \frac{E_0^2}{\sqrt{\varepsilon'}}. \quad (8)$$

With regard of the expression (6) we obtain

$$E = \sqrt{\frac{P}{\varepsilon_0 \sqrt{\varepsilon'} c S}}. \quad (9)$$

Thus, formula (9) takes into account interrelation between VHF-generator capacity and inner electromagnetic field in a food product.

For calculation of change of electromagnetic field strength according to the depth of a product  $E_\Delta$  we use formula

$$E_\Delta = E \cdot e^{-\alpha\Delta}, \quad (10)$$

where  $\alpha$  – wave attenuation ratio ( $\alpha = \frac{1}{\delta}$ );

$\Delta$  – distance between the surface of a product to the point where electromagnetic field strength is determined, m.

$\delta = \frac{c}{\pi f \sqrt{\varepsilon'} \operatorname{tg} \delta}$  – depth of penetration of electromagnetic field into the product, m.

In the formula (10) significant factor is wave  $\alpha$  attenuation ratio the value of which depends on the set of dielectric

properties of food semi-product and their changes during heating and dehydration.

Electromagnetic field strength by the volume of food semi-product together with the set of its dielectric and thermal and mass-exchange properties influence the value of specific power and consequently heating rate and moisture transfer.

Thus, by solving the task of determining electromagnetic field strength that is formed by VHF-generator on the surface of the inner layers of the food semi-product, the possibility of adapting of the above examined methodology for further solving the tasks of heat transfer in the working oven of VHF-device is substantiated.

Conducting calculations with the use of formulas (9), (10) allowed obtaining data for forming-up relations of electromagnetic field strength to capacity of VHF-generator (500...3000 W) and surface area of a product in surface and inner layers: 1 – mixtures of finely-chopped roots of spicy vegetables (fig. 1); 2 – mixtures of finely-chopped greenery of spicy vegetables (fig. 2).

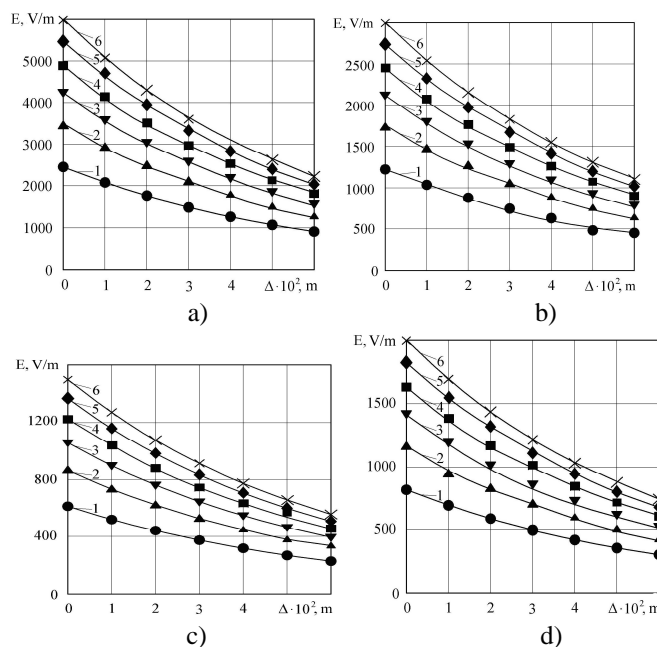
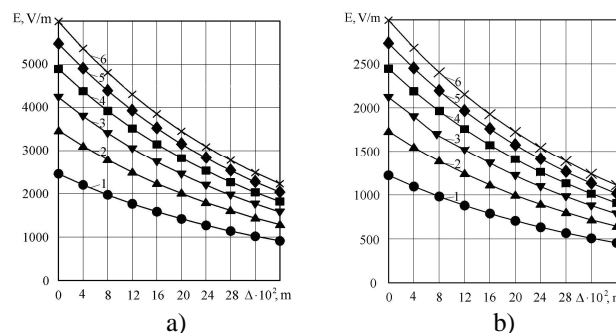


Figure 1. Electromagnetic field strength depending on the thickness of the layer ( $\Delta$ ) and VHF-capacity ( $P$ ) for mixture of finely-chopped roots of spicy vegetables: 1 – 500 W; 2 – 1000 W; 3 – 1500 W; 4 – 2000 W; 5 – 2500 W; 6 – 3000 W, for surface area of a product: a – 50  $cm^2$ ; b – 200  $cm^2$ ; c – 450  $cm^2$ ; d – 800  $cm^2$ .



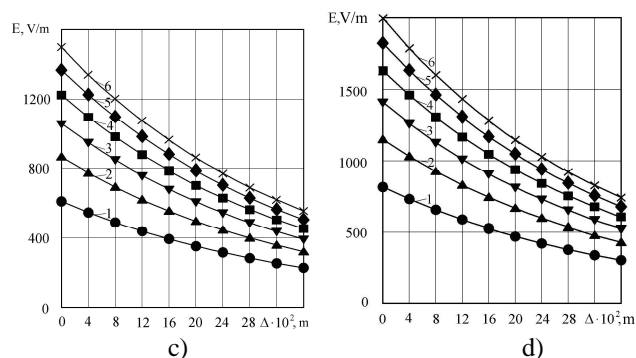


Figure 2. Electromagnetic field strength depending on the thickness of the layer ( $\Delta$ ) and VHF-capacity ( $P$ ) for mixture of finely-chopped greenery of spicy vegetables: 1 – 500 W; 2 – 1000 W; 3 – 1500 W; 4 – 2000 W; 5 – 2500 W; 6 – 3000 W, for surface area of a product: a – 200 cm<sup>2</sup>; b – 800 cm<sup>2</sup>; c – 1800 cm<sup>2</sup>; d – 3200 cm<sup>2</sup>

Thickness of the examined layer of the above mentioned products was chosen on the base of the previously obtained data concerning the depth of penetration of VHF-energy [6].

According to the data of (fig. 1) it can be seen that with the increase in capacity of VHF-generator within the above mentioned range from 500W to 3000W electromagnetic field strength increases by 2,25 times in all cases. It should be mentioned growth of strength with increase in capacity has non-uniform character. Thus, when changing capacity from 500W to 1000W electromagnetic field strength increases by 1,41 times and from 1000W to 1500W = by 1,22 times, from 1500W to 2000W = by 1,15 times, from 2000W to 2500W = by 1,11 times and from 2500W to 3000W = by 1,09 times.

Change of electromagnetic field strength is proportional to the surface area of a product. Thus, with the surface of 50 cm<sup>2</sup> electromagnetic field strength within the examined range of capacity is within the limit of 2450...5990 V/m, with the surface of 200 cm<sup>2</sup> – within 1220...3000 V/m, with 450 cm<sup>2</sup> – 815...2000 V/m, with 800 cm<sup>2</sup> – 610...1500 V/m. Penetration of electromagnetic energy inside the layer of a product is followed by its decrease by exponential relation. At the above mentioned values of ranges of strength on the surface of a product, at a depth of 0,06 m its value is consequently within such limits – 910...2220 V/m, 450...1100 V/m, 360...740 V/m, 230...555 V/m.

On the basis of the analysis of the obtained relations of electromagnetic field strength for mixture of finely-chopped greenery of spicy vegetables (fig. 2) we can draw a similar conclusion concerning influence of capacity of VHF-generator and surface area of a product. However, reduction of electromagnetic field strength within the above mentioned limits occurs at a depth of 0,36 m that is explained by more than 10 times less values of dielectric features of the mixture of finely-chopped greenery of spicy vegetables [5].

On the basis of the obtained data it can be seen that when choosing rational parameters of heat processing and dehydration of food raw material by VHF-heating (at a specified duration of a process) necessary condition for ensuring efficient work of VHF-generator is adjustment of the external factors – frequency of electromagnetic oscillations, power output and surface area of a product as well as factors of

internal character – reduction of electromagnetic field strength with regard to dielectric properties of a food semi-product and their change during heating.

## CONCLUSIONS

1. Development of methodological principles of energy efficiency upgrading of microwave treatment of food semi-products is based on the systemization of scientific information concerning generation of electromagnetic energy, its transfer and transformation into heat energy that allowed developing the conceptual scheme of system interrelation of determining factors during VHF-heating that allows broadening the idea about possible variants of improvement of the process of VHF-heating with the aim of ensuring its energy efficiency and obtaining high quality products.

2. It is proved that to ensure efficient work of VHF-generator and obtain high quality products it is necessary to determine rational values of capacity with regard to change of one of the most significant factors during VHF-treatment - electromagnetic field strength.

3. Methodology of determining electromagnetic field strength that takes into account interrelation between capacity of VHF-generator and surface area of a product for solving practical tasks of thermal and mass-exchange concerning VHF-heating and concentration of food semi-products was improved.

4. By the example of calculations conducted for mixtures of finely-chopped roots and greenery of spicy vegetables it was determined that electromagnetic field strength can be regulated by changing capacity of VHF-generator and surface area of a product that determine capacity of the internal sources of heat and consequently intensity of thermal and mass-exchange processes for obtaining specified quality of a final product.

5. To ensure efficient use of VHF-energy it is necessary to adjust influence of external factors – frequency of electromagnetic oscillations, power output and surface area of a product – to factors of internal character – depth of penetration of electromagnetic waves and thermal and physical characteristics of a product.

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# Curing At High Temperature On Mechanical Of Geopolymer Adding Carbon Fiber

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**Abstract-** Geopolymers have attracted the interest of scientists due to their excellent fire resistance, low density, low cost, low curing/hardening temperatures, easy processing, excellent mechanical properties, environmentally friendly nature, long-term durability, heavy metal ions fixation and acid resistance. In this experiment, geopolymer resin was synthesized with with Si/Al molar ratio of 2.0 with sodium hydroxide (NaOH) and sodium silicate ( $\text{Na}_2\text{SiO}_3$ ). After 28 days, the image of scanning microscope, compressive strength of geopolymer adding Carbon fiber with 1%, 3 %, 5 %, 7 %, 8 %, 10 % in weight were observed in different curing time at 200°C, 300°C, 600°C, 800°C. The compressive strength of geopolymer is decreased while temperature and curing time increase, at 200°C for 8 hours strength is highest in 43.15 MPa with 8 % Carbon fiber and lowest value is 5.59 MPa of geopolymer adding 10 % fiber at 800°C for 5 hours.

**Key words:** geopolymer, concrete, Carbon fiber, compressive strength.

## I. INTRODUCTION

There are several directories of green building products and materials to help customers and builders to choose green products [1],[2]. However, criteria used to select green products are subjective, and a product may perform well under one criterion but poorly under another. The most important criterion that is used for green materials is that they are low emitting. This criterion generally applies to so-called "primary" emissions, typically of volatile organic compounds, which are emitted from the actual components of the manufactured product. However, measurement of primary emissions of indoor materials alone may not be sufficient, since secondary emissions that are generated from ozone reactions with those materials may dominate over the time that a product is in use [3].

Buildings are energy consuming structures that have large impact on global climate change and other energy-related environmental issues. Buildings are responsible for almost 40 percent of the total primary energy consumption and 70 per-

cent of electricity consumption. Approximately 40 percent of  $\text{CO}_2$ , 50 percent of  $\text{SO}_2$ , and

20 percent of  $\text{NO}_x$  emissions are produced in the US as a result of building-related energy consumption [4]. Today there is a growing trend in most countries towards design

for construction of green buildings. A green building should have certain unique features and during its entire life cycle should contribute to conservation of resources (energy, land, water and materials), reduction of pollution, to be improved in indoor environment quality and protection of the environment [5-6].

## Properties and applications

Geopolymer was researched for usage from solid waste and by-products. It can lead to provide a mature and cost-effective solution to a lot of problems where contain hazardous residue has to be treated and stored under critical environmental conditions. Components of geopolymer are silicates and aluminates with by-products to undergo processing of geopolymerization. Geopolymer materials have attracted many attentions for various applications due to their characteristics such as excellent fire resistant, low cost, low density, environmentally friendly nature, easy process, and excellent thermo-resistance, needs moderate energy to produce. They can be use these materials up to 1000 degree C, tend to be uncombustive and no toxic smoke would be released [8-10]. According to literatures, the certain mix compositions and reaction conditions such as  $\text{Al}_2\text{O}_3/\text{SiO}_2$ , alkali concentration, curing temperature with curing time, water/solid ratio and pH significantly influence the formations and mechanical properties of geopolymer. It is used to manufacture precast structure and non-structural elements, concrete pavements and concrete products. In recent years, geopolymer materials have shown significant promise as aircraft cabinet and heat resistant materials, and have been investigated as an alternative to polymer composites.

Some wastes, such as mining, metallurgical, municipal, construction and demolition that are produced today in huge quantities in every country can be also utilized for the production of geopolymeric materials like concrete, building components, fire resistant coatings and insulators [11-12]. Some of them (e.g fly ashes, slags) are only partially utilized today in Portland cement production. Potential applications of geopolymers are stabilization immobilisation of hazardous wastes, surface capping and stabilization of waste dumps, construction of low permeability base liners in landfills, water control structures, and construction of heap leach pads. In the mining sector, geopolymerisation due to fast setting and high early strength of the paste may be considered in back-fill or cut-and-fill operations [13-14]. Geopolymers can even find applications as biomaterials. They have previously been considered for implant applications, where they have shown to be bioactive with low tendency of ion leakage. Geopolymers are produced with process of mixing a pulverised raw material alkaline (KOH or NaOH) and sodium silicate solutions. An indicative recipe when ferronickel slag is used as raw material is slag 82%, H<sub>2</sub>O 6%, KOH 3% and Na<sub>2</sub>SiO<sub>3</sub> 9%. The homogeneous paste obtained is then cast in moulds and in most cases cured shortly at room temperature before heated, if required, to temperatures up to 80 °C for 1 or 2 days. The specimens are then left for 7 or 28 days to enhance development of structural bonds [8].

Geopolymer is hardened quickly and has excellent mechanical properties with high compressive strength after 28days. Commonly compressive strength of geopolymer is about 50-70 Mpa, in special case it is can be acquired exceed 100 Mpa [8]. Inside maybe there is less porosity than of cement or mortar. Geopolymer has low shrinkage, with excellent resistance fire, to avoid in acid environment and low corrosion.

## II. EXPERIMENTAL STUDY

### Specimen preparation

Mixing of geopolymer paste, the geopolymeric fly ash precursor and alkaline silicate solution were mixed by hand for 10min and a further 5min with a mixer. The

mixture was then cast into molds of various shapes and sizes. The samples were then vibrated to release any residual air bubbles. Subsequently, the molded samples were sealed with a film and transferred to an air-tight container to prevent moisture loss. Each sample batch was prepared in duplicates.

### Curing regime

All specimens were cured undisturbed for 24h at room temperature before being subjected to high temperature curing (80 °C; relative humidity 93%) for a further 24h in a laboratory grade oven. At the end of the curing regime, the specimens were removed from their molds (at low temperature) and allowed to cool before initial physical properties were recorded. An electrically-heated furnace designed for a maximum temperature of 1200 °C was used. Specimens were subjected to temperatures of up to 800 °C at an incremental rate of 5 °C per

minute from room temperature. The temperature was sustained at 800 °C for 1 h before the specimens were allowed to cool naturally to room temperature inside the furnace. Meanwhile, the unexposed samples were left undisturbed at ambient temperature.

## III. RESULTS AND DISCUSSIONS

### Compressive strength of mortar

Compressive tests were performed according of the ASTM C39/C 39M - 01. Three samples of each formulation were tested and the average data were reported. The loading was displacement-controlled at a constant rate of 2.4 mm/min for all the tests. The compressive strength of mortar ( $f'_{cm}$ ) was calculated using equation:

$$f'_{cm} = \frac{F_{max}}{A_c} \quad (1)$$

Where:  $f'_{cm}$  is compressive strength, MPa;

$F_{max}$  is the maximum load, N;

$A_c$  is the original cross-sectional area of a specimen in a compression test, mm<sup>2</sup>

### Microstructure of geopolymer by SEM and X-ray

A scanning electron microscope (SEM) was used to investigate the adhesion between geopolymer matrix and nanofiber in samples after curing room temperature. The structural and chemical composition of the pure geopolymer and mortar were investigated with an Energy Dispersive X-ray Spectrometer (EDX). Examination of the geopolymer mortar was made on the scanning electron microscope with the dispersive radiation spectrometer at the maximum magnification of 2000x, using the secondary electron detection, and the Esprit 1.8 software, using 30 kV acceleration voltages.

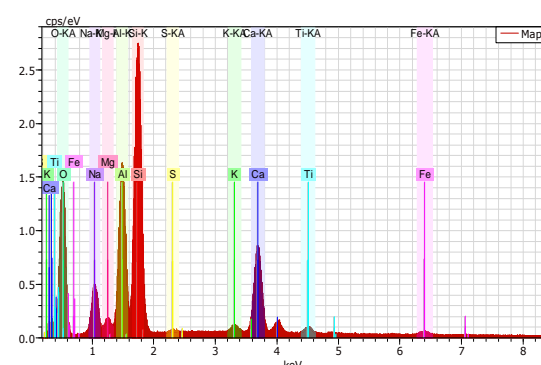


Figure 1. EDX spectrum of pure geopolymer

TABLE I. CHEMICAL COMPOSITIONS OF GEOPOLYMER L160 IN WEIGHT PERCENT (X-RAY ANALYSIS)

Element	Na <sub>2</sub> O	MgO	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	SiO <sub>3</sub>
Wt %	9.24	2.12	24.03	50.94	0.44
Element	K <sub>2</sub> O	CaO	TiO <sub>2</sub>	FeO	Σ
Wt %	0.61	10.08	0.97	0.85	99.28%

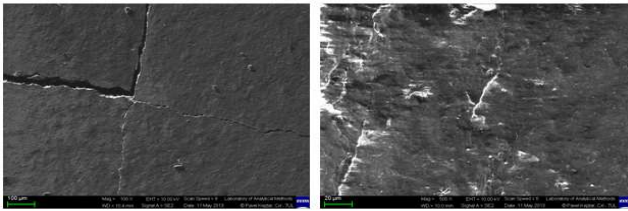


Figure 2. SEM of pure geopolymer

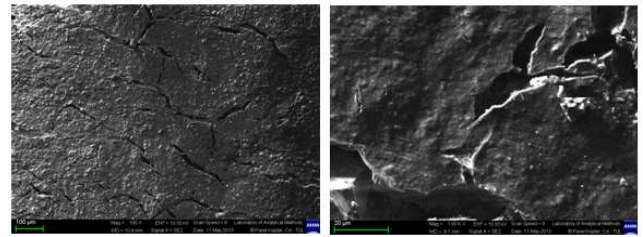


Figure 7. SEM of geopolymer adding 10% C-fiber

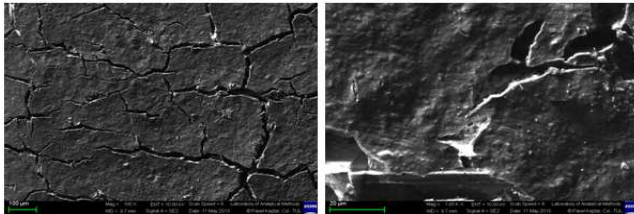


Figure 3. SEM of geopolymer adding 5% C-fiber

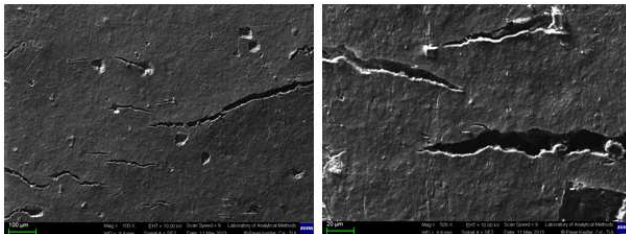


Figure 4. SEM of geopolymer adding 3% C-fiber

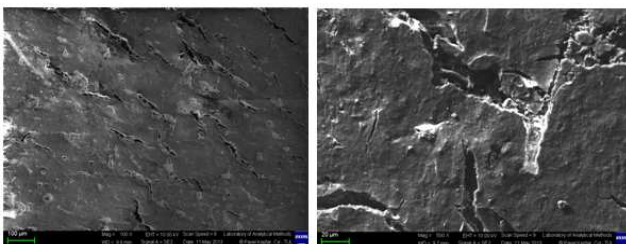


Figure 5. SEM of geopolymer adding 7% C-fiber

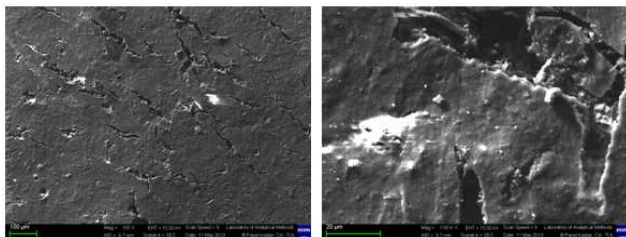


Figure 6. SEM of geopolymer adding 8% C-fiber

TABLE II. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 200DEGC FOR 16 HOURS

t (°C )	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 200°C for 16h	0%	199±10.0	1.810	22.7
	1%	247±6.33	1.676	22.19
	3%	226±9.1	1.554	22.87
	5%	229±4.68	1.536	26.16
	7%	231±6.72	1.524	26.98
	8%	225±3.64	1.448	40.54
	10%	186±5.14	1.371	28.35

TABLE III. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 200DEGC FOR 8 HOURS

t (°C )	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 200°C for 8h	0%	194±4.87	1.760	20.23
	1%	247±6.33	1.676	21.03
	3%	223±2.30	1.590	22.83
	5%	241±7.21	1.561	24.7
	7%	231±3.87	1.534	29.65
	8%	231±6.58	1.449	43.15
	10%	199±8.21	1.431	25.03

The results of the curing temperature and strength are given in Fig. 8. In this test, the geopolymer were placed in the oven right after casting and wrapping with vinyl sheet with no delay time. At 200°C strength was decreased from maximum value of geopolymer with 8 % C.fiber inside 43.15 MPa to 40.54 MPa while the curing time was elevated from 16 hours to 8 hours.

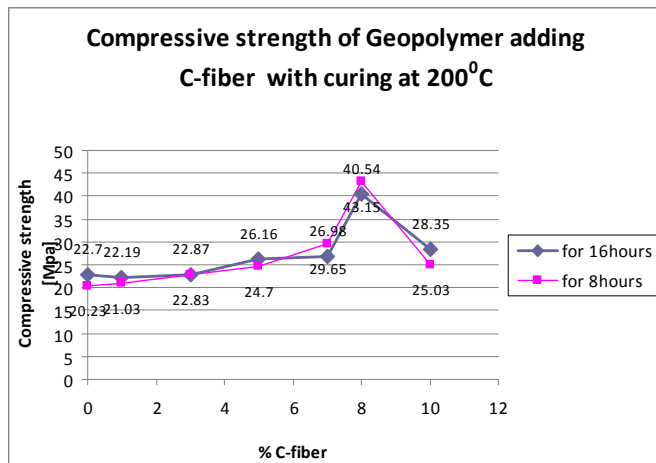


Figure 8. Compressive strength of Geopolymer adding C-fiber with curing at 200°C

TABLE IV. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 300DEGC FOR 16 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 300°C for 16h	0%	206±5.05	1.717	24.78
	1%	238±6.32	1.590	20.32
	3%	250±9.54	1.548	22.13
	5%	238±2.77	1.495	27.88
	7%	242±6.08	1.461	32.13
	8%	232±8.14	1.378	16.00
	10%	227±3.32	1.243	17.70

TABLE V. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 300DEGC FOR 8 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 300°C for 8h	0%	231±2.66	1.602	25.4
	1%	215±4.35	1.530	24.44
	3%	224±3.02	1.481	25.68
	5%	232±8.21	1.462	27.62
	7%	224±5.64	1.456	33.11
	8%	216±4.79	1.432	39.23
	10%	201±6.33	1.293	39.01

The diagram shows that at 300°C for 8hours, strength is increased while the percentage of Carbon fiber is added more from 1 % to 8 % after 8 % of C.fiber, the strength is lower. But for 16hours, with 8 % C.fiber inside, compressive strength of geopolymer reaches minimum value.

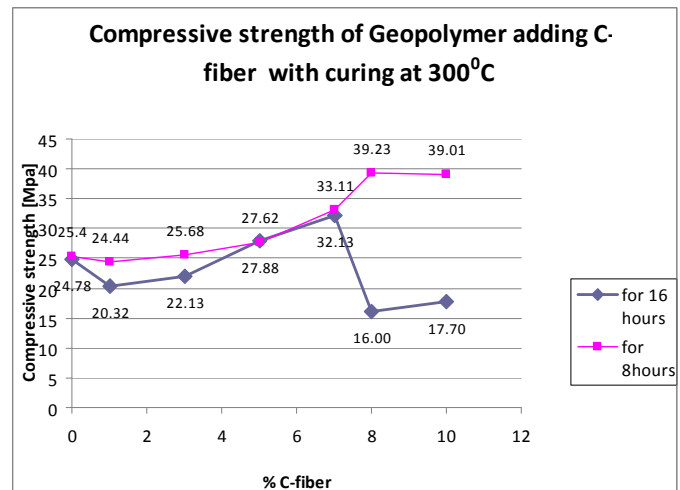


Figure 9. . Compressive strength of Geopolymer adding C-fiber with curing at 300°C

At 600°C, from fig.10 we can see the curing time is shorter so the strength is higher. With 1hour after curing, the maximum of 21.88 MPa with 8 % C.fiber inside is obtained. The strength of geopolymer at 600°C were too low.

TABLE VI. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 600DEGC FOR 1 HOUR

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 1h	0%	188±4.24	1.613	15.16
	1%	173±3.06	1.483	10.25
	3%	204±7.09	1.435	10.59
	5%	220±5.1	1.427	16.48
	7%	202±6.8	1.394	21.88
	8%	206±2.9	1.363	21.62
	10%	182±7.1	1.159	5.07

TABLE VII. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 600DEGC FOR 3 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 3h	0%	183±5.51	1.466	10.07
	1%	189±7.32	1.472	9.57
	3%	191±3.8	1.454	10.95
	5%	175±8.07	1.411	13.34
	7%	181±6.06	1.305	14.87
	8%	184±4.1	1.269	10.67
	10%	171±3.2	1.073	9.08

TABLE VIII. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 600DEGC FOR 5 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 5h	0%	183±8.64	1.596	12.36
	1%	194±3.54	1.490	10.43
	3%	192±2.32	1.397	10.59
	5%	207±7.11	1.357	10.87
	7%	195±6.02	1.323	10.20
	8%	196±3.6	1.280	10.71
	10%	178±5.5	1.104	3.22

TABLE X. CHARACTERISTICS OF GEOPOLYMER ADDING CARBON FIBER WITH CURING AT 800DEGC FOR 3 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 3h	0%	201±5.21	1.592	4.37
	1%	191±7.64	1.578	7.34
	3%	196±5.32	1.542	8.73
	5%	200±8.05	1.492	13.14
	7%	203±4.03	1.355	9.87
	8%	186±2.5	1.360	12.92
	10%	196±6.0	1.111	8.24

TABLE XI. CHARACTERISTICS OF GEOPOLYMER ADDING C.FIBER WITH CURING AT 800DEGC FOR 5 HOURS

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 5h	0%	201±5.1	1.940	9.37
	1%	194±4.03	1.709	8.84
	3%	200±6.21	1.621	9.08
	5%	211±3.15	1.491	8.80
	7%	190±7.04	1.387	9.96
	8%	191±3.05	1.369	10.92
	10%	188±2.29	1.122	5.59

When percentage of Carbon fiber increases, mechanical properties of geopolymer increase. From 1 - 8 wt% Carbon fiber, compressive strength increases and it is decreased with 10 wt% Carbon fiber inside.

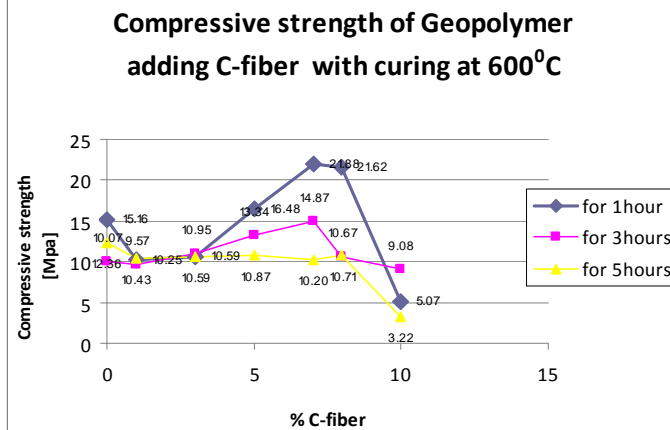


Figure 10. Compressive strength of Geopolymer adding C-fiber with curing at 600°C

TABLE IX. CHARACTERISTICS OF GEOPOLYMER ADDING CARBON FIBER WITH CURING AT 800DEGC FOR 1 HOUR

t (°C)	C.fiber %	Hardness (HV)	Density (g/cm <sup>3</sup> )	$\sigma_{max}$ (MPa)
At 600°C for 1h	0%	236±7.37	1.657	5.18
	1%	202±2.19	1.578	10.66
	3%	184±4.05	1.533	7.34
	5%	192±8.32	1.525	11.90
	7%	182±9.75	1.401	9.36
	8%	203±5.01	1.376	12.81
	10%	179±3.2	1.119	8.01

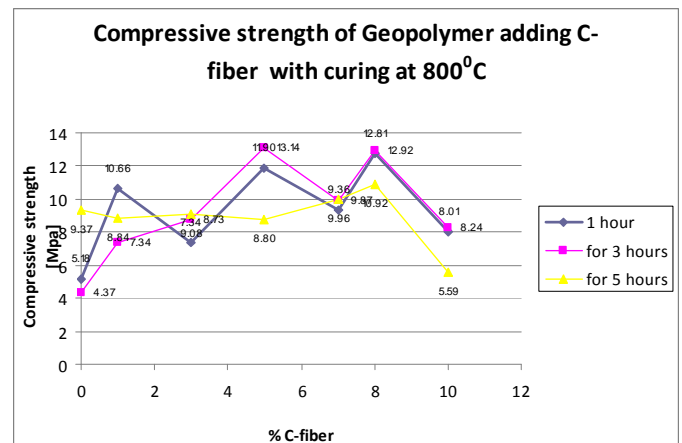


Figure 11. Compressive strength of Geopolymer adding C-fiber with curing at 800°C

When increasing curing temperature, compressive strength decreases quickly, especially at 800 degree C, its do not change according to the rule.

The compressive strength of geopolymer is decreased while temperature and curing time increase, at 200°C for 8 hours strength is highest in 43.15 MPa with 8 % Carbon fiber and lowest value is 5.59 MPa of geopolymer adding 10 % fiber at 800°C for 5 hours.

The experimental shows that geopolymer mortar are prepared with 1 ÷ 8 wt% of C.fiber exhibited acceptable flowability while more than 10 wt% C.fiber containing mortars were stiff and difficult to pack into the plastic moulds.

Geopolymer mortars with varying levels of C.fiber were prepared and their mechanical properties studied. The linear regressions of compressive strength value of geopolymer mortar are exhibited on the diagram. The results indicate that compressive strength of mortar is a strong relationship between types of percentage of C.fiber, curing time, temperature of curing.

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# Modelling and Simulation Techniques for Assessment of Urban Form Sustainability

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**Abstract**— The sustainability of urban form is widely discussed on political and professional level, however the debates usually don't have strong foundation (e.g. in strategic planning documents of European Union the need to achieve more sustainable, compact and mixed urban form is often declared, but any measurable expression for these characteristics is not provided). This often leads to confusion and misinterpretation of urban planning goals. The sustainability of urban form can be measured by several characteristics, describing spatial distribution of urban elements and level of mixed functions. This article shows general principles of obtaining such data from readily available satellite images.

**Keywords**—GIS and spatial analysis, sustainability of urban form, geomatics, spatial data mining and knowledge discovery

## I. INTRODUCTION

The problem of urban form sustainability has become most popular topic among politicians and urban planners in recent years. As a result there were many attempts to create a system of indicators for monitoring sustainability of urban environment [1-5]. The principal objective of sustainability indicators is to inform public policy-makers and support the decisions of town planning professionals. There are many systems of sustainability indicators but none of these systems is related directly to urban form, they include mostly indicators that provide information on various aspects of the interplay between the environment and socio-economic activities. Most prominent examples are the system created by United Nations Commission on Sustainable Development (it is often referred as CSD indicator set, the system now contains 96 indicators, including a subset of 50 core indicators), set of sustainable development indicators (SDIs) by Eurostat etc.

Although these systems are well known on a political level and are widely discussed between the politicians and economists, they are based mostly on global economic factors and therefore fail to provide monitoring and understanding of urban form. The planners and local authorities therefore need different approach and methods to support their decisions.

Urban form, i.e. spatial distribution of urban elements, is the key factor to achieve sustainability of urban environment. It is commonly agreed between town planners that the most important criteria are compactness of urban form, proper population density, mixing of functions or mixed land use and also urban diversity [6-9].

It implies the need to measure mentioned characteristics. There were several attempts to establish methods and techniques to obtain these measures [10, 11], and although they didn't gained popularity there is a trend that it will become more functional in urban planners work in the nearest future. The driving force for this to happen is the availability of good quality satellite images and advancement in remote sensing applications and software.

## II. SPATIAL DATA MINING FOR URBAN ANALYSIS

The main source to spatial data today has become satellite images of urban territories, which are readily available for every user. Besides that at the end of the year 2012 the *Google Maps* with *Street View* was launched. It lets the user to explore places around the world through 360-degree street-level imagery. It is therefore easy to explore landmarks, height and types of the buildings and obtain other information useful in urban planning. Many satellite remote sensing applications to regional planning (e.g. CORINE Land Cover in Europe) are also providing open data source for planners.

Steps for preparing data for urban analysis usually involve vectorization of satellite or aerial images and adding descriptive information to vector entities in spatial database to create GIS maps for further analysis and visualisation of results. Database entities represent the spatial elements of urban structure and in many cases can be multiplied, to obtain more precise results. The techniques of multiplying the entities are covered in this article also. Few different examples of data mining are given here to show the variety and possibilities for the research.

*The example of CORINE Land Use Land Cover map usage* shows how to prepare and use the data from land cover maps similar to CORINE in Europe. By such analysis it is possible to obtain numerical expressions of compactness, degree of land use mix and other very useful urban sustainability characteristics. This technique is less time consuming, but the obtained results are not precise enough to analyse smaller territories. It can be used for comparative analysis of big urban areas (towns, villages) or city districts.

*The other example* show how by adding information of functionality and users of spatial objects more detailed analysis can be made. This analysis gives unique results by which the sustainability criteria values can be measured. However here the big amount of data collection and preparation works must

be done. Not all the data can be available or possible to collect for bigger urban areas at all.

The sustainability of urban form can be understood in slightly different way between different specialists, but these examples together demonstrate enormous possibilities for spatial data mining and knowledge discovery in the field of urban planning.

### III. SUSTAINABLE SPATIAL DISTRIBUTION OF URBAN FORM ELEMENTS

Sustainable distribution of spatial elements in urban form is generally understood as highly clustered, compact formations of urban elements, but in different regions and countries different urban densities are considered to be sustainable. In Europe and USA the main problem for planners is to deal with sparse development called "urban sprawl" and the attempt of planners is usually to create bigger densities. However it can be contrary in developing Asian countries with tendency to overbuild the territory. In every case spatial distribution and density analysis can help to find the solutions and support the measures.

Urban form elements for analysis can be districts, neighborhoods, housing blocks or separate buildings according to the map scale and level of detalization. This data is the basis for the following calculations. In this research we are concentrating on 3 main sustainable urban form criteria (Table I).

TABLE I. CRITERIA OF URBAN FORM SUSTAINABILITY

Criteria	Object type	Description	Measurement
Compactness level	Housing blocks, neighborhoods, separate buildings	Shows the closeness of urban elements and concentration around the center	Mean distance between the objects, mean distance to the center of concentration, Compactness index <sup>a</sup>
Spatial interaction level	Towns, districts, neighborhoods, housing blocks, separate buildings	Shows the closeness of urban elements which are creating interaction with each other (e.g. living places-working places)	Set of mean distances between the objects of different categories, Spatial interaction index <sup>a</sup>
Mixed use level	housing blocks, separate buildings	Shows the clusterization level of separate function elements	Mixing index <sup>a</sup>

a. The measurement depends on the method and can be used for comparative analysis only

The measurements for sustainability criteria depend greatly on the approach of the researcher, but some fundamental statements must be considered. One basic statement is that sustainability of urban form can be characterized by the ability to access the urban objects of daily need by walking. It helps to solve communication for society groups who have no possibilities to use cars (children, elder and disabled people), reduces the traffic and saves the energy

for travelling, it also shows that the environment is vital and human scaled. It impacts the distance in which one urban object can attract people from other urban object. This distance in planning theory is referred as 400-700 meters or 5-15 minutes walking distance. Next still sustainable distance is up to 2-5 km and corresponds to possibility to use the bicycle for traveling. It can only be applied in territories with provided bicycle infrastructure. Fig. 1 shows the relation between the distance and level of attraction of two buildings. The level of attraction falls down rapidly at 550 meters and from 700 meters, when the possibility to walk becomes low it comes to the other level of reachable bicycle distance and then again falls to the last level of reachable distances by motorized vehicles.

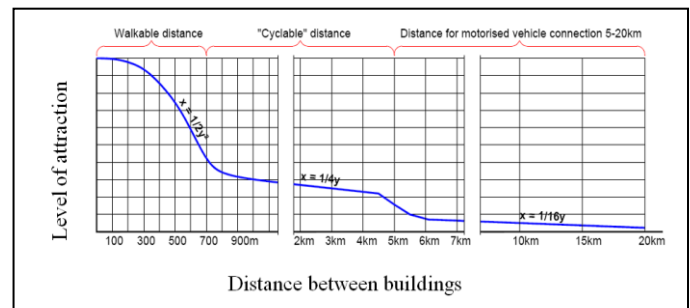


Figure 1. Relation between the distance and level of attraction between two buildings, used in research.

Different approaches can be considered to simplify the calculation of attraction. Some authors adopt gravitation formula (1), other formulas can also be successfully adopted if comparative analysis only is done. For the calculations the vectors are established between each pair of objects and spatial interaction is estimated by formula:

$$g_{ij} = k_f \cdot \frac{s_i \cdot s_j}{d_{ij}^2}, \quad (1)$$

where  $g_{ij}$  represents spatial attraction between objects  $i$  and  $j$ ,  $k_f$  is the coefficient of attraction between different categories of objects,  $s_i$  and  $s_j$  are the weights of objects  $i$  and  $j$ ,  $d_{ij}$  is the distance between objects.

The gravity calculated by (1) itself does not give correct results when we meet big contrast in weights of objects. For better compatibility the proposal is to use gravitation relative to object weight:

$$g_{ij}^s = \frac{g_{ij}}{s_{ij}}, \quad (2)$$

where  $g_{ij}$  is the gravitation calculated by formula 1, and  $s_{ij}$  – gravity of the object or cell.

In this case we can compare objects to each other and see which object contribute to more sustainable, more compact urban environment, and which object are reducing overall compactness of analyzed territory (fig. 2).

These operations can easily be performed by creating simple scripts for calculation. The core algorithm for calculation can be as follows:

```
elements = [ list of center coordinates and weight
              e.g. [105.10, 52.32, 15],[22.10, 55.12, 5] ....]
```

```
num = 1
```

```
gravitation = [ empty list ]
```

```
for el1 in elements:
```

```
    sum = 0.0
```

```
    for el2 in elements:
```

```
        dist = distance (el1.x, el1.y, el2.x, el2.y)
```

```
        if (dist > 0):
```

```
            sum = sum+(el1.weight*el2.weight/(dist*dist))
```

```
    gravitation.append(sum/el1.weight)
```

The list of gravitation values relative to object weights will be created and then the average gravitation can be calculated additionally to compare the compactness of the whole urban structure:

```
sum = 0.0
```

```
for g in gravitation:
```

```
    sum = sum + g
```

```
T = sum / gravitation.length
```

#### IV. LAND USE LAND COVER MAP FOR MEASURING SPATIAL DISTRIBUTION AND LEVEL OF FUNCTIONAL MIXING

The quickest way to make an urban analysis without many steps of GIS data preparation is to use readily available land cover data, like *CORINE Land Cover* in Europe. From such maps made to 1: 10 000 scale polygon features, marking different land uses in an urban area can be retrieved. These features usually represent quite big territories, representing few blocks or even whole neighborhood in town and it is better to divide these polygons by 200x200m or 500x500m mesh. The mesh can be either simple – rectangular or hexagonal or triangular mesh. Before dividing the polygon average density of it must be calculated and after division the weights of the cells must be recalculated according to the area of the cell.

Spatial distribution can be measured by (1) and (2), creating an array of average sum gravitation for each calculated cell. Mean relative gravitation here will represent the overall Compactness index which can be compared between different towns or territories.

In Fig. 2 the results of such calculations made for Vilnius city in Lithuania are presented. The positive cells, contributing to the higher compactness of territory where gravitation exceeds the gravity of the cell and it can be clearly seen by yellowish circles exceeding black gravitation circles. The cells where gravity is higher than relative gravitation reduce overall compactness and sustainability of urban form and here are seen in solid black color without yellow circle around.

When we the planner needs to analyze smaller territory, the maps showing the buildings are useful. They give enough information to calculate the same compactness, spatial interaction and level of mixing criteria on smaller scale. The building are can be automatically calculated by GIS software. Sometimes the function of the building (living, working, commercial etc.) is very important. The type can be easily defined using *Google Street View*. The whole town area or only the separate neighborhoods can be analyzed. These results can be compared and most problematic neighborhoods can be defined.

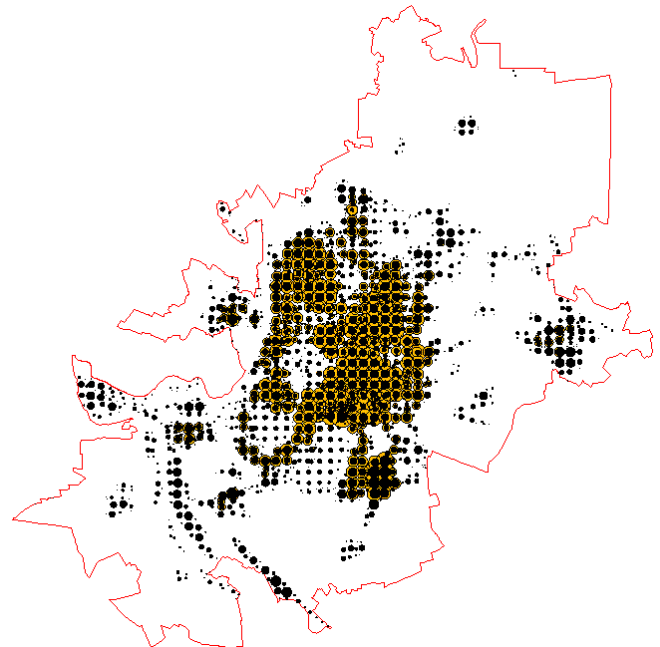


Figure 2. Visual presentation of object gravity to created relative gravitation ratio for Vilnius town, Lithuania (● – cell weights, ● – relative gravitation).

#### V. ANALYSIS OF SPATIAL INTERACTION AND MIXED USE LEVEL

The spatial interaction between urban objects differs according to the type of objects. Mainly urban objects between which interaction is taking place are buildings, because most of human activity is taking place in buildings. In this calculation other urban objects like parks, streets and public spaces can be skipped. The objects can be divided into three categories – living places, working places, places of public attraction (retail centers, clubs, other commercial, cultural and social infrastructure objects). The data can be collected for separate buildings or building blocks. The best and most precise way is to collect a number of residents, workers and visitors for each building (see Table II).

TABLE II. OBJECT CATEGORIES IN URBAN STRUCTURE

Category	Weight units
Living places	Residents of the building
Working places	Workers working daily in the building
Places of public attraction	Number of daily attracted people to the building

If such data is not available it is possible to model the data by assigning the numbers according to the area and function of the building (how to define the area and function was described in chapter 2).

Spatial interaction is different from gravitation index, because it measures actual processes happening in the urban environment. Here the same formula can be used but in addition to it the gravitation coefficients must be added and the gravitation must be calculated between different categories of objects using their coefficients (3). By described calculations the travel demand can be found if the data is correct.

For each category of object the sum of gravitational vectors is calculated by the formula:

$$a_n = k_{ff_1} \frac{\sum_{1,i} g_{ni}}{s_n} + k_{ff_2} \frac{\sum_{1,j} g_{nj}}{s_n} + k_{ff_3} \frac{\sum_{1,k} g_{nk}}{s_n}, \quad (3)$$

where  $a_n$  is the relational value of gravitation,  $k_{ff}$  – coefficients of attraction between different categories of objects,  $g_n$  – gravitation between two objects calculated by formula 1,  $i, j, k$  – number of objects in each category.

For the analyzed area the average gravitation of each category of objects and overall average gravitation is calculated:

$$T_{category} = \frac{\sum_i G_{category} [a_1 \dots a_i]}{i}, \quad (4)$$

$$T = \frac{T_{living} + T_{working} + T_{attraction}}{3}. \quad (5)$$

The value T describes the real compactness of spatial distribution of the objects and the values of T for different categories of objects describe rationality of the distribution of specific categories of objects.

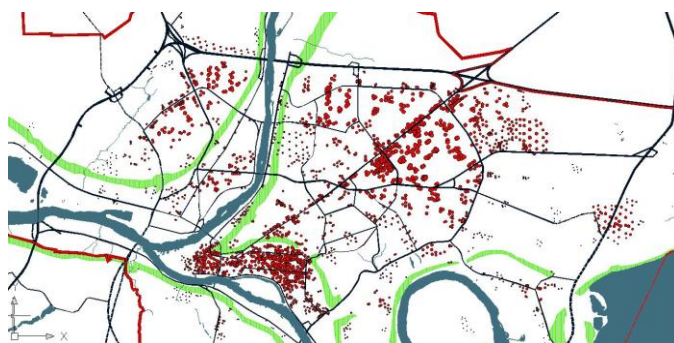


Figure 3. Visual presentation of spatial interaction of public attraction objects in Kaunas town, Lithuania.

The same model can be used for prediction of average daily travel distances. The prediction is based on assumption of daily travel needs. An average distances from each object to each category of objects can be calculated and multiplied by the weight of the object. In this way an average travel distance can be found (6).

$$D_{daily\_travel} = 0,3 \cdot D_{average}^{liv-liv} + 0,7 \cdot D_{average}^{liv-work} + 1,3 \cdot D_{average}^{liv-attr} + 0,32 \cdot D_{average}^{work-work} + 0,5 \cdot D_{average}^{work-attr} + 0,15 \cdot D_{average}^{attr-attr}, \quad (6)$$

where  $D$  represents average distances between different categories of objects.

## VI. CONCLUSIONS

Latest researches in sustainable urban structure area show that there are no clear methods to analyze and compare sustainability and compactness of urban areas developed.

The paper presents classification of urban elements which was well known in previous epocha when computer calculations were not used so widely. When used with modern computer scripting and GIS technologies these methods open new possibilities for urban analysis. This article demonstrates how several methods for describing the spatial distribution of urban elements can be combined and applied for evaluating sustainability of urban areas.

Described methods mainly can be applied in comparative studies, but also can be used as a tool for town planner and in the decision making process to enhance motivation.

Selected methods are not scientifically new, rather they are simplified examples of the most profound methods found in recent urban research studies. Criteria to select these methods was their simplicity and availability of data needed to perform the calculations. Collected techniques demonstrate the possibilities to use a scientific approach in the daily work of the town planner.

Calibration of selected example models is needed according to local differences. Especially formula 6 needs further analysis of travel pattern and consistency.

Gravitation formula (1) which is used in most of recent studies can be successfully changed to more complex assessment of gravitation according to reach distance of pedestrians, bicycle and moto-car users described in figure 1. It can be organized in simple “if...then” sequence inside the script.

Described methods can be used with commercial GIS computer software and any scripting language. The scripts can be enhanced and the selected methods can be used as a basis in CA (cellular automata) models for simulation of urban growth.

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# SECTION 20.

*Informatics*

# Data Integration with Evolving Ontologies

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**Abstract** — Data integration provides the ability to manipulate data transparently across multiple data sources. An important problem when dealing with ontologies is the fact that they are living artifacts and subjects to change. When ontologies evolve, the changes should somehow be rendered and used by the pre-existing data integration systems. In most of these systems, when ontologies change their relations with the data sources i.e. the mappings, are recreated manually, a process which is known could be error-prone and time-consuming. In this paper, the theoretical solution is provide to allows query answering under evolving ontologies with mapping redefinition.

**Keywords:** *Ontology; Semantic; Data Integration;*

## I. INTRODUCTION

Ontologies are becoming more and more important in data integration. It is relevant to a number of applications including enterprise information integration, medical information management, geographical information systems, and E-Commerce applications. The development of new techniques and the emergence of new high throughput tools have led to a new information revolution. The nature and the amount of information now available open directions of research that were once in the realm of science fiction.

During this information revolution the data gathering capabilities have greatly surpassed the data analysis techniques, making the task to fully analyze the data at the speed at which it is collected a challenge. The amount, diversity, and heterogeneity of that information have led to the adoption of data integration systems in order to manage it and further process it. However, the integration of these data sources raises several semantic heterogeneity problems.

## II. ONTOLOGIES

Ontology is a formal, explicit specification of a shared conceptualization [1]. In this definition, “conceptualization” refers to an abstract model of some domain knowledge in the world that identifies that domain’s relevant concepts. “Shared” indicates that ontology captures consensual knowledge, that is, it is accepted by a group. “Explicit” means that the type of concepts in ontology and the constraints on these concepts are explicitly defined. Finally, “formal” means that the ontology should be machine understandable.

Typical “real-world” ontologies include taxonomies on the Web (e.g., Yahoo! categories), catalogs for on-line shopping (e.g., Amazon.com’s product catalog), and domain-specific standard terminology (e.g., UMLS and Gene Ontology). As an online lexicon database, WordNet is widely used for

discovery of semantic relationships between concepts.

*Existing ontology languages include:*

- XML Schema – semantic markup language for Web data. The database-compatible data types supported by XML Schema provide a way to specify a hierarchical model. [3] However, there are no explicit constructs for defining classes and properties in XML Schema, therefore ambiguities may arise when mapping an XML-based data model to a semantic model.
- RDF and RDFS – data model developed by the W3C for describing Web resources. [2] The main aim is to describe vocabularies of RDF data in terms of primitives such as *rdfs:Class*, *rdf:Property*, *rdfs:domain*, and *rdfs:range*. In other words, RDFS is used to define the semantic relationships between properties and resources.
- DAML+OIL – full-fledged Web-based ontology language developed on top of RDFS. [3] It features an XML-based syntax and a layered architecture. It provides modeling primitives commonly used in frame-based approaches to ontology engineering, and formal semantics support found in description logic approaches. It also integrates XML Schema data types for semantic interoperability in XML.
- OWL – semantic markup language for publishing and sharing ontologies on the Web. It is developed as a vocabulary extension of RDF and is derived from DAML+OIL. Other ontology languages include SHOE (Simple HTML Ontology Extensions), XOL (Ontology Exchange Language), and UML (Unified Modeling Language). [4] Among all these ontology languages, we are most interested in XML Schema and RDFS for their particular roles in data integration and the Semantic Web [5].

## III. SEMANTIC DATA INTEGRATION

Semantic data integration is the process of using a conceptual representation of the data and of their relationships to eliminate possible heterogeneities. At the heart of semantic data integration is the concept of ontology, which is an explicit specification of a shared conceptualization. Ontologies were developed by the Artificial Intelligence community to facilitate knowledge sharing and reuse [6]. Carrying semantics for particular domains, ontologies are largely used for representing domain knowledge. A common use of ontologies is data

standardization and conceptualization via a formal machine-understandable ontology language.

For example, the global schema in a data integration system may be an ontology, which then acts as a mediator for reconciliation the heterogeneities between different sources. As an example of the use of ontologies on peer-to-peer data integration, we can produce for each source schema a local ontology, which is made accessible to other peers so as to support semantic mappings between different local ontologies.

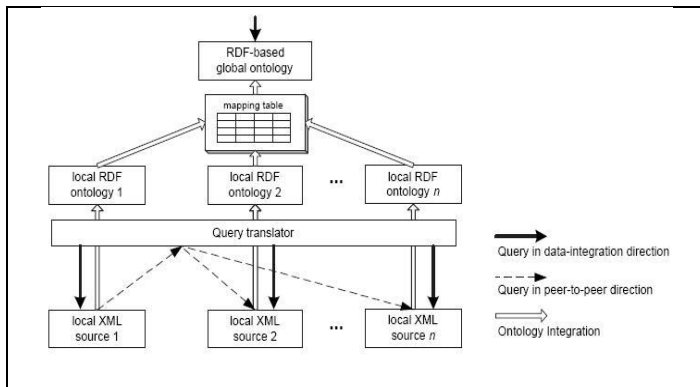


Figure 1. Semantic Data Integration and Interoperation

By accepting ontology on Fig. 1. as a point of common reference, naming conflicts are eliminated and semantic conflicts are reduced. During the last years, ontologies have been used in database integration [3], obtaining promising results, for example in the fields of biomedicine and bioinformatics. When using ontologies to integrate data, one is required to produce mappings, to link similar concepts or relationships from the ontologies to the sources (or other ontologies) by way of equivalence – according to some metric. The key in bringing legacy data with formal semantic meaning has been widely recognized to be the inclusion of mediation between traditional databases and ontologies [5, 9]. During the last years, ontologies have been used in database integration, obtaining promising results, for example in the fields of biomedicine and bioinformatics.

In various areas data sources can be heterogeneous in syntax, schema, or semantics, thus making data interoperation a difficult task [6]. Syntactic heterogeneity is caused by the use of different models or languages. Schematic heterogeneity results from structural differences. Semantic heterogeneity is caused by different meanings or interpretations of data in various contexts. To achieve data interoperability, the issues posed by data heterogeneity need to be eliminated.

Due to the rapid scientific development, ontologies and schemata need to change. When ontologies evolve, the changes should somehow be rendered and used by the pre-existing data integration systems, a problem that most of the integration systems available today seem to ignore.

#### IV. MODELING ONTOLOGY EVOLUTION

For modeling ontology evolution we use a language of changes that describes how an ontology version was derived from another ontology version. In its simplest form, a language of changes consists of only two low-level operations, Add(x)

and Delete(x), which determine individual constructs (e.g., triples) that were added or deleted [7]. Such a language is called a low-level language of changes. However, a significant number of recent works [6, 8, 10] imply that high-level change operations should be employed instead, which describe more complex updates, as for instance the insertion of an entire subsumption hierarchy (they group individual additions and deletions).

Consider the example RDF/S ontology shown on the left of Fig 2. This ontology is used as a point of common reference, describing persons and their contact points. We also have two relational databases DB1 and DB2 mapped to that version of the ontology. Assume now that the ontology designer decides to move the domain of the “has\_cont\_point” property from the class “Actor” to the class “Person”, and to delete the literal “gender”. Moreover, the “street” and the “city” properties are merged to the “address” property as you can see on the right side of Fig 2. Then, DB3 is mapped to the new version of the ontology leading to two data integration systems that work independently. In such a setting we would like to issue queries formulated using any ontology version available. Moreover, we would like to retrieve answers from all underlying databases.

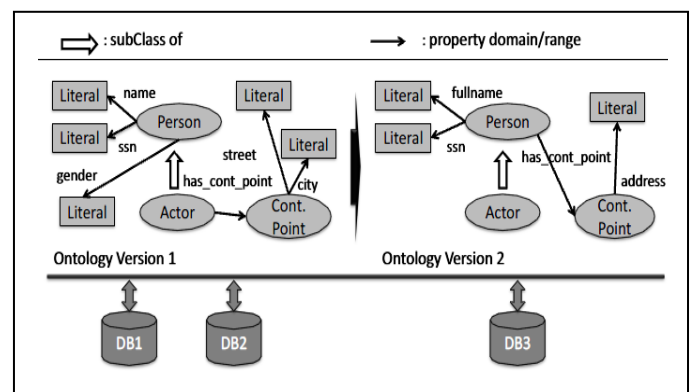


Figure 2. Example of an evolving ontology

Furthermore, several research works tried to deal with similar problems. For XML databases, for example, there have been several approaches that try to preserve mapping information under changes [11] or propose guidelines for XML schema evolution in order to maintain the mapping information [12]. Moreover, augmented schemata were introduced in [3] to enable query answering over multiple schemata in a data warehouse, whereas other approaches change the underlying database systems to store versioning and temporal information such as [6].

However, our system differs from all the above in terms of both goals and techniques. To the best of our knowledge no system today is capable of retrieving information mapped with different ontology versions.

#### V. ONTOLOGIES FOR DATA INTEGRATION

Ontologies have been extensively used in data integration systems because they provide an explicit and machine-understandable conceptualization of a domain.

1) In fact Ontologies have been practical used in one of the three following ways.

a) *Single ontology approach*: All source schemas are directly related to a shared global ontology that provides a uniform interface to the user [9]. However, this approach requires that all sources have nearly the same view on a domain, with the same level of granularity. A typical example of a system using this approach is SIMS [3].

b) *Multiple ontology approach*: Each data source is described by its own (local) ontology separately. Instead of using a common ontology, local ontologies are mapped to each other. For this purpose, an additional representation formalism is necessary for defining the inter-ontology mappings. The OBSERVER video surveillance system is an example of this approach.

c) *Hybrid ontology approach*. A combination of the two preceding approaches is used. First, a local ontology is built for each source schema, which, however, is not mapped to other local ontologies, but to a global shared ontology. New sources can be easily added with no need for modifying existing mappings.

2) *Data integration across heterogeneous data sources and data aggregation should, ideally, allow for*:

a) Data to be searched, queried, extracted, integrated and shared in a scientifically and semantically consistent manner across heterogeneous sources, both public and proprietary, ranging from chemical structures and omics to clinical trials data;

b) Discovery and invocation of scientific tools that are shared by the community, rather than repeatedly developed by each and every organisation that needs to analyse their data;

c) Both the sharing of tools, and their integration as modules in a generic framework, applied to relevant dynamic datasets. We refer to this process as “discovery driven scientific workflows” which ideally would also execute fast and in an unsupervised manner.

We conceive an Evolving Data Integration system as a collection of data integration systems, each one of them using a different ontology version as global schema. Therefore, we extend the traditional formalism from [10] and define an Evolving Data Integration system as a tuple of the form  $((O_1, S_1, M_1), \dots, (O_m, S_m, M_m))$  where  $O_i$  is a version of the ontology used as global schema,  $S_i$  is a set of local sources and  $M_i$  is the mapping between  $S_i$  and  $O_i$  ( $1 \leq i \leq m$ ).

Considering  $O_i$  we restrict ourselves to RDF/S knowledge bases, as most of the Semantic Web Schemas (85,45%) are expressed in RDF/S [12].

The most relevant approaches that could be employed for resolving the problem of data integration with evolving ontologies is mapping composition, inversion mapping adaptation and mapping adaptation as you can see on Fig. 3 [9]

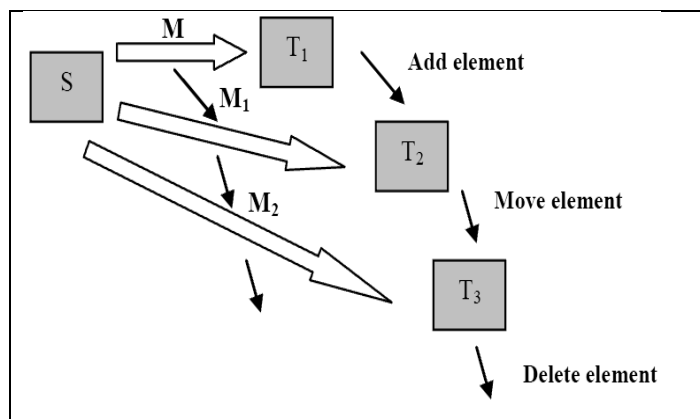


Figure 3. Adapting Schema Mapping Redefining

In mapping adaptation [6] the main idea is that schemata often evolve in small, primitive steps; after each step the schema mappings can be incrementally adapted by applying local modifications. However, this approach is integration system dependent, and is not specified in which way the list of changes might be discovered when two schema versions are directly provided. But even when such a list of changes can be obtained, applying the incremental algorithm for each change and for each mapping in this potentially long list will be highly inefficient.

Another problem is that multiple lists of changes (by introducing redundant additions/deletions for example) may have the same effect of evolving the old schema into a new one [11]. Finally, there is no guarantee that after repeatedly applying the algorithm, the semantics of the resulting mappings will be the desired ones.

This happens because complex evolution might happen, that cannot be modeled with simple additions and deletions, and dependencies might be lost. In order to tackle these problems we use a more expressive language of changes that leads to unique sequence of changes between two ontology versions with reduced size compared to the long list of low-level operators. In addition the initial semantics of the provided mappings are maintained since we do not change the mappings but instead we rewrite the queries.

Moreover the properties like composability and inversibility can be exploited for improving efficiency and change operation is defined as a change operation  $u$  over  $O$ , is any tuple  $(\delta_a, \delta_d)$  where  $\delta_a \cap O = \emptyset$  and  $\delta_d \subseteq O$ . A change operation  $u$  from  $O_1$  to  $O_2$  is a change operation over  $O_1$  such that  $\delta_a \subseteq O_2 \setminus O_1$  and  $\delta_d \subseteq O_1 \setminus O_2$ .

Obviously,  $\delta_a$  and  $\delta_d$  are sets of triples end especially the triples in  $\delta_d$  are triples coming from the ontology  $O$ . For simplicity we will denote  $\delta_a(u)$  ( $\delta_d(u)$ ) the added (deleted) triples of a change  $u$ . From the definition, it follows that  $\delta_a(u) \cap \delta_d(u) = \emptyset$  and  $\delta_a(u) \cap \delta_d(u) \neq \emptyset$  if  $O_1 \neq O_2$ .

For the change operations proposed in [12] and the corresponding detection algorithm, it has been proved that the sequence of changes between two ontology versions is *unique*. Moreover, it is shown that for any two changes  $u_1, u_2$  in such a sequence it holds that  $\delta_a(u_1) \cap \delta_d(u_2) = \emptyset$  and  $\delta_d(u_1) \cap \delta_d(u_2) = \emptyset$ .

These nice properties and their consequences are among the reasons that led us to adopt that specific language for describing changes among ontologies. Hereafter, whenever we refer to a change operation, we mean a change operation from those proposed in [12]. Now we need to define their application semantics. The application of a change  $u$  over  $O$ , denoted by  $u(O)$ , is defined as:  $u(O) = (O \cap \delta_a(u)) \setminus \delta_d(u)$ .

Two key observations here are that the application of out change operations is not conditioned by the current state of the ontology and that we don't handle inconsistency, (i.e.,  $(O \setminus \delta_d(u)) \setminus \delta_d(u)$  is always assumed to be consistent). In the next example the change log between  $O_2$  and  $O_1$ , consists of the following change operations:

```
u1:Rename_Property(fullname, name)
u2:Split_Property(address, {street, city})
u3:Specialize_Domain(has_cont_point, Person, Actor)
u4:Add_Property(gender, o, o, o, o, Person, xsd:String, o, o)
```

The definition of the change operations that are used in this paper can be found on [12]. It is obvious, that applying those change operations on  $O_2$ , results  $O_1$ .

Finally, since a change operation is actually a mapping function that maps  $O_1$  to  $O_2$ , a question is whether there exists the inverse function, the inverse change operation that maps the  $O_2$  to the  $O_1$  ontology version. By automatically constructing the inverse of a sequence of change operations (from  $O_1$  to  $O_2$ ), we will be able to rewrite queries expressed using  $O_2$  to  $O_1$  and vice versa.

Ontology representation formalisms involve the notion of validity, meaning that certain combinations of ontology axioms are not valid. This is not true for databases, in which any set of tuples that corresponds to the schema is valid (barring the use of integrity constraints, which are, in essence, logical formulas). The notion of validity also affects the change process, forcing us to introduce adequate side-effects in each change operation, in a way that would allow us to maintain validity in the face of such changes.

Therefore, maintaining the correct mappings is more difficult in ontologies (where side-effects must also be considered) than in databases.

For similar reasons, the notion of inference, which exists in ontological formalisms but not in relational databases, affects the process of maintaining the mappings. This issue has two facets: one is related to the different semantics (foundational or coherence [13]) that could be employed during change and its effects on the update results, and, consequently, on the mappings; the second is related to the fact that inferred knowledge could also give rise to inferred mappings, which should similarly be maintained.

## VI. CONCLUSION

In this paper, we argue that dynamic ontologies are very common, so data integration systems should be aware and ready to deal with that. We reviewed existing approaches for handling schema and ontology evolution and assessed their applicability in an ontology-based data integration system.

To that direction a theoretical approach that allows query answering under evolving ontologies with mapping redefinition is presented. To conclude, an ideal solution should try to exploit the initial mappings, the changes of the ontology and the query expressed using a specific version of the ontology to try to get answers from all databases mapped.

As future work, several challenges need to be resolved as it might not be possible to extract information mapped to a class, using a later ontology version in which the specific class is deleted or moved. An interesting topic would be also to extend this approach for OWL ontologies and to expand this approach to handle the full expressiveness of the SPARQL language. It becomes obvious that ontology evolution in data integration is an important topic and several challenging issues remain to be investigated in near future.

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# Distributed Greedy Approach to Solving Travelling Salesman Problem

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**Abstract**—The travelling salesman problem attracts the attention of researchers in many different fields of science. Apart from researching fast approximate solving methods we suggest a different approach aimed at finding an approximate solution with the simplest possible means. This paper describes such an approach based on an agent system composed of agents representing cities and roads. Agents perform only elementary operations while generating paths that are elongated and at the same time selected. As a result, the system finds an approximate solution of the travelling salesman problem without using any sophisticated algorithm or performing complex calculations.

**Keywords**—travelling salesman problem; heuristics; agent systems; approximation

## I. INTRODUCTION

One of the best known examples of optimization problems is finding the minimum Hamiltonian cycle in a complete weighted graph, known as the travelling salesman problem (TSP). In addition to many practical applications this problem has also profound theoretical importance, because it belongs to the NP-complete complexity class. Hypothetical discovery of an algorithm capable of finding exact solution in polynomial time would result in a new era in the development of computer science and many other disciplines [1]. Equally important, though less spectacular research topic concerns approximation-preserving reductions which allow to replace approximate solution for one problem with still approximate solution obtained for another NP-complete problem [2], such as TSP [3]. Therefore the development of approximate solving techniques for TSP is useful and can help solve other difficult optimization tasks.

TSP has countless practical applications and represents many equivalent or derivative problems that require analogous cost minimization in various branches of economy and science. Examples include logistics, public transport, machine tools and industrial robots control, testing of electronic systems, reducing the amount of waste in production lines, cluster analysis in data warehouses, web search engines or digital images, genetic research and prediction of drug action. The difficulty in TSP solving leads to distinguishing two major, mutually exclusive categories of solutions which can be either exact but slow, or fast but approximate. Both extremes are of vital economic importance in practical applications. Apart from these two we propose a third line of research, focused neither on performance nor accuracy, but on solving TSP using the

simplest possible measures that do not require complex algorithms or data structures.

Traditional exact approaches use sophisticated linear programming concepts like cutting plane method [4]. On the other hand, heuristic and approximation approaches are using the knowledge of geometrical relationships between the cities [5] or employ complicated mechanisms such as genetic algorithms. Development and implementation of both kinds of methods require not only knowledge but also adequate computing technology. On the other hand, similar optimization problems occur in nature, especially among living organisms that constantly need to optimize their behaviour and adapt to the conditions imposed by their environment. Plants and animals do not possess highly developed intelligence nor do they use advanced mathematics, yet they are able to quickly solve optimization problems in an approximate way.

This suggests another line of research mentioned above: to seek mechanisms as easy as required to be implementable within the means remaining at the disposal of biologic organisms. The agent-based method described here does not rely on any assumptions regarding the topography of cities and roads, does not use advanced computational processes and is not based upon results of abstract mathematical considerations. However, as experiments have shown, it provides TSP solutions of satisfying quality.

## II. PROBLEM REPRESENTATION AND SOLVING METHOD

Consider optimization of Hamiltonian path in a set of  $n$  cities  $v_1, v_2 \dots v_n$ . Pairs of cities are connected by roads with various travel costs and  $d_{ij}$  is the cost of travel from town  $v_i$  to town  $v_j$ . It is not necessary that the costs are symmetrical, so  $d_{ij}$  may be different than  $d_{ji}$ . There is also no assumption that costs satisfy the triangle inequality, i.e.  $d_{ab} + d_{bc} \geq d_{ac}$  for any  $a, b, c$ . This means that the described method can be used for both metric and non-metric, symmetric and asymmetric TSP. Moreover, the graph of roads does not have to be complete, as some cities may not be connected directly to each other (which could equally well be interpreted as a particular route of infinite cost, in practice represented by a sufficiently large value).

For each city  $v_i$  two path pools are introduced, the input pool  $I_i$  and output pool  $O_i$ . These pools collect candidate paths generated in the process of searching for the optimal solution. Each path is described by two sequences:

$$s = i_1, i_2, \dots, i_k, \quad (1)$$

$$d = d_{i_1 i_2}, d_{i_2 i_3}, \dots, d_{i_{k-1} i_k}, \quad (2)$$

where  $s$  is a sequence of indices of cities visited in turn by the path, and  $d$  is a sequence of costs of consecutive path segments. For a path  $p = (s, d)$  the length  $l(p)$  and the total cost  $d(p)$  are defined as:

$$l(p) = \text{card}(s), \quad (3)$$

$$d(p) = \sum_{i=1}^{k-1} d_{(i)(i+1)} \quad (4)$$

The distinction of input and output path pools is a consequence of the mechanics of the system, which relies on generation and disposal of paths. Paths contained in output pools are extended, modified and added to input pools. Paths collected in input pools are compared and the best of them are stored in output pools while the rest is discarded.

Two rules are enforced during the operation of the system. First, each path must not contain duplicated cities, i.e. all cities along the path must be visited only once. The only exception is the same city allowed at the beginning and end of the path which is a closed cycle. Second, each path in pools  $I_i$  or  $O_i$  must end in the same city  $v_i$ , which the pools are assigned to, although the path can begin in any city.

The task of modifying, extending and selecting paths is assigned to two types of agents,  $R$  and  $C$ . Type  $R$  agents correspond to roads between cities and are responsible for path modifications. Type  $C$  agents correspond to the cities and they are responsible for selection of the best tracks. The number of  $R$  agents is equal to the number of all roads connecting the cities, so it is many times greater than the number of  $C$  agents.

Agent  $R_{ij}$  corresponds to the road leading from  $v_i$  to  $v_j$  and knows the cost  $d_{ij}$  of that road. It is also the entire information that is needed to modify the path taken from  $O_i$  pool and to add it to  $I_j$ . Agents of this type have several options for handling paths. The first and most simple is to extend the path by adding a new road. Assume that in pool  $O_i$  is a path  $p = (s, d)$  in which

$$s = 1, 2, 3, \dots, k, i, \quad (5)$$

$$d = d_{12}, d_{23}, \dots, d_{ki}. \quad (6)$$

Then agent  $R_{ij}$  can create elongated path  $p' = (s', d')$ :

$$s' = 1, 2, 3, \dots, k, i, j, \quad (7)$$

$$d' = d_{12}, d_{23}, \dots, d_{ki}, d_{ij}. \quad (8)$$

If the tail city  $v_j$  is already present in the original path  $p$ , then the resulting path  $p'$  is invalid and it is discarded. However, if  $j = 1$ , then the resulting path is cyclic.

Another possibility is to reduce and extend a path at the same time. The first city is cut off from the beginning of the

path, and then  $v_j$  is added at the end thus creating another path  $p''$ :

$$s'' = 2, 3, 4, \dots, k, i, j, \quad (9)$$

$$d'' = d_{23}, d_{34}, \dots, d_{ki}, d_{ij}. \quad (10)$$

Trimming and extending help to overcome stagnation in case when paths become closed cycles which cannot grow any longer. Initial cutoff opens the cycle and allows the path again to elongate further. It is also apparent that if  $i = 1$  and  $j = 2$ , then the path  $p''$  is the same cycle but rotated by one city forward.

It is important to notice that when adding or removing path sections the agent neither knows nor is able to calculate the costs for all roads in the path. The index of the destination city  $v_j$  and the cost of road  $d_{ij}$  are the only numbers agent  $R_{ij}$  is knowing. One can visualize the path as a sequence of numbers written on paper tape, and in that case the agent is only able to add memorized number at the end of the tape and cut off the beginning of the strip. The knowledge of any  $R$  type agent does not depend on the structure of the rest of system, which means that it is possible to change the topology of some cities and roads without changing all agents.

All paths generated in the above way reach input pools in corresponding cities. Before being transferred to output pools they need to undergo some form of selection limiting their numbers. This is a task for type  $C$  agents, associated with cities and responsible for maintaining a ranking of paths ending in their city.

Agent  $C_i$  retrieves a path from the input pool  $I_i$  and compares it with other path of the same length stored in the output pool  $O_i$ . If the cost of path taken from  $I_i$  is less than the cost of path from  $O_i$ , then the latter is removed from  $O_i$  and replaced by the former. Otherwise the path from  $I_i$  is discarded and  $O_i$  remains unchanged. As the result,  $O_i$  stores only paths with the lowest cost encountered so far, separately for each length, both opened and closed. These paths are then retrieved again from the output pools by type  $R$  agents and thus the information flow within the system closes. The closed path  $p_{\text{opt}}$  of maximal length and lowest cost, chosen from all the output pools, is the solution to the problem.

Operation of the entire system starts with minimal paths containing only one city. The activity of type  $R$  agents leads to elongation of paths from which only the shortest are selected for further modifications by type  $C$  agents. If path elongation was the only kind of modifications, the entire process would reduce to classic greedy algorithm. That algorithm achieves rather poor results, using up the shortest roads at the beginning and leaving the longest distances to be covered at the final stage. However, the proposed mechanism is different from the greedy algorithm in two aspects. First, cutting off initial segments of generated paths helps to overcome local minima where the paths may get stuck. Second, paths are being closed at any stage of their growth, and by cutting that cycles new open paths are in turn generated, having their ends in the vicinity. Moreover, the rotation of cycles causes them to propagate to other cities, which also helps to overcome the

greedy algorithm tendency to start from the shortest road distances.

### III. COMPUTER IMPLEMENTATION AND EXPERIMENTS

The described method is characterized by massive parallelism of data processing, as each agent performs its tasks independently. Interactions between agent threads occur in input and output path pools. In a system of roads which makes up a complete graph the total number of agents reaches  $2n^2 - n$ . For 1000 cities it is almost 2 million agents. It is impossible to achieve such a number of concurrent threads using conventional hardware. On the other hand, converting the process to sequential regime instead of parallel one leads to significant memory requirements. If  $C$  type agents do not immediately remove redundant paths arriving to input pools, the size of required memory increases with the fourth power of the number of cities.

Therefore a compromise between the parallel and sequential approach is needed. The vast majority of paths generated and accumulated in input pools will be discarded when they are selected, so they can be removed concurrently while they are generated without propagating them further. The sooner new, less expensive paths reach the output pools, the sooner their modified, longer variants can be generated. Thus the  $R$  and  $C$  types of agents can be grouped into two parallel processes, internally split into as many threads as it is suitable for the particular computer architecture.

The system described has been implemented with Java technology and used to carry out a series of experiments. To make the results comparable to the results provided by other methods and algorithms, random two-dimensional set of cities arranged in a unit square has been chosen as the solved TSP instance where road costs are equal to Euclidean distance. The average cost of random Hamiltonian cycle in the unit square with  $n$  cities is [6]:

$$M(n) = n (\sqrt{2} + 2 + 5 \ln(1 + \sqrt{2})) / 15. \quad (11)$$

This value can be used as a reference point in assessing how effective – or rather ineffective – the process would be if it generated completely random paths. On the opposite side is the Held-Karp lower bound estimate of the shortest Hamiltonian cycle in a randomly filled unit square [7]:

$$L(n) = 0.71n^{1/2} + 0.55 + 0.63n^{-1/2} + 0.80n^{-1}. \quad (12)$$

In [7] there is also given a very practical advice for limiting the number of roads between cities. Numerical experiments show that, without a significant impact on the ability to achieve the optimal solution for TSP in the unit square, the number of graph edges can be highly reduced by leaving connections only to 20 nearest neighbors at each vertex. For 1000 cities it gives nearly 48-fold reduction of the number of roads and corresponding agents, which is why such a limit was applied in the experiments.

### IV. RESULTS AND CONCLUSIONS

The experiments carried out have provided satisfactory results, showing in particular that the proposed mechanism

works as expected and generates solutions of surprisingly good quality. Two different scales of problems were evaluated. One involved 1000 cities and required about 90 minutes processing of a virtual machine computing with performance of 0.9 Gflops. The other involved 5000 cities and required eight hours of operation of the same machine.

Solutions obtained for problems with 1000 cities reached an average  $d(p_{\text{opt}}) = 27.2$ , while  $L(1000) = 23$ . The cycle found by the system was thus 1.18 times longer than the estimated lower bound of the shortest possible cycle. For comparison,  $M(1000) = 521$ . For 5000 cities the solutions reached on average  $d(p_{\text{opt}}) = 67.5$ , while  $L(5000) = 51$ . Sub-optimal paths were 1.32 times longer than the estimated shortest cycle (Fig. 1). The difference in solutions quality between 1000- and 5000-cities problems is associated with deliberate limiting the computation time for larger problems for practical reasons. To provide a context for comparisons one can refer to known Christofides algorithm [8], which guarantees that the result is not worse than 1.5 times longer than the optimal solution.

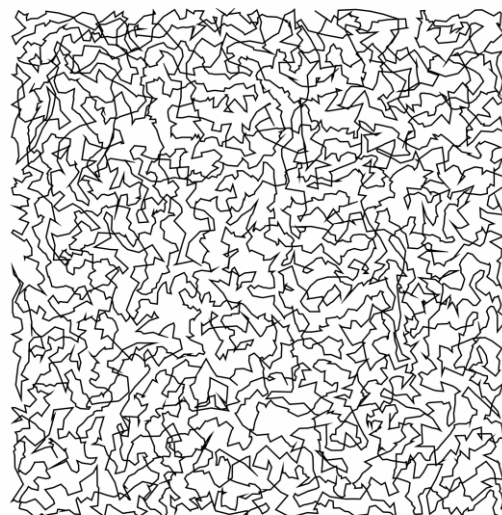


Figure 1. Sample TSP solution for 5000 cities distributed randomly within unit square. This particular path is 38% more expensive than the lower bound Held-Karp estimate.

Finding an average quality approximate solution for several thousand cities within eight hours of computation is surely not the most spectacular achievement, since there are many heuristics of much better performance. However, the TSP solving method described here is not a heuristics, as none of the agents has any knowledge of the road network topology or use any intelligent rules of constructing and improving paths, such as the search for nearest neighbors or straightening self-intersecting paths. Modifications of candidate solutions carried out by each  $R$  type agent are trivial and consist solely of adding always the same road segment and possibly cutting off another. Selection of paths performed by  $C$  type agents does not require any strategic decisions, but only checking whether the sequence of cities contains no duplicates and ensuring that it is not worse than the previously stored.

The system thus follows very straightforward recipe which in fact is also the formulation of the problem being solved: to select the longest possible simple cycle with the lowest cost among many different possible paths. It is difficult to ask the question, what intellectual motivation lies behind that method because instead of using any technique resulting from the analysis of the problem, it directly addresses the issue – it just creates different paths and chooses the best. Heuristics, or any form of understanding the problem, if present at all, in this case is hidden and scattered throughout the system so that it is impossible to determine the individual role that any of the agents plays in determining a solution.

At this stage of the research it is too early for rigorous testing the performance of such optimization, and even more so for comparing it to conventional algorithms. However, a prototype application shows that the results provided by the system can be very subjectively determined as acceptable, given the moderate computing power and performance of Java technology used in computer experiments. To provide some context of comparisons the Concorde TSP solver [9] can be used as an example of exact algorithm which is regarded as one of the best TSP solvers currently available. According to Concorde benchmarks [10] TSP instance with 4461 cities required 14 hours of calculations performed on a machine roughly one order of magnitude slower than used in experiments described here. It must be noted however that Concorde finds exact solution, not an approximate one.

On the other hand the proposed method can be compared to approximate techniques, for example to the well-established evolutionary approaches as described in [11]. These methods yield suboptimal results within 110-120% cost of the exact optimal route, whereas human solutions obtained by knowledge-based heuristic can reach 130% optimum. Thus the method presented in this paper can be summarized as providing moderate quality approximate solutions at the expense of computational work typical for exact solutions.

The above characteristic can be perceived as a flaw in the proposed method. However from the author's viewpoint process efficiency or the quality of obtained solution is not as important as the simplicity of the structure and functions necessary for system operation. The only data type transmitted between agents are the paths which are basically sequences of numbers. Connections between agents have a simple many-to-many network topology. Agents are performing only a simple

operations including addition and sequence trimming and concatenation. The design of TSP solving system being so simple matches the capabilities of organic systems that are unable to perform advanced calculations, but they can operate on basic data sequences. Representation of such sequences can be diverse, from chains of organic macromolecules, to sequences of neural impulses, to matter and energy pathways in the ecosystem. One can hypothesize that such systems through simple manipulation and selection of sequences can solve optimization problems similar to TSP or even use approximation preserving reductions to map the solutions to different kinds of computationally hard problems. Such hypothesis requires further consideration and it will become the topic of author's future research.

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# SECTION 21.

*Information Technology*

# The impact of virtual space on the evolution of the direct environment of an enterprise in the context of the customer

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**Abstract**—Virtual enterprises, a new type of business enterprises whose functioning is based on virtual space, can reach the needed solutions and information much easier. As a result, the process of digitalization of economic space is irreversible. This paper analyzes the impact of virtual space on the evolution of the direct environment of an enterprise in the context of the customer, and presents the available theoretical knowledge from the scope of the use of virtual space. It is also a review of domestic and foreign publications. The first part of the paper provides an overview of the concept of virtual organization through definition of the concept of virtuality, discussion of the characteristics of organizations that are operating in virtual space, and the presentation of their forms. The second part, in turn, discusses direct and indirect impact of virtualization on the external environment of an enterprise from the perspective of: the resources, production flexibility and consumer satisfaction. It may be concluded that virtual space shapes an environment in direct proportion to the demand from this environment.

**Keywords**- *Virtual organization, virtual space, virtuality, information technology*

## I. INTRODUCTION

Nowadays, enterprises are forced to constantly search for more and more effective solutions, to respond faster to the challenges of the market and consumer expectations. An impulse for this search can be the dynamic development of information technology and the expansion of global communication infrastructure, which is entailed by it.

Information technology has achieved the status of a strategic resource of many enterprises. Virtualization of economic activities opened new opportunities for growth. It created tools that not only improve the management, but also increase its efficiency. The occurring transformations affect the formation of both new elements of the traditional organizational structures and new forms of them. In the market game, virtual organizations become increasingly important.

The aim of this paper is to present the available theoretical knowledge from the scope of the use of virtual space and to discuss its impact on the creation of an enterprise environment.

The paper consists of two parts. The first part provides an overview of the concept of virtual organization through definition of the concept of virtuality, discussion of the

characteristics of organizations that are operating in virtual space, and the presentation of their forms.

Part two discusses direct and indirect impact of virtualization on the external environment of an enterprise from the perspective of: the resources, production flexibility and consumer satisfaction.

## II. THE CONCEPT OF VIRTUAL ORGANIZATION

### A. *The role of information technology in creating virtual reality*

The first step towards the evolution of information technology was the advent of personal computers, which enabled access to the new tool in almost all areas of social and economic life. The second step was the creation of information systems which are sets of information about senders and recipients, as well as information channels, which are spatially distinguished and ordered with regard to time [1]. However, it was the emergence of the Internet, known to be the component of many compatible computer networks [2], which created a novel virtual reality. The development of information technology has become a strategic resource for modern enterprises, creating new areas and opportunities for action.

Information technology is the total of technological solutions from the fields of:

- computer hardware – relatively cheap computers with rapidly increasing computing power,
- software – information systems supporting various areas of organization and management of an enterprise; network information structures,
- the architecture of communication networks – the Internet connections, which dynamics of development is based largely on the development of digital telephony [3].

The basic technologies of the information space include: the Internet, the World Wide Web, the email, Lotus Notes for collaboration and videoconferencing, etc. [4].

The Internet, being the most rapidly developing instrument of communication, offers many tools multiplying the uses of information technology. Because of the richness of services

offered by the Internet, it has become the basis for functioning of many organizations. The characteristics of the Internet that are relevant from the point of view of running a business are among others:

- its global reach,
- relatively low communication costs,
- lack of temporal and spatial access restrictions,
- the possibility of adapting to individual needs,
- interactivity, little degree of regulation [5].

Thanks to information technology, it is possible to operate in a completely new dimension – in cyberspace – which is an artificial environment wholly created by man. Thanks to the Internet, the world of services is now at your fingertips. Without leaving home, it is possible to perform a bank and stock transaction, to borrow books from the library, to shop for food and other goods, to read your favorite newspaper or a book, to watch a movie, play social games, listen to your favorite radio station on a trip abroad, to track stock exchange and weather forecasts, to book a hotel, buy a railway, flight or concert ticket, or to watch this concert on the Web, to sell and buy a house along with equipment, to graduate from university through e-learning and to learn a new language, finally: to find a job online, so that you could earn money for all of that [6].

#### *B. The characteristics of virtual organizations*

The term “virtual organization” denotes a new type of business enterprise, which could come into existence thanks to the development of global information networks and the Internet in particular [7]. Its functioning is based on virtual space, which is an information channel, used by an enterprise to provide information about themselves and their products [8].

A virtual organization operates in space, which can be characterized as a virtual space of:

- communication – being a new area for the exchange of views and ideas that inspire innovative solutions,
- distribution – creating channels of distribution of goods and services,
- transactions – relating to the use of Internet channels to complete formal commercial transactions (orders, invoices, payments) [8].

Although it does not exist physically, the virtual organization groups professional, loyal, and complementary economic units into a unified set. The units act in a common economic reality, in order to make the optimum use of emerging opportunities. Individual units undertake cooperation in order to find new sources of revenue or increase the resources that they would not be able to access, if they were operating alone. The virtual organization is seen as a business model, assuming the extension of business processes beyond the boundaries of a single enterprise and allowing its participants to access new markets, offer new and more innovative products, and allow flexible adaptation to new market requirements [9].

In the light of another definition, virtual organizations constitute forms of cooperation of companies, institutions and / or individuals that provide products or services on the basis of a common understanding of the business. They form a network of units connected by information technology in order to increase opportunities for action or extend access to knowledge [10].

The essence of virtual organization is its ability, not included in traditional business patterns, to use resources that are located in different places of the world, through the constant search for new opportunities for growth and market expansion [11].

The virtual organization is focused on the implementation of market tasks and assumes a structure that is relevant to their scope. The main tasks of such an organization are:

- to organize a functional structure capable of achieving the goals of Web-consumers;
- to collaborate with competent partner companies which implement physical flow processes;
- to coordinate the activities of all economic units in the scope of the thus created super-organization [12].

Attributes of the virtual organization include:

- its existence based on the use of information and telecommunication technologies,
- network features – distribution of skills and knowledge in multiple locations of the network,
- integration – using participants’ synergy to increase cooperation,
- flexibility and dynamics – manifested by the absence of any restrictions on space and time,
- variability – caused by the level of innovation and creativity [12].

#### *C. Forms of virtual organizations*

Virtual organizations can be created on the basis of various forms of business, which include:

- partnership in the creation of joint ventures,
- agreements and cooperation agreements,
- consortia,
- holding companies,
- joint ventures,
- strategic alliances,
- linking units in a new corporation,
- creating networks of enterprises to manufacture a joint product or service,
- providing distribution services [13].

Taking into account the activities of the above-mentioned forms of virtual organizations, we can distinguish the following types:

- virtual enterprises – persistent entities created in a planned way as organizations of this nature, where all aspects of the business are virtualized,
- virtual ventures (projects) – temporary actions of time- and space-limited scope, where planning and implementation is carried out by separate enterprises interacting with each other within the same or different sectors,
- virtual teams – created within a company by a group of specialists and experts, who perform various functions within the traditional organization, established in order to perform a specific job [14].

Virtual organizations can have the form of:

- home offices, which constitute a workplace that is shifted in space,
- a fractal factory built of macro-modules, which navigate basic processes and the work of micro-modules, which monitor and complete supporting processes,
- business (technological) parks created with the intention to obtain a competitive advantage in the field of advanced technology, especially scientific research centers,
- employment agencies specialized in HR services, usually for short-term, project-based tasks,
- advisory agencies providing “full service” in the following areas: organization and management, accountancy, tax and finance, marketing, logistics, production, technological and technical services [15].

### III. CREATING THE ORGANIZATION ENVIRONMENT BASED ON VIRTUAL SPACE

Virtual enterprises as well as traditional businesses operate in a certain space called the environment. S. Sudol distinguishes the following types of the environment:

- closer (direct) environment covering all systems, with which the company is in immediate relation, e.g. the market, contractors, lenders,
- distant environment, also known as indirect or macro-environment, composed of the systems with which the company is in indirect relation, e. g. the social situation of the country, politics or the legal system [16].

According to I. Pawełszek-Korek, the components of the virtual environment of an enterprise are:

- websites which reflect real-world objects (companies, institutions),
- discussion forums as a tool to create virtual communities,

- Internet search engines functioning as business intermediaries,
- open and hidden knowledge resources, which include widely available information and limited resources, which often require payment,
- identifiable customers who have their websites and email addresses and anonymous ones, who mostly limit themselves to browsing and completing network transactions [17].

The environment in which virtual organizations operate, is primarily the dynamically developing local, national and international market; it is still increasing risk and competitiveness [18], continuous technological progress and evolution of the consumers' needs.

#### A. *The impact of virtualization on the company resource potential*

The virtual organization promotes the occurrence of a series of positive economic phenomena. Among the advantages of the virtual organization are:

- efficient use of resources,
- increasing of the operational flexibility,
- great innovativeness,
- lower costs of operation,
- increased speed of operation,
- implementing innovative solutions in the enterprise,
- voluntary participation and the principle of equality,
- effective use of information and communication technology, etc. [19].

The main advantage of the concept of virtual organizations is the ability to achieve synergy through the use of individual resources belonging to its participants [19].

The effect of the functioning of a virtual organization may be reaching a certain critical mass allowing for integrated use of assets belonging to its units [20]. This type of organization allows for the integration of distributed resources, creating conditions for the transition from providing the customer with simple solutions to granting more complex ones, and from activity on the local or regional market to competing on the global market [20].

In terms of economic processes, the virtual space creates possibilities for a business based on cost and time reduction, as well as on optimization of quality. The low cost consumption of the activities is achieved through the cooperation of units, which generates synergy.

The virtual organization as a whole can incur significant capital expenditure with little involvement of various participants. It may cause an increase in financial flows for each of the participants in the network without the need for engaging external resources [21].

This type of organization allows for the production of goods and services based on the cooperation of individual market players pursuing the task on the basis of common economic relations established over organizational, geographical, or legal boundaries. It allows for the efficient use of information technology during the collaboration between the units that form it through:

- joint acquisition of: experience, know-how, knowledge,
- shortening the communication channels between partners and customers,
- increasing consistency and productivity of actions [21, p.156-157].

Great innovation that characterizes units operating in cyber space is a result of their constant evolution. Innovations do not have to be created in one place and flexible research teams may consist of the employees performing tasks within different areas of activity and locations [22]. In addition, through the effective concentration of activities and efficient management of resources, virtualization of the economic space has a positive impact on economic growth [23].

#### *B. The impact of virtualization on the flexibility of production*

One of the characteristic features of virtual organizations is the ability to increase the adaptability of the scale and range of activities to the market needs. This type of flexibility of activities increases the resistance to economic fluctuations and related organizational and economic dangers [24]. The flexibility of the virtual organization is related to the speed with which virtual enterprises appear and disappear. Economic units set up businesses in a situation where there is a specific market opportunity, and disappear when there is lack of interest or profits from the project.

The virtual organization is not territorially unique due to strong, trans-territorial interconnections between companies, infrastructures, and organization of activities in different phases – production, distribution, and development of goods and services [25].

Virtual enterprises owe its elasticity of production to specific organizational problem solving solutions, which are associated with the quick response to environmental stimuli [26]. Because of the fact that individual partners are independent entities, reconfiguration of the system can be done without serious disruptions [27].

The virtual organization, which is an externally disaggregated organization, can do better in the complex world, because it is at a specific point – on the edge of chaos [28]. Thanks to this fact, it is constantly evolving – smoothly passing from one stage to another, avoiding the expanses of revolution, i.e. sudden, jumpy changes [28, p. 172]. Therefore, it is able to offer completely different products in a short time.

The flexibility of the virtual organization enforces a certain kind of safety measures in the form of specific material surpluses which guarantee a rapid reaction in the event of a particular opportunity or threat. The diversity of an enterprise potential allows for taking actions in every circumstances and

reacting to the whole spectrum of diverse economic phenomena [29].

It can be concluded that the flexibility of production of virtualized enterprises manifests itself by:

- the ability to keep up with changes in the environment,
- rapid development,
- quick response to market expectations [29, p. 186].

#### *C. The impact of the virtual space on consumer satisfaction*

The primary goal of the virtual organization is to achieve the maximum level of efficiency by providing the best product or service in the shortest possible time [30].

The virtual organization is not an institution, but a way of solving problems [30, p. 67]. Doing business in cyber space requires from the involved parties extensive knowledge on the mechanisms and information tools, which enable them to increase the efficiency of business processes [31]. Because of the fact that consumer groups are more and more stratified, it is the expertise which becomes the basis for creating virtual value [32]. The consumer fulfilling their needs through a virtual space has been defined by J. Hagel and A. Armstrong as a member of the virtual community, i.e. a group of people united around common interests, created to meet their needs for information and completing bank transactions [33]. Therefore, the virtualization of market processes is related to the creation of networks serving the development of relationships with consumers, provoking and fulfilling their needs. The stability of the established relationship varies depending on the preferences of the network participants, the links between them, as well as the whole of events that accompany their relationship [34].

Through direct contact with the client, the information space provides knowledge that is necessary to create new and competitive market offers [35]. The use of a virtual environment not only provides excellent opportunities for acquiring information, but it also allows for implementing an efficient information system that could contribute to gaining strategic advantage over competition. Transmission of information in all directions: enterprise – consumer, consumer – enterprise, or consumer – consumer, takes place with lightning speed [36]. Without leaving home, the consumer can acquire e-books, newspapers, music, movies, purchase consulting services or accept an educational offer. They can study catalogues of offers, compare them with each other and choose one, systematically calculating the expenses.

Due to the fact that the consumer can do it all from home, it can be stated that virtual communication space increases the satisfaction of the consumer.

Excellent examples of the application of the virtual enterprise are solutions used in the tour operator businesses, which allow consumers to find and purchase a properly personalized tourism product in a most convenient way.

The functioning of such units is based mainly on the use of a wide range of programs for handling both external and internal customers [37], in two main areas:

- in internal management and relationships with external partners employed are: specialized internal management programs, databases, automated office systems, knowledge management systems, intranets / extranets [38], payment card systems, telecommuting (telework) systems [39], electronic data interchange (EDI), sale of a business-to-business type [40], etc.
- in the area of distribution used are: specialized distribution programs, computer reservation systems (CRS), Global Distribution Systems (GDS), connecting applications (switches), Tourist Destination Management Systems (DMS), the Internet, including help and utility online programs (Expedia, Travelocity, Preview Travel, Internet Travel Network, Priceline), mobile devices (PDA, WAP, GPRS), and finally, technologies that support automated systems in the form of telephone, kiosks, CDs [41], sale of a business-to-consumer type, Customer Service Centers (Helplines), etc. [42].

The example of internal processes virtualization in tourism organizations may be used to make a short analysis of the positive and negative aspects of the application of information technology.

Virtualization of the functioning area of tour operators certainly streamlines and systematizes a series of steps of a record and organizational nature and plays a fundamental role in reducing costs. Synergy of activities facilitates the processes of resource management and significantly increases the use of the company's potential. It forces technological innovation and the need for continuous implementation of innovative solutions in organization and management.

"Virtualization within the company removes many of the risks; however, is not unproblematic" [43]. It may give rise to a number of risks related to the organization of work in the forms of: difficulties in coordinating activities, producing communication noise, employees' resistance to the rapid pace of changes, or the development of conflicts caused by misunderstanding of the division of tasks. A risk of making wrong decisions may appear due to lack of time to perform a detailed analysis before deciding on strategic matters. One of the negative sides of the internal virtualization is also the fact that it causes a need to constantly invest in modern technology and management systems that may not be fully explained among other needs of the organization.

In the area of cooperation with business partners, apart from positive features, which include wide-ranging co-operation that uses both the effect of globalization, synergy and exchange of experience and knowledge, along with the distribution of risk, there are also undesirable features. The negative aspects of virtual collaboration of large-scale tourism enterprises include the high risk of formal and legal issues related to the global distribution of co-operating units and difficulties in finding partners presenting the desired level of competence. There may also appear problems with the coordination of tasks, the elaboration of an appropriate organizational culture, or a risk of losing key competences. The negative side to this type of business is "the need to build relations based on trust and ethics" [44], which in itself is

pretty hazardous. The distribution area, in turn, is related to the development in quality, speed and efficiency of the spatially unlimited information medium between the enterprise and the consumer. It allows for maintaining contact with potential and regular customers and building the desired image of the enterprise.

Apart from many advantages and benefits associated with the functioning of virtual organizations, there are some disadvantages as well. One of the most important drawbacks is related to institutional credibility, "which cannot be localized in the real world" [45]. Finally, what is worth emphasizing, the functioning of a virtual enterprise moves interpersonal verbal communication into dehumanized cyberspace.

#### IV. CONCLUSION

The development of information technology, which shapes the virtual space, creates opportunities for development and creating new forms of organizations that are functioning in the digital reality. Reasons for change are derived from current economic trends, as well as consumers' needs and preferences.

All existing theories divide companies into those that could compete mainly in terms of costs and differentiated products. Nowadays, a company that wants to be competitive must offer a good product for as low as possible price, and it is therefore forced to continuously modify its activities in the sphere of resource management and manufacturing processes. The need for growing consumer orientation determines the increased operational flexibility, the necessity of collecting more and more information about market needs, expectations and opportunities for contractors and consumers. All these activities are possible because of the network nature of the organizational and market links. Virtual enterprises, using modern information technology, can reach the needed solutions and information much easier. As a result, the process of digitalization of economic space is irreversible.

Taking everything into account, it may be stated that virtual space shapes an environment in direct proportion to the demand from this environment.

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# Approach for an Object-Based Data View for Mobile PDM Users Supported Through a Timeline

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**Abstract**— Social networks like Facebook have introduced a new feature that allows users to organize content in a unified view. The so-called timeline helps to keep the contents in a chronological sequence of events at a glance. Mobile PLM users could benefit from a timeline that makes activities of other users more transparent within the product life cycle management. The approach within this paper presents a generic architecture for collecting and presenting PLM information on a timeline.

**Keywords**—Timeline; PDM; PLM; object-oriented View; Data Visualization; Mobile User; Facebook; Architecture; Product Development; Lifecycle; Mobile Device; Mobile Context

## INTRODUCTION

PDM<sup>1</sup> systems are known for their complex data structures and require elaborate data management. The variety of processes, data, organizations and life cycles in the PDM system takes a seemingly unmanageable proportion over time. Caused by the ever-growing amount of information, structured administrations [1] and new perspectives on the data are necessary. To organize user information more clearly, some social networks like Google+ [30] and QZone [29] increased their efforts to represent user activity in a time sequence.

The social network Facebook has already organized the view on the data through user's context by a chronological arrangement of activities. Therefore, an enormous amount of data with more than a trillion connections must be searched [14]. Such data view as used in Facebook's Timeline [18] could be useful for PDM systems to provide a new perspective on information and relationships, as they represent the data reorganized in a new way. New interpretations of the network of PLM<sup>2</sup> information would thus be possible.

The view of product data in today's PDM systems is regulated by the particular user's context through its role assignment. PDM systems provide for user's assigned roles a pre-configured and tailored data view, for example for engineers, designers, production planners and technicians. Data view represents a portion of the amount of data that is generated during the product development process (PDP). Thereby each user gets only access to the data that are necessary to carry out its role.

Due to a unified view of information on reduced and clearly structured data, the user would firstly get a better overview of the history of activities and their relationships. Secondly, the user would look up more complex data structures on demand.

Mobile users have other demands on the data view due to the surrounding environment and their mobile devices [15]. Mobile users are constantly on the move and have the demand to be always connected. Mobile devices do not claim to provide a full environment with all the available information, but rather to be a universal communication tool that communicates with the business world. For this purpose, a reduction of the complex data structures must be made to allow the navigation on small touchscreen displays.

Too much information can negatively affect the user experience. For this reason, a one-to-one translation of the different data views for the mobile user is difficult [2]. Therefore a customized data view for the mobile user is necessary.

This paper is to be shown the advantages of the timeline integration in PDM systems for stationary and mobile users. In addition a generic architecture is presented that can be used to extract information of an object from the PDM system. The information reduced data view is displayed in a chronological arrangement on a mobile device.

This paper is organized as follows: Section 1 reviews related research and the use of timelines. Section 2 analyzes currently used data views, and describes its characteristics in PDM systems. In this context, a content classification of an activity is performed. Section 3 introduces the viewpoint concept. Section 4 presents the architecture with its limitations. Section 5 discusses the results of the survey regarding usage of an object-based data view. Finally, in Section 7 the conclusion is formulated and suggested further research.

## I. RELATED WORK

Timelines are used in different research fields. Rainer use multi-dimensional timelines for software projects [32] whereas Walz et al. use a timeline for project staffing for a limited number of major events [33]. In the field of computer forensic, Olsson and Boldt have developed a prototype which uses a timeline to plot all evidence by their time variables to find coherent evidence [34]. The detection of inconsistent information in timelines is discussed by Marrington [35]. Hargreaves and Patterson provide an approach for an

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<sup>1</sup> Product Data Management

<sup>2</sup> Product Lifecycle Management

automated timeline reconstruction based on high-level events [36].

## II. FUNCTIONAL VIEW VS. OBJECT VIEW

Today's PDM systems structure and present the data according to the principle of functionality. The connections between data objects can be seen only when the corresponding functions in the PDM system were called. Browsing tools such as the *Navigator* in *Enovia V6* [17] or *Relation Browser* in *Siemens Teamcenter 9* [16] help to examine the connections and relationships between objects. The examination of an object and its relationship is limited to the corresponding area in which the object is located. A unified, cross-functional and chronological created overview of multiple objects and relationships from different areas of the lifecycle does not exist. Figure 1 shows a component-based model including functional views. Each component delivers an own collection of user views and has a flat overlap to other components. A composition of data views from different areas of the life cycle is currently achieved only through customization.

A unified view of chronological-driven object does not exist. Instead, the data of different objects of the corresponding PLM modules are loaded and linked presented in a functional view (Figure 2). Different views (PV *n*, etc.) are provided by the PDM system to track the different stages (PR *n*, PS *n*, PL *n*, PC *n*, etc.) of a product life cycle. Users are able to consume or contribute information in the respective views. The user must switch between the views if they have the need to consume or contribute information from other lifecycle stages. A combination of data from different phases of the product life cycle can provide a new perspective on complex data structures. The approach is not related to a specific data range, but uses the data from the different areas of the life cycle.

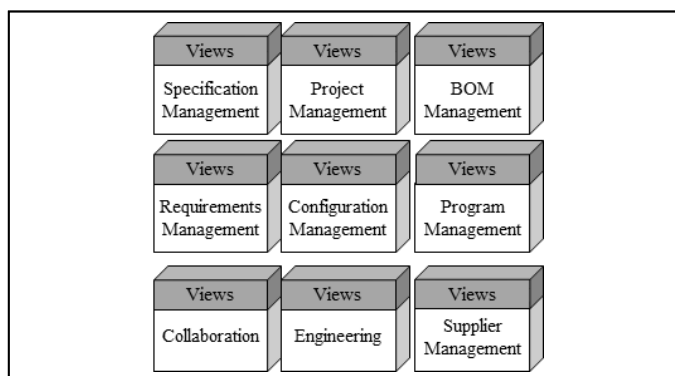


Figure 1. Each PDM component delivers an own set of views.

The focus is not only on the specific function, but now it is focus on the object itself with its impact and interactions to other objects in the life cycle. For example, objects can represent programs, projects or people. Table 1 compares the functional view with the object-driven view.

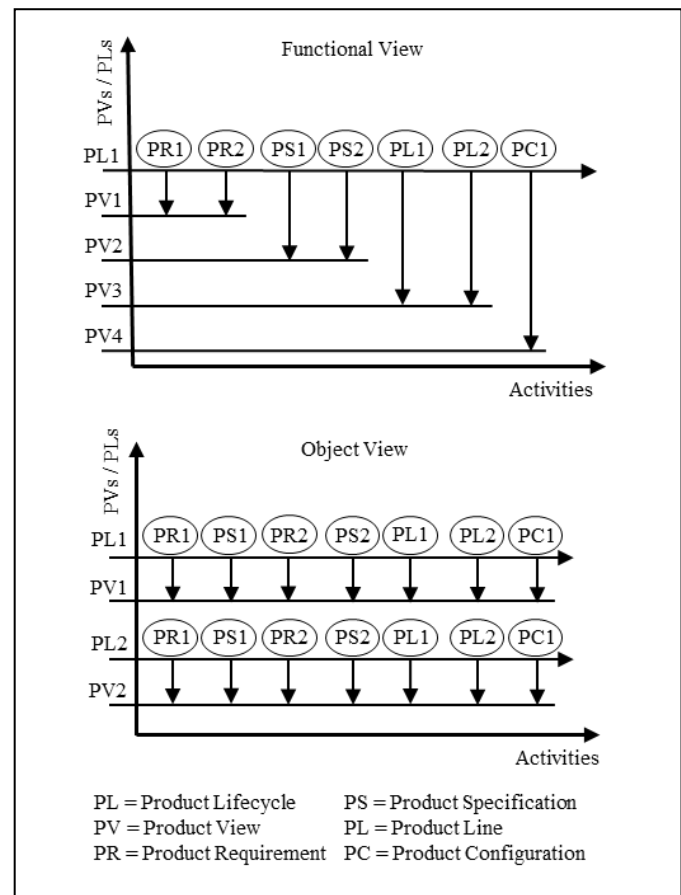


Figure 2. Functional view vs. object view.

TABLE I. COMPARISON OF TABULAR VIEW VS. OBJECT VIEW

Data View Characteristics	Functional View	Object View
Data View is driven by	Function	Object
Information Coverage	Limited to a lifecycle stage	Covers single or multiple stages of a lifecycle
Focus on	List of Objects	Single Object with its Relationships
Type of Information	Complex structured	Simple structured
Arrangement of Information	Sorted by column attribute (e.g. name)	Chronologically sorted list
Content Type	Textual strings	Mixed content
UI Navigation	Scrollable UI	Scrollable and zoomable UI
Content Filter	Attribute filter	Filter applied by viewpoint and visual filter provided by visualization frontend (e.g. zoom in / out)

While complex data structures on mobile devices have a different user experience than on desktop computers, the amount of data must be reduced. Therefore the volume of data must be limited to a predefined count of important information.

More comprehensive information will only appear if the visitor wants detailed information about the selected object. Such a load-on-demand function reduces the server load and the amount of data to be transmitted to devices.

The second aspect is particularly beneficial for mobile devices. The perspective of an object takes place with a reduced amount of data in a chronological view. The data are shown as a so-called Activity. An Activity represents a compilation of information, which is represented through a box. Figure 3 illustrates this approach. An Activity can include a variety of information from objects and relationships that are only limited by the PDM system. A distinction must be made between necessary and optional information.

Necessary information is data used for the presentation of the timeline. Such data shall specify an activity subject and temporal information for anchoring the activity on the timeline.

Optional information includes detailed information about the object itself, about relationships to other objects, or information about other objects. For example, information about the owner, its status, its relations to other objects (such as CAD files, videos or images) are presented, which have triggered an Activity. Table 2 lists a set of activity-boxes for different application purposes.

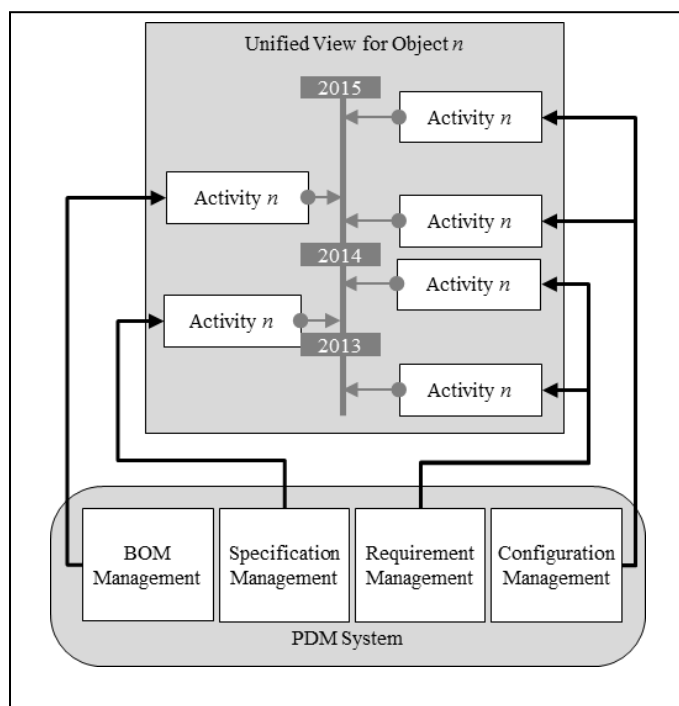


Figure 3. Unified view of an object.

TABLE II. TYPES OF ACTIVITY BOXES

Activity Box	Content Type	Sample
Information	Textual-Information	Textual Information about project state and tasks
Embedded Content	Inline Frame	External embedded content from third-party systems
Distribution	File Download	Distribution files, Excel sheets, Word documents
Video	Video Player	Captured construction manual
Picture	Single, Dual or Strip Matrix of Pictures	JPEG, PNG, Drawing Print
Map	Map Plugin	Location of project members
3D Content	3D Plugin	Embedded 3D viewer displaying an Engine part
Collaboration	Video and Audio Conference	Collaboration with Engineers about Contributed context
Mixed Content	Text, Medias, Maps, Plugins	Context Description, Story
Interactive	Interactive Lifecycles and Charts	Financial Charts
Contribution	Simple User-Contribution	Approve Task, Promote an Object

### III. VIEWPOINTS

Viewpoint is understood as a system engineering concept that describes the distribution of affairs in certain groups. Affairs is relating to the interests of the parties in relation to the architecture [24]. The definition of a viewpoint is necessary to manage the aspects separately. Thus, the selection of viewpoints through the division into specific subject areas is useful [23]. In IEEE 1471 [25] a distinction is made between Views, Viewpoints, Stakeholders and Concerns. Viewpoints provide the conventions, rules and languages that are needed for the construction, interpretation and analysis of the views [24]. In IEEE 1471 the viewpoint is defined as a defined specification of a view. A View is the representation of the entire system from the perspective of a defined affair (or concerns) [26]. A method to define viewpoints is presented in Koning and van Vliet [27].

The following requirements are placed on viewpoints: (1) Each view corresponds to exactly one viewpoint, (2) A viewpoint is a pattern for the construction of views, (3) Viewpoints define the rules for the Views, (4) The selection of viewpoints are determined by particular request. [28]

The following aspects of viewpoints are specified: (1) Each viewpoint is assigned a name; (2) the actors are addressed by the viewpoint; (3) the concerns of the stakeholders are defined by the viewpoint; (4) the used language, modeling techniques, or analytical methods of the viewpoint; (5) the source (if present) of the viewpoint (e.g. users, product, project). In addition, the viewpoint can consider the following aspects: (A) consistency and completeness checks, with the associated underlying method to be applied to the data model in the PDM system; (B) An evaluation or analysis technique that is applied to the data model within the view; (C) All heuristics, patterns or other guidelines that supports the synthesis of an associated view [28].

In the context of PLM, the view is understood as a point of view from which the data will be considered. Usually the data view is defined through the user roles. Since the view for an object-based approach will shift from a vertical data view to a horizontal data view, extra roles must be added to the user to gain access to additional data (Figure 4).

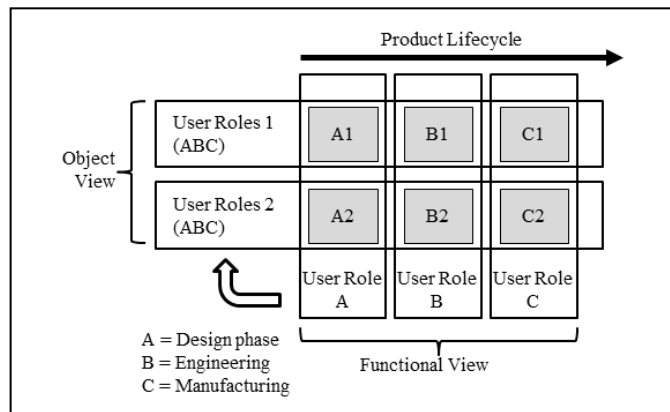


Figure 4. Shifted data view depending on the user role.

Through a new perspective, a new View for the user must be declared, which is specified by a viewpoint. The viewpoint restricted the amount of data through rules and patterns. For example, the viewpoint can be specified for the case that the View is based on an individual project or the entire product. Likewise, the viewpoint can be also defined so that the user themselves is used as a starting point to track the activities of other users. Other conceivable examples could be chronologically presented public discussions, meetings and e-mail traffic in the PDM system.

#### IV. THE DESIGN FOR AN ARCHITECTURAL APPROACH

The three-tier architecture consists of the following three components (see Figure 5): (1) The *Visualization* to display the information, (2) The *Information Collector* provides the logic and (3) the *PDM collector* for the extraction of data from the *PDM System*.

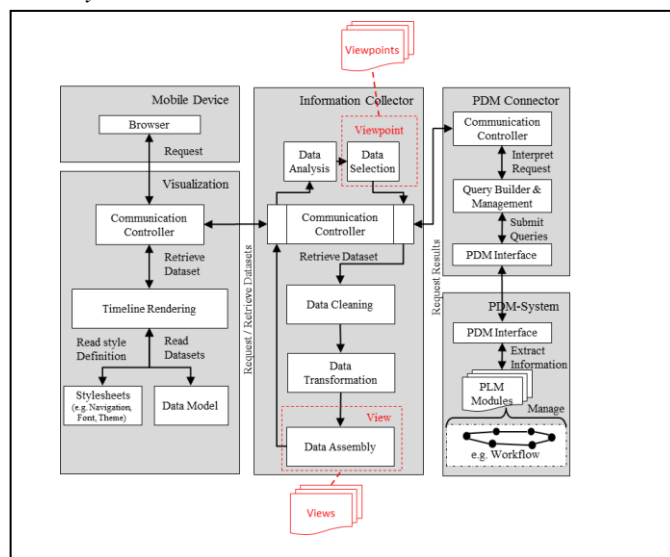


Figure 5. Architecture.

#### A. Components

1) The *Visualization* is responsible for the presentation of information. As a first step, a HTTP request is sent to the Information Collector to get the required data for the representation. In response the corresponding amount of data is returned in the appropriate format which is used by the visualization. JSON has been proven as a conventional data interchange format for structured information. All relevant information for the virtualization is provided in the required data format to focus only on the user experiences. The visualization focuses on the implementation of the content display by the web browser (rendering), the navigation between the chronologically arranged activities as well as the loading of data objects. Moreover, the loading of other data objects would reduce the amount of transferred data in terms of mobile use.

2) The *Information Collector* receives the incoming requests from visualization frontend and interprets the parameters to select the amount of data based on the defined user's viewpoint. The viewpoint specifies the selected data volume, which is applied for the corresponding view. Following sample attributes are specified to the viewpoint:

##### Basic fields

- Name: Project Space Tracking
- Assigned View: Timeline View
- Owner: John Doe
- Language: JSON

##### Data specification fields

- Location Code: DE
- Brand Name: Automotive
- Program Name: Coupe 700
- Data Attribute Selection: Name, Description, Status
- Data Limitation Clause 1: Limited to Design Department
- Data Limitation Clause 2: In the period from 2009 to 2013

The specific request is submitted to the PDM Connector, which an answer to the corresponding data is returned. The response from the PDM connector contains the requested data in the PDM-specific data format. Due to the predefined data structure of the PDM system, the returned data are predominantly of high quality, so that no contradictory or redundant data are to be expected.

The Information Collector filters out irrelevant information and converts into a format that is needed for the visualization frontend. Subsequently the collection of information in so-called Activity boxes (table 2) is performed as shown in figure 6 for a document type .

```
"asset":
{
  "media":"http://server/text.doc",
  "caption":"Verify this document"
}

"asset":
{
  "media":"http://server/wheel.png",
  "caption":"Notice my red marks",
  "thumbnail":"optional-24x24px.jpg"
}
```

Figure 6. Media declaration in JSON format.

3) The PDM Connector has the task of the agent to manage an incoming request from the Information Collector as well as formulate the database query and to deliver the results back. A request contains all necessary information of the viewpoint to create and submit a query to the database. This component is also responsible to performing the authentication against the PDM system. The PDM Connector uses proprietary libraries provided by the PDM manufacturers to communicate to the respective PDM system. JSON is used as data format for the communication with the Information Collector.

#### B. Data Exchange

For data exchange JSON (JavaScript Object Notation) is used. JSON is a simple structured Human-Readable Text format which is encoded by default in UTF<sup>3</sup>-8. The data can be nested, as well as data types such as objects and arrays are supported. The syntax of JSON has a lower overhead compared to XML<sup>4</sup>.

In a comparative study of the two data formats, JSON showed more efficient performance as XML, in which the efficiency is significantly affected by such factors as the number of retrieved objects as well as the implemented data structure [19]. These JSON properties are especially beneficial for mobile users because a smaller amount of data needs to be transmitted, and thus the battery of the mobile device will be less burdened [20].

The JSON communication between the visualization frontend and the Information Collector is depending on the JSON notation which is dictated by the frontend. In addition to the data objects for the visualization of information, additional configuration parameters can be declared for the behavior of the timeline. Thereby configuration parameters determine the context in which the data objects will be presented. For example, the parameters affect within which period of time the information will be displayed or which styling for the timeline and the front cover should be assigned. Figure 7 illustrates the declaration of the data objects for the JSON data format.

```
{
  "timeline":
  {
    "headline":"PLM Timeline for Project X",
    "type":"default",
    "startDate":"2013,10,28",
    "text":"<p>Project description</p>",
    "date": [
      {
        "startDate":"2013,10,28",
        "headline":"Task 'Review geometry'",
        "text":"<p>This task has been assigned to person John Doe and is under review.</p>",
        "asset":
        {
          "media":"http://server/text.doc",
          "caption":"Verify this document"
        }
      }
    ]
  }
}
```

Figure 7. JSON request performed by the timeline visualization.

In the above example, firstly the options for the timeline are set under the key "timeline". The section "date" contains the declaration of the data objects in the array of objects.

#### C. Filter to reduce the data quantity

For mobile devices is the selection of data objects in addition to reducing the volume of data a benefit of clarity. Without limiting the amount of data a primary advantage of the timeline would be lost.

Miles and Huberman [31] present in their sourcebook multiple analytic techniques and ideas. Thus, they address the complexity of a chronological timeline that is caused by a variety of events. The risk presented will result that the event flow can no longer be understood in its fullness by sorting out events from different domains or a misleading importance of preceding events on following events.

The selection of attributes must be based on the user's perspective. Users are mainly interested in information about their own context as well as contextual information of third parties which have certain relevance. For example, a user in the field engineer could be interested in information about: What are the tasks that need to be done with the respective dates; which status changes have occurred in other areas of the product development process; if changes in requirements management are present or which tasks have colleagues in the personal surroundings.

#### D. Data conversion

Extracted data from the PDM connector are in a raw state, with the result that a conversion is necessary for the visualization. The conversion process has the aim of converting the raw data into the required format of the visualization data. The tasks include the date conversion, the extraction of sub-strings as well as other data types and string operations.

<sup>3</sup> Unicode Transformation Format

<sup>4</sup> Extensible Markup Language

Since an Activity box can also include files (e.g. delection files), they must be accessible and readable for the user of the timeline. While the PDM system is responsible for managing the externally generated distribution files, a conversion of the content from a CAD format to a neutral or lightweight version is not usual for this architectural approach.

A comparison of the formats is discussed in [5, 13]. A selection of web-based 3D viewers already exist for CAD formats including CATIA and Pro-E [6], for neutral formats like STEP and IGES [6, 10], as well as lightweight formats such as DWG [6, 9], JT [6, 8] and 3DXML [7].

In order to view these formats in a browser, the viewer must be installed mostly in the form of a browser plug-ins. Due to the variety of mobile platforms and browsers the use of a browser plug-in is not always possible for mobile users, so that a file download for local viewing through Apps [11] is necessary.



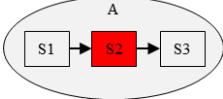
### E. Composition of the information

The composition is the task of the Information Collector which is based on the defined View with the defined rules set in the related viewpoint. The combination of information to an Activity box, as is the case with the selection of the attributes, depends on the *Data Specifications Fields* defined in the user's viewpoint.

The perspective on compiled information can give conclusions on timing related activities in the life cycle and allows a chronological assessment of the object relationships as well as other involved objects in the life cycle. The collection of information is an important task, since this merged information is presented in the timeline to the user. While there is a relation between the presented information, the data objects must be connected by way of a respective logic. The examples in table 3 are intended to illustrate the requirements for such specific logic.

Firstly the perspective of the user must be clarified for the generation of text phrases in order to subsequently identify possible combinations to the relevant information. Secondly, the information must be linked over the relationships to other objects.

TABLE III. LOGIC FOR INFORMATION PRESENTATION

Generic	Example	Illustration
Object A has entered a relationship to object B	Document A.doc was added to the workspace B	
Object A has changed the revision from X to Y	Document A.doc has been updated	
Object status was changed from „Assigned“ into „Review“	Part A was promoted to the review process and is ready for review by Person A	

### F. Limitations

In the object-based data view, two limitations have been identified, which may negatively influence the perspective on the data for the user.

1) *Complex data structures*: Simple-structured data can be easily visualized in contrast to complex data structures. Complex data structures like those found in the Engineering Change Management (ECM) are difficult to visualize. Engineering Changes (ECs) can claim any size and type as well as any number of people can be involved in any arbitrarily long time to complete a task [3]. Therefore, ECs should be taken into consideration to make a first preselection to separate the important attributes (e.g. EC name and people) from less relevant attributes (e.g. document size and type).

For Bill of Material (BOM), as with the ECs, can have complex data structures with a variety of relationships. The structure of the BOM is dependent on the industry. For instance, the automotive industry and aerospace are using mostly modular BOMs with an emphasis on traceability whereas the shipbuilding industry tends to use BOMs with less variant traceability [4]. Therefore, complex data structures need to be transformed into simple structured data for these areas. This reduction of the data can influence the perspective negatively, when information is presented in an incomplete or wrong context.

2) *Information Overload*: The second limitation is talking about a flood of data. Too much information can heavily impair the clarity for the user, so that relevant information can no longer be recognized. In addition, a mobile user is limited with a smaller display of his mobile device. Intelligent solutions that support the downloading of information on user's demand would mitigate this issue. Furthermore, the visualization could support the user with navigation functions through data objects. Filtering by object types, properties and content could support the reduction of the amount of data. Nevertheless, the object-based approach should focus on presenting only distinctive information so that the clarity is maintained even without the support of visualization.

### V. SURVEY

The proposed architecture has been implemented by a prototype. As visualization frontend was chosen the TimelineJS by VeriteCo [21], which is subject to the Mozilla Public License. This frontend provides JSON as data format as well as Google Docs [22]. During the implementation JSON was used as an exchange format for data objects. JSON has been also used for the communication between the Information Collector and the PDM connector. PDM system Enovia V6 was used and prepared with test data sets to visualize data objects on the timeline. Figure 8 shows the prototype and its functions.

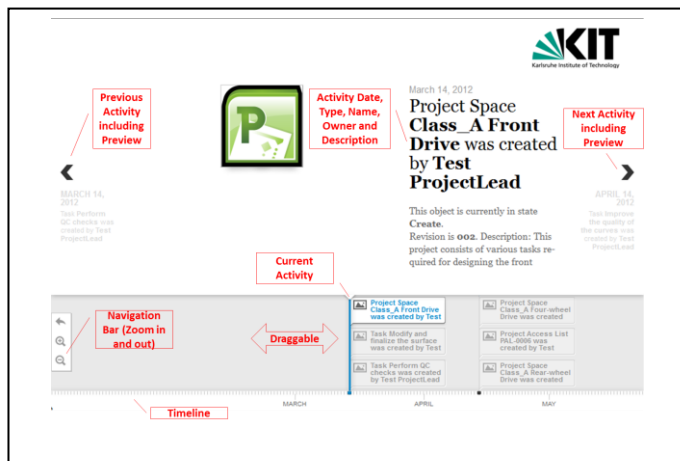


Figure 8. Prototype: Object view for PDM information by a timeline.

First survey was carried out in order to gain the initial experience of the user. The results of the survey should determine if a benefit to the user may result from the combination of information as well as what types of information linking deliver benefits to the user. The survey was covered with 10 subjects among people aged between 30 to 55 years. 80% of subjects were male. The investigation was limited to the presentation and use of the prototype in the test field.

The results showed that 80% of subjects were able to derive a benefit from the linked information in a timeline. 60% of participants indicated a unified information interface from different areas of the life cycle valuable. A deeper link between the information collected across the various data areas of the PDM system was noted by participants as an additional benefit.

A new visualization frontend could base on online analytical processing (OLAP) as a cube with multiple dimensions to meet the demands of an ever greater information networking (Figure 9). One dimension could be the stages of a product lifecycle, a second dimension could represent the timeline and the last one could be represented by the users, groups or department. OLAP offers multiple basic operations like slicing, dicing, pivoting, drill operations as well as many others for analysis purposes.

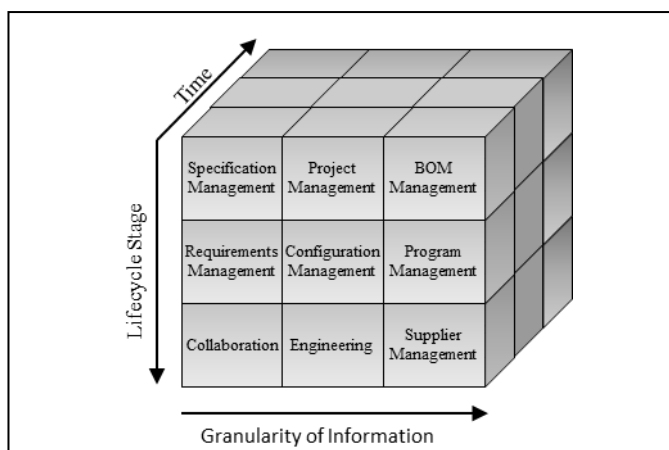


Figure 9. OLAP cube as visualization frontend.

## CONCLUSIONS AND FUTURE WORKS

A timeline for PDM information allows a better view of related information in a chronological arrangement in real-time. Information can be better interpreted by the user to visualize and promote a better understanding of process structures and workflows. The developed architecture is extensible and is not limited to PDM systems or specific visualization front ends. The architecture would be also suitable for ERP<sup>5</sup> and CMMS<sup>6</sup> software.

Nowadays, the relationship between objects is perceived, but is not understood in the appropriate context by the Information Collector. At present, the right context must be interpreted and assigned by the user itself. Further research should focus on methods of enhanced and automated interpretation of the relationships between objects to process the conjunct information in an entire story supported by a timeline. Also the representation of newly created types of objects and relations should be taken into consideration.

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<sup>5</sup> Enterprise Resource Planning

<sup>6</sup> Computerized Maintenance Management System

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# Web-Based Monitoring and Evaluation

## Research Activity Assessment Case Study

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**Abstract—** The work is devoted to issues of monitoring and evaluation system development. It is suggested to use the web as the source of data for monitoring. The assessment of web-based indicators for monitoring is realized with the help of Rasch model. The application of suggested approach is illustrated by the case study of universities research activity assessment.

**Keywords-** monitoring and evaluation; web mining; research activity; information system; Rasch model

### I. INTRODUCTION

Nowadays any enterprise's functioning requires some control and audit activities. They provide management with information about success or failure of the development strategy. This can be achieved by continuous monitoring and evaluation (M&E) of enterprise's work.

This work is devoted to monitoring issues of research quality in higher education establishments (HEE). Generally the scope of our interest covers the usage of information technologies (IT) for quality management in HEE.

As everyone knows, HEE has many directions of its functioning. This includes the basic ones (educational process and scientific researches) and a number of supporting and organizational processes. In this work we consider research activities as those which define the place of HEE in the world scientific society. The results of researches are expressed in different ways. Scientists highlight the benefits of their results and experience participating in the conferences and workshops and publishing papers.

Nowadays to manage conferences and publications scientists often use web resources, since they make all up-to-minute information available for everybody. Therefore we suppose that HEE research activity can be estimated based on data located on the web.

The goal of our research is development of web-based monitoring IT. Such IT system must support the search of appropriate data on the web and its processing. Not only the HEE research activity is represented on the Internet, but the enterprises highlight their outcomes on the web as well. Therefore we suppose that the suggested approach may be useful not only for monitoring of HEE's academic and research activities, but also for enterprise functioning M&E.

The rest of the paper is organized in the following way. Section 2 describes the stages of M&E, methods of data

collection and processing. Section 3 represents the reference model of web-based M&E. The case study of the suggested approach is given in section 4. The conclusions and future work directions are presented in section 5.

### II. ISSUES OF MONITORING AND EVALUATION SYSTEM DEVELOPMENT

There are two basic types of M&E: implementation-focused and results-based [1]. In the given work we consider the second one. Results-based M&E is a powerful tool that management can use to measure outcomes and feed the obtained information back into the process of decision-making. We can distinguish the following common steps: readiness assessment, agreeing on goals and outcomes, selecting key indicators to monitor, determining baseline data on indicators, planning for improvement, monitoring and evaluation themselves, reporting and using findings. During readiness assessment we explore which existing resources can be used for establishing M&E system. The next step supposes that long-term goals, corresponding outcomes and short-term targets have to be defined. Key indicators must be monitorable, clear, relevant, economic and adequate. To determine baseline data collection methods are chosen and the current situation is evaluated. Planning for improvement provides us with target performance which is the baseline plus desired level of improvement. Monitoring means continuous collection of data on defined indicators. The gathered data must be reliable and valid. Evaluation provides data that explain managers why the goal has or has not been achieved.

Traditionally such data collection methods as official records review, interviews, observations and surveys are applied for M&E [2]. Most of the mentioned methods intend some kind of communication with enterprise's employees. To organize interviews and surveys the questionnaires must be prepared and some trained people must conduct them. Often special experts and organizations profiled on sociological researches are involved in this process. To support review of official records analyst's facilities become necessary. In all cases this requires human resources, time, and financial expenses.

Monitoring activities provide a large amount of data that are usually processed with the help of statistical methods. Different types of statistical analysis allow defining central moments and parameters of distribution laws for collected data.

This includes factor, correlation, variance, discriminant analyses [3].

There are some problems in organization of M&E system. Often the outcomes of some enterprise's policy are reflected in some implicit data that can't be observed directly. To analyze such data special techniques have to be applied. Methods of data collection have some constraints, therefore they should be improved. Generally M&E requires automation, for this purpose M&E information system (IS) must be elaborated.

### III. WEB-BASED MONITORING AND EVALUATION REFERENCE MODEL

The traditional sources of data for M&E include the administrative data, results of interviews, direct observations and surveys. Generally all data sources can be classified into external and internal for the targeted system, primary and secondary, quantitative and qualitative, discrete and continuous, structured and unstructured. In this work we suggest to use the Internet as the external source of heterogeneous data which continuously change (are included, updated or removed from the web) and are stored in a structured or unstructured form depending on the particular web page. First of all it can be noticed that traditional sources are already presented on the web. The results of surveys, some administrative data are published on special web sites. And on the other hand the Internet stores huge amount of information that implicitly reflects the outcomes of enterprise's work. So the outcomes are evinced on the web in different forms. The implicit data stored on the Internet can be used to construct the indicators of outcomes. To gather such data web mining techniques are applied. Web content mining implies extraction of useful data, information and knowledge from web page contents.

We suggest the following reference model of the web-based monitoring and evaluation (fig. 1).

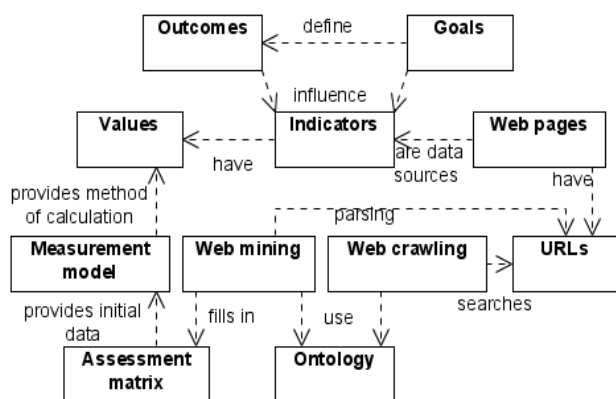


Figure 1. Reference model of web-based M&E

Based on goals and outcomes of system functioning the indicators of its progress are defined. Since we are talking about web-based M&E, the sources of data are web pages. The result of web crawling is the collection of all URLs where necessary information may be located. To extract that information web mining is used. It provides methods and algorithms for searching particular words and phrases on the

web pages. The ontology defines the direction of search. The results of web mining techniques application are assessment matrices which reflect the presence of definite terms on particular web pages. The values of indicators are calculated based on the obtained assessment matrices and measurement model.

To find the web pages web crawling is applied. When the seed is processed, it takes one web page from the frontier and the process is repeated recursively (fig. 2). The order in which a web crawler visits pages from the frontier is defined by the crawling algorithm. In our work we use the breadth-first algorithm [4]. The next step is indexing of stored content. The result of indexing is term-by-document matrix.

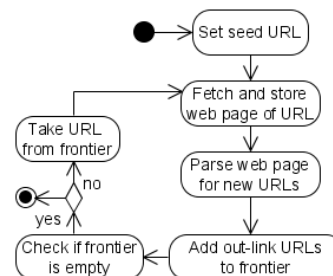


Figure 2. Web crawling activity

When the relevant pages are determined, we can extract the necessary data from them to fill in the indicators with values. The indicators' values form the initial data for evaluation.

We suggest the following framework for estimation of indicators. We assume that the indicators are latent and can't be observed explicitly. Ontology can be helpful when there is a need to define a common vocabulary of terms in investigated domain. We suppose that the probability of appearance of terms on web pages is connected with indicator's value. Therefore to estimate indicators we suggest to use Rasch model [5].

In the beginning we need to form the assessment matrix  $N \times M$  with elements  $x_{ij} = \{0,1\}$ , where  $i \in \overline{1, N}$  is the term from the ontology and  $j \in \overline{1, M}$  is the targeted web page.  $x_{ij}$  is equal to 1, if the i-th term is present on j-th web page, otherwise it equals 0. The indicator's value is defined from the following dependency:

$$P(x_{ij} = 1 | \theta_i, \beta_j) = \frac{\exp(\theta_i - \beta_j)}{1 + \exp(\theta_i - \beta_j)},$$

where  $P(x_{ij})$  is probability of presence of i-th term at j-th web page;  $\theta_i$  is a value of i-th indicator associated with i-th term;  $\beta_j$  is difficulty of j-th web page.

Both parameters of Rasch model are measured in logits [5]. Initial estimates are calculated by PROX algorithm for Rasch model parameters estimation [6]. The final estimates are obtained by adjusting initial ones with the help of maximum likelihood estimation procedure. The reliability of obtained estimates is confirmed by KR20 reliability coefficient [6].

#### IV. CASE STUDY

In the given work we consider monitoring and evaluation in HEE. In different HEEs M&E are organized in different ways. The accounting activities are common to any university. HEEs collect data about its students and their progress in studies, about the staff and their results of work and much more data on financial operations. For today all modern universities have IS that support administrative data collection, analysis and either centralized or distributed storage [7]. Such IS may totally cover all activities in HEE or support the work of particular departments and offices.

Another kind of M&E is HEEs ratings. Many non-governmental and non-profit organizations make ratings of the universities worldwide [8]. Such ratings consider all aspects of HEE's work. The following criteria are often used to evaluate HEE: teaching and research quality, level of graduates employment, resources and infrastructure quality, international cooperation and knowledge transfer, etc. The problem is to estimate these criteria. Since they have different nature, different methods are applied for this purpose. For example, calculation of citation indexes (which is statistical processing of data from bibliographic databases like Scopus) requires the high quality of input data, including its availability, timeliness and reliability. Employers community surveys concerning HEE reputation and students surveys about their satisfaction also use statistical data processing and in this case the main problems are the sample volume, uncertainty measurement and reliability estimation. Some criteria are estimated via expert methods which obvious disadvantages are experts' subjectivity, competency level and efficient organization of the work of experts' group in the case of collective methods. When the values of all criteria are known the final step is to obtain the comprehensive university's score – a single number which defines its place in the rating. The most common method is to use weighted means. The problem here is to define weight coefficients. And again usually experts methods are used which disadvantages were mentioned above.

Public organizations and universities by themselves often conduct different polls and questionnaire surveys for students and staff [9]. The obtained estimates are used by HEE management to improve the program, policy and strategy.

In this work we consider the web as the source of data for M&E in HEE. The data that characterize the outcomes of HEE work are presented in the ratings, news, blogs, job offer and CVs web sites, corporative web sites, social networks and so on.

We pay attention to research activity monitoring in HEE. We consider the part of research activities connected with conferences carrying out. In this case the indicators of high research quality may be the following: the number of persons from particular HEE who participate in the conference, who are present in the organization committees and technical program committees, the number of conferences in which HEE members take part, the level of those conferences according to the ratings. These indicators can be considered dynamically from year to year.

As an example we consider the assessment of indicator called Level of Activity in Conferences Organization (LACO). Usually each conference on its web site has some web pages devoted to organization, technical program, workshops, tutorial and other committees. There are the lists of persons who are the chairs and the members of the committee. As a rule the person's name is followed by the affiliation and the country. So we can find out names of HEEs which take an active part in conferences organization.

To extract data about conference's committee's members we implement the web crawler which has to perform in the following way. The seed web page is the page with the list of conferences. With the help of querying we define the presence of web pages where we can find conference name, words "program committee", "technical program committee", "organization committee" and the name of HEE. If such page exists, we can make a conclusion that the HEE takes part in conference organization.

In the given work we take top 50 universities in computer sciences according to world rating [10]. The list of conferences includes top 25 conferences in computer sciences according to rating [11]. We form the assessment matrix in which  $X_{ij}$  is equal to 1, if the name of  $i$ -th HEE is mentioned at least once in any committee of  $j$ -th conference, and 0 – otherwise. The frequency histogram of HEEs scores is represented on fig. 3.

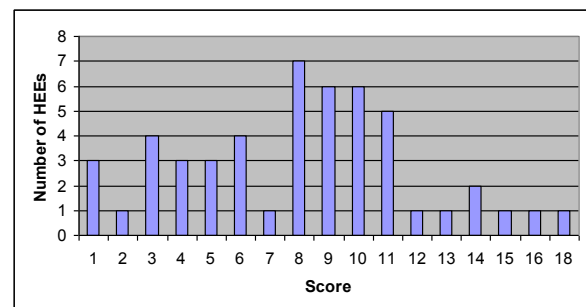


Figure 3. HEEs scores frequency

According to Rasch model the LACO estimates of 50 HEEs were calculated. The total score, presence rate, initial and final LACO estimates and standard errors (SE) for the first 10 universities are given in Table 1. Maximal, minimal and mean values of LACO, its variance (Var), standard deviation (SD) and mean standard error are presented in Table 2.

Reliability of the obtained results is shown in Table 3. Separation indexes and separation reliability for HEEs (PSI and PSR) and conferences (ISI and ISR) are presented there.

The domain of definition of LACO varies from -5 to 5 logits according to Rasch model. Generally we can see that universities internationally recognized as leaders in computer sciences demonstrate high results in research activity. The current research shows the difference in arrangement of HEEs because the official rating includes different criteria for estimation, not only research quality. We consider only activity in conferences organization which may be one particular indicator of the research quality.

TABLE I. LACO ESTIMATION (FRAGMENT)

HEE	Score	Presence rate	Initial $\theta$ , logits	Final $\theta$ , logits	SE
Massachusetts Institute of Technology	14	0.56	0,24	0.27	0.44
Stanford University	14	0.56	0,24	0.27	0.44
Carnegie Mellon University	16	0.64	0,57	0.68	0.46
University of California, Berkeley	9	0.36	-0,57	-0.7	0.45
Harvard University	6	0.24	-1,15	-1.36	0.5
University of Oxford	8	0.32	-0,75	-0.9	0.46
University of Cambridge	9	0.36	-0,57	-0.7	0.45
ETH Zurich	10	0.4	-0,41	-0.5	0.44
National University of Singapore	11	0.44	-0,24	-0.3	0.44
Princeton University	5	0.2	-1,39	-1.63	0.53

TABLE II. ANALYSIS OF LACO ESTIMATION

Max $\theta$ , logits	Min $\theta$ , logits	Mean $\theta$ , logits	Var $\theta$	SE $\theta$	Mean SE
1,12	-3,56	-1,04	1,08	1,04	0,52

TABLE III. RELIABILITY ESTIMATION

PSI	PSR	ISI	ISR
1,53	0,7	2,33	0,84

## V. CONCLUSIONS AND FUTURE WORK

The given work provides the idea of introduction of web mining techniques into traditional M&E activities that are already organized in universities worldwide. Since the Internet is a huge and open source of data of different sort, we suggest to extract the useful data and based on it make analysis of some indicators. To start with we propose to estimate research activity of HEEs. Obviously data about achievements of scientists from different universities are presented on the Internet. In particular the lists of members of conferences committees are usually available in the full or cut form. To mine these data we need a web crawler which searches for targeted web pages and makes their indexing. To process the data obtained from the web we use Rasch model.

The obtained estimates of research activity express only one aspect of HEE's research quality connected with efforts in conferences organization. They can be used in M&E to assess the university's policy concerning science promotion. These estimates are the values of research activity indicator which should be considered together with the set of indicators that characterize research quality. Data on these indicators must be

collected within HEE's M&E information system. Also the indicator of such kind may be used in universities ratings construction as one of possible criteria for assessment.

As the extension of the introduced idea we suggest to investigate the variation of research activity estimates in time. Often we can find the data about the previous conferences of the last up to ten years on the conferences' web sites. So it is possible to screen how the university's activity changes over time. Based on this the conclusions about success of HEE's strategy can be made. Another proposal is to research the activity of authors from specified university by analyzing the presence of their works in the collection of abstracts of some conference, which also may be available on the conference web site.

Generally by the presence of university's name in different ratings, news and articles on the Internet we may infer about the quality of the provided education and research work. Such kind of research requires more complex web mining techniques to analyze web content. Exactly this can be specified as one of the future directions of our work.

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# Plate recognition algorithm for ITV spanish system by mathematical morphology

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**Abstract**—This paper presents a new method for the automatic recognition of number plates of vehicles by means mathematical morphology. Our method provides the number extraction of the vehicle independent of light conditions, color, size and the inclination (angle) of the plate number. The algorithm recognizes quickly and correctly the number plates of vehicles of European Union. The pattern learning of mathematical skeletons has high efficiency in the process. The performance of the algorithm has been tested on a Spanish ITV system.

**Keywords**- License plate recognition; mathematical morphology, ITV system.

## I. INTRODUCTION

Number plate recognition is playing an important role in image processing field. The fundamental issue in number recognition is the shape analysis. Many methods on shape analysis have been seen in the past ten years such as methods using Morphological Functions [1], methods based on gradient propagation [2] and methods by comparing weighted shape graphs [3]. Many other techniques such as Fourier description, template matching [4], mathematical morphology and neural network [5] are also used for shape analysis. All these methods require a precise angle of image acquisition. The algorithm proposed in this paper is designed to recognize in real time the license plates of vehicles by means mathematical morphology and specifically, using skeletons which are add in a database. These skeletons are no angle sensitive.

We have tested the new algorithm in a Technical Inspection Vehicles system (ITV), where vehicles are checked for driving on Spanish roads.

The organization of the paper is as follows: section 2 deals with the processes of plate localization and extraction. Section 3 deals with the character recognition based on skeletons of mathematical morphology and a pattern-learning algorithm. Section 4 discusses experimental results and the paper concludes with section 5.

## II. EXTRACTION OF VEHICLE PLATE NUMBER

The first stage of the process is to locate the license plate area in the input photo. In order to do so, we need to emphasize regions of high spatial frequency that correspond to edges (image enhancement). In the European Union, the characters of the plate license are black on a white or yellow, as we can see in Figure 1.



Figure 1. Common license plates in the European Union. (a) Italy, (b) Spain, (c) UK, (d) Netherlands, (e) Portugal and France (f).

We apply the same technique of Karim *et al.* in [5] to locate the plate area, but using a new morphological enhancement, which consists in a Top-hat contrast operation [6] applied to the grayscale image of the car.

The white Top-hat (wth) is added to the original image to enhance bright objects and the black top-hat (bth) is subtracted from the resulting image to enhance dark objects. We denote this top-hat operator by  $k^{TH}$ . Next in the process is the binarization (Figure 2.b).

$$k^{TH} = f + WTH - BTH = 3f - \phi - \gamma \quad (1)$$

where  $\phi$  and  $\gamma$  correspond to the classical morphological operators of closing and opening, respectively [7].

Finally, we use a morphological operation of area opening to select the plate area (by size) and delete the rest of false positives (lights, car logo, etc.). The resulting image of area opening will be the marker that identifies the plate license area or region of interest, ROI (Figure 2.c). This operation consists in removing all connected components whose area in number of pixels is smaller than a threshold value  $\lambda$ :

$$\gamma_{\lambda} = \bigvee_i \{ \gamma_{B_i} \mid B_i \subseteq B \text{ and } \text{card}(B_i) = \lambda \} \quad (2)$$

where  $\lambda$  is the specified area (parameter depending on the image capture).

Once we have identified the correct plate region (ROI), the next is to identify numbers and letters in the plate license [7, 8]. We use color information to eliminate the areas with at least 50% of high saturation pixels. This area corresponds to the blue European Union logo. Next, the morphological operation of opening  $\gamma$  allows us to eliminate the small spots between the numbers of the plate [9]. In Figure 2.d we can see the result of this stage of the algorithm.

We achieve speed up the process of identification the plate area using this mathematical morphology technique, compared to other detection techniques of plate number recognition. We reduce up to 15% of time on this stage.

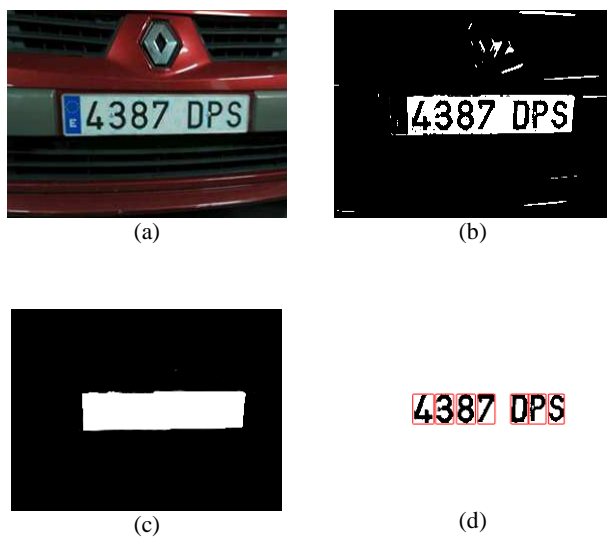


Figure 2. . Plate selection in Spanish vehicle. (a) Original image. (b) Binarized image of top-hat contrast. (c) Marker image for processing (ROI). Area opening of plate license. (d) License plate after eliminating anything that does not correspond with characters.

### III. CHARACTER SEGMENTATION AND RECOGNITION

In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining the characters individually. The recognition of the number plates is developed based on the morphological operators of hit/miss transformation of skeleton (medial axis transform). We use the mathematical procedure called homotopic marking, which means reducing an image to the smallest possible information while preserving the homotopy of the input image [7]. We avoid the typical mistakes present in classic pattern recognition [10, 11] because our skeletons are no angle sensitive. Small variations of these skeletons will be dynamically added to a database.

Usually, a homotopic marking is not preserving enough information about the shape of the input pattern. A solution to this problem is to predefine a set of pixels that should belong to the skeleton. By definition, these pixels are non-deletable and cannot be thinned when performing homotopic thinnings until idempotence. It follows that the resulting skeleton is anchored

to these predefined pixels. They are therefore called “anchor points”. A classical set of anchor points consists of the centers of maximal discs or equivalently, the skeleton by opening. This ensures that the obtained skeleton is suited for the reconstruction of the original image. When processing a binary set, the anchor points should be selected in accordance with the connectivity used for the foreground pixel. The skeleton gets a simpler structure by using the ultimate eroded set or, equivalently, the regional maxima of the distance as anchor points [6]:

$$SK(f) = \bigcup_{\lambda \geq 1} \{ \mathcal{E}_{\lambda B}(f) \setminus \gamma_B[\mathcal{E}_{\lambda B}(f)] \} \quad (3)$$

where  $B$  is the elementary square 8-connected ( $3 \times 3$ ) and  $\lambda B$  is a square of  $(\lambda=2) 5 \times 5$ ,  $(\lambda=3) 7 \times 7$ ,  $(\lambda=4) 9 \times 9$ , etc.

Note that Eq. 3 corresponds to the union of the white top-hats of successive erosions of the original set. Figure 3 shows the morphological skeleton (medial axis) of plate characters. The identification of points critical to shape representation, and the identification of further points necessary to preserve homotopy is guaranteed.

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Figure 3. Homotopic marking of plate license: morphological skeleton of characters.

The final step of the algorithm is template matching. In our case, data mining uses pattern recognition. The skeleton image is compared with the ones in the database and the best similarity is measured. To measure the similarity and find the best match, statistical method correlation is used [12]. The correlation is an effective technique for image recognition, which was developed by Horowitz [13]. The capabilities of this operator in detecting patterns with specific geometric properties has been used to teach the algorithm to reduce his complexity: since there are two signals as unknown input skeleton and known database skeleton in this system, a particular and efficient cross-correlation is used. Let  $f_1(j,k)$  and  $f_2(j,k)$  represent two discrete skeleton denoting the skeleton to be searched and the template respectively. The normalized cross-correlation used in our algorithm is defined as:

$$R(m,n) = \frac{\sum \sum f_{1(j,k)} f_2(j-m+(M+1)/2, k-n+(N+1)/2)}{\left[ \sum \sum f_{1(j,k)}^2 \right]^{1/2} \left[ \sum \sum f_2(j-m+(M+1)/2, k-n+(N+1)/2)^2 \right]^{1/2}} \quad (4)$$

for  $m=1,2,\dots,M$  and  $n=1,2,\dots,N$ , where  $M$  and  $N$  are the size (height x width) of all skeletons. In our case, the database works with 33 sets of alphanumeric skeletons of characters (23 alphabets and 10 numerals) with the size of  $M=36$  and  $N=18$  pixels. These sets contain hundreds of pattern variations of valid skeletons of characters.

#### IV. EXPERIMENTAL RESULTS OF THE ALGORITHM

Experiments have been performed to test the proposed system. The system is designed in software Matlab 7 for recognition of European license plates (Figure 4). The images used for this work have been 75 RGB images of 1400x1200. The images were acquired from a ITV system in Alicante city (Spain), at different lightning conditions and angle position of cars, with respect to the digital camera.

Table 1 gives the experiment results. The results report a high accuracy rate above 96% for extraction plate and 95% for the correct identification of the plate numbers. Our data mining achieves a complexity reduction with respect to others plate recognition methods. In order to speed up morphological operations with respect to commonly used, large, convex structuring elements, and logarithmic decomposition of structuring elements are used [14]. Experiments indicate that the new algorithms are more than 30 times faster for pixelwise operations and about an order of magnitude faster for the basic morphological transforms than the fastest known software implementations.



Figure 4. License plate recognition system.

TABLE I. EXPERIMENTAL RESULTS OF OUR ALGORITHM.

Steps of the algorithm	Number of accuracy	Percentage of accuracy
Extraction of plate	68 / 75	91.3%
Segmentation	71 / 75	95.2%
Recognition	72 / 75	96%

#### V. CONCLUSIONS

This paper describes an algorithm that allows the extraction of plate license numbers of cars by means mathematical morphological. Firstly, we extracted the plate location. Next, we separated the plate characters individually. Then, we obtained the character skeletons and finally, we applied a

template matching of character skeletons for the recognition of plate license numbers (by machine learning). The main advantage of our algorithm is the high accuracy of the technique that works irrespective of the color, size, location, and angle of the number plates.

Now, we work in the use of fuzzy morphological operator to make our approach more powerful and to reduce the processing time of the algorithm. Today, our system can be easily updated for multinational car license plates.

#### ACKNOWLEDGMENT

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# E-learning system in vocational reahabilitation

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**Abstract**—this article presents the text to speech (and speech to text) benefits for e-education in a case vocational rehabilitation. Analysis consists of several parts: the human need analysis, e-learning system adaptation.

**Keywords**- formatting; e-learning; text to speech, vocational rehabilitation

## I. INTRODUCTION

Making lifelong learning and mobility a reality by implementing lifelong learning strategies, by developing qualifications frameworks and measures to enable more flexible learning pathways, and by promoting learning mobility of all learners.[2] This is a set of principles for institutions that are "Lifelong learning programme" participants.

This article is emphasized "more flexible learning pathways" part. The following article is a brief description of the vocational rehabilitation of the performance-determining participants need. It also describes the software and hardware required of pilot test for the participants with disability, e-learning system adaptation steps and technical solutions.

## II. NEEDS ANALYSIS

### A. E-learning 'Sub-script'

Vocational rehabilitation was carried out in a pilot test of the e-learning system "Sub-script. People with vision, movement, intelligence, mental disability tried to do the following steps to find the self-study courses. Following are the results of the pilot test-feedback interference solutions that can help to get the required information in the e-learning system.

### B. Distance Learning System Management User Access

"D. Leclercq and M. Poumay (2003) proposed distance learning criteria divided into four groups. Second important criterion is the technical aspects.'[4] The following sections focus on the technical aspect. The survey results show that the standard system of distance learning system is not suitable for people with disabilities. 'Sub-script' is being developed and tested in several countries. All the participants in a rehabilitation centre customers with hearing, vision, movement, and mental disability. All was explained by Sub-script intended use of the system. The following images (Figure1. and Figure2. ) is a system interface used by the participant. 'Courfiner' is part of searching learning course; 'My Portfolio' is part of personal information.



Figure 1. Sub-script system main parts

Figure 2. Sub-script system registration

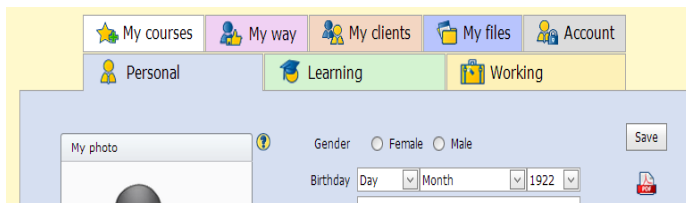


Figure 3. Sub-script system user portfolio

Registered users have their own control panel (Figure. 3.). Control panel is filled within formation about user. This information is visible to potential employers or the company of training courses. Therefore, this system is also unique in the fact that potential user's employers of the system see user's learning course evaluations and recommendations.



Figure 4. Sub-script system Coursefinder

'Subs-script' part 'Coursefinder' (Figure. 4.) is used to find information about the courses. Used to filter the information and found the course. "My searching style" panel allows specify how the system is disabled by the user disability. The information can be presented in an alternative format. Different formats or manipulation of format to access information means that persons with color blindness, or sensitivity to light, for example, are able to adjust the color of text and background displays and persons with visual impairments are able to adjust the size of font.[5]

### C. Pilot Testing Reviews

Remote training system subscript has been tested in 17 people who have various health impairments. During the testing involved one hearing impaired people, four people with visually impaired, six people – with movement disabilities, six people - people with mental. 35% of respondents aged 18-25 years old, the other 65% 25-50 year of the age. 45% of the respondents said that did not understand registration fields. 35% of respondents said not find learning courses. 30% of respondents said they not understand this site.

Participants indicated personal opinion of the sub-script system's benefits (Table. 1). This table provides information as significant parts of the system. The worst rated was website part "Website customization for your disability". Five people

note that this was poor. Similarly, the assessment is part of "My portfolio content".

TABLE I. 1. DISTRIBUTION OF PARTICIPANTS' SCORES IN THE RATINGS

	Very bad	Bad	Poor	Neither good nor bad
Quality design and	2	3	4	2
Website benefits	1	3	4	2
Website customization for your disability	2	3	5	1
My portfolio content	2	3	5	1

### III. E-LEARNING SYSTEM ADAPTING

#### A. For People With Mental and Intellectual Disabilities

One disadvantage of a system was incomprehensible registration form. Technical solution is to insert an audio file on the remote control next to the course registration window. Recorded voice explains what purpose and how to fill registration fields. In order to realize this solution can be used for encoding hypertext tag '<audio>' Below (Figure5. ) is a sample code, which could be inserting near registration fields code. This solution can make more understandable registration and management fields. It is important for mental and visual impaired

```
<audio controls="controls">
  <source src="1laukelis.ogg"
  type="audio/ogg">
  <source src="1laukelis.mp3"
  type="audio/mpeg">
  element.
</audio>
```

Figure 5. HTML5 code for audio file

#### B. For People with Hearing Impaired

Technical solution for people with hearing impairments can be achieved by using java script. The following code fragment, which was accompanied by a sub-script system. First save the graphic state, then draw the border and Fill the balloon's path using the background brush.

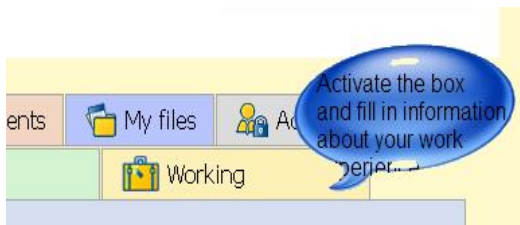


Figure 6. 'Sub-script' system adaptation solution for hearing impaired

### C. Sub-script System Orientation Tree

Navigational aids should be supplied for users with disability.[1] Theoretical sources and study participants emphasize system navigation options. This disadvantage can be improved by the development of sub-script system directory tree (Figure. 7). Seeing or reading (in case of blindness) system directory tree, users could easier understand navigation of system

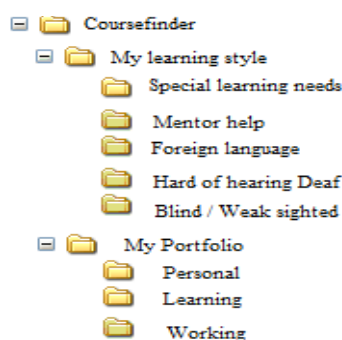


Figure 7. Sub-script system tree.

### D. Active Links for Blind Users

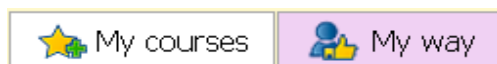
In time of pilot testing people with visually impair note that screen reading programs not recorded sound of menu column (Figure8. ) The blind people can not manage a personal portfolio section. Sound recording program for blind people can recognize and open active links. [3] This disadvantage can be fixed if menu bar text will be coding as active link (Figure 9.)



```
table border="1">
|  |
| --- |
| My courses |
| My way |

</table>
```

Figure 8. Sub-script system menu column



```
<a href="my-courses.html ">My Courses</a>
element { background-color: rgb(240, 209
border-bottom-width: 1px; border-bottom-style: solid;
border-bottom-color: rgb(168, 168, 168);
```

Figure 9. Sub-script system menu column

## IV. TEXT TO SPEECH, SPEECH TO TEXT

Text to speech, speech to text feature would be an emphasis on vision and mobility impaired people. This aided in the case when a person has extremely high level of disability, want to learn, but unable to attend the local rehabilitation center. This practice has not been tested, so the first step should be to review problems which problems that can be solved with this feature:

### A. Text to Speech, Speech to Text Pross

- Provides educational opportunities for people who do not manage the limbs.
- Provide access to education for people who do not see and do not manage the limbs (with complex disabilities)
- Can be used for people who have mental disorders (eg.: depression)

Each tested innovation raises many questions. Text to speech, speech to text the next few issues, no matches.

### B. Text to Speech, Speech to Text Cons

- Should a problem arise, if the participant is a representative of the Spanish language, and the program is in English and the participant does not understand.
- Human intervention is inevitable. Need an assistant to advice on how to use this function.
- Mentally retarded people may not understand the function of the destination.

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# Modeling of random Markov processes in view of time factor

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**Abstract** – This article is devoted to modeling of Markov processes in view of the time factor. The statements allowing investigating this case are formulated. The software package realizing the developed algorithm of modeling is created, the results of experiment are submitted.

**Keywords**- Markov process, Markov chain, modeling interval.

## I. INTRODUCTION

Nowadays the computer modeling is one of the main methods of big scientific and economic problems decision. Whereby, difficult economic systems often present themselves as *Markov process* where system conduct at the moment of time  $t_0$  are characterized by possibility of the first order  $p(x_0, t_0)$ , and system conduct afterwards depends from system value  $x_0$  and does not depend from when and how the system has become of such condition [1].

## II. MATHEMATICAL FORMULATION OF THE PROBLEM

Markov processes are described by two parameters:

- 1) Probability of the first order  $p(x_0, t_0)$ ;
- 2) Conditional probability  $p_{ij}(x_2, t_2 / x_1, t_1)$ ;

Probability  $p_{ij}$  characterizes the system value  $x_2$  at the moment of time  $t_2$  provide that the system had value  $x_1$  at the moment of time  $t_1$ . It is possible to form system conduct in advance afterwards having the conditional transfer matrix.

Markov processes are named as Markov chain with transfer probability  $p_{ij}$ , when process is studied in discrete moments of time. The main character features of Markov chains are the events probabilities  $S_i(k)$ :

$$p_i(k) = p(S_i(k)) (i = 1, \dots, n; k = 1, 2, \dots),$$

that are called as probabilities of states.

Thereby the probability of  $i$  state on  $k$  step  $p_i(k)$  there is the probability that system  $S$  from  $k$  to  $(k+1)$  step will state in

$S_i$  condition. The amount of probabilities of these events for each  $k=1, 2, \dots$  is equal to unity:

$$\sum_{i=1}^n p_i(k) = 1, k = 1, 2, \dots$$

The transfer matrix is look so:

$$P = (p_{ij})_{i,j=1}^n = \begin{pmatrix} p_{11} & p_{12} & \dots & p_{1n} \\ p_{21} & p_{22} & \dots & p_{2n} \\ \dots & \dots & \dots & \dots \\ p_{n1} & p_{n2} & \dots & p_{nn} \end{pmatrix},$$

$$\sum_{j=1}^n p_{ij} = 1, i = 1, \dots, n \quad (1)$$

If the transfer probabilities are not depended from steps  $k$ , so Markov chain is called homogeneous. If even one probability is changed with  $k$  step change the chain is called non-homogeneous. It is possible to foresee and investigate the economic system behavior using the transfer matrix provided that this system is presented by Markov processes [1, 4].

Let's consider the case when user is interested in changing states economic object chain and also in moments of time when such transfers were occurred as well as the duration of object stay in every state. Let's formulate the following statements in order to investigate of this case.

**Statement 1.** While modeling Markov chain with given chain  $k$  length of economic object states the  $T$  modeling interval may be only calculated but not set.

Let Markov chain is modeled with states  $k$  chain length  $S_1 \rightarrow S_2 \rightarrow S_i \rightarrow \dots \rightarrow S_k$ , given on Picture 1. Here  $\tau_i$  –

duration of object stay in  $S_i$  state,  $t_i$  – moment of object transfer from state  $S_i$  to  $S_{i+1}$ . It is necessary to find the duration  $\tau_i$  object state in  $S_i$  state in order to calculate  $T$  modeling interval, for example under the simple stream formula:

$$\tau_i = \frac{1}{p_{ij}} \ln(z) \quad (2)$$

where  $z$  – basic random value.

In this basis the modeling interval is calculated so:

$$T = \sum_{i=1}^k \tau_i \quad (4)$$

Therefore the statement 1 is true.

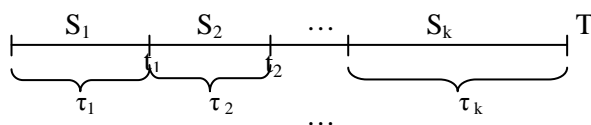


Figure 1. Markov chain state

*Statement 2.* If it is necessary to model the behaviour of economic object with given  $T$  modeling interval so the length of  $k$  Markov chain object states may be only calculated but not set.

It is necessary to perform state modeling and economic object state duration modeling in this state simultaneously in order to calculate object states  $k$  chain length. Let  $t_0=0$ , where  $t_0$  – initial moment of time,  $i=1$ , where  $i$  – chain element number. After this the economic object  $S_i$  state and object state  $\tau_i$  duration in its state is modeling. Further the moment of time  $t_i$  of object transfer from  $S_i$  state in  $S_{i+1}$  state is calculated under the following formula:

$$t_i = t_{i-1} + \tau_i$$

After this the  $t_i \leq T$  condition is checked. If the moment of object transfer from  $S_i$  state to  $S_{i+1}$  state does not exceed the modeling interval,  $S_{i+1}$ ,  $\tau_{i+1}$  new values are modeled and the  $t_{i+1}$  moment of time is calculated. If  $t_i > T$ , it means that moment of object transfer from  $S_i$  state to  $S_{i+1}$  exceeds the modeling interval. Therefore, the economic object state duration in the last  $S_i$  state is calculated in the following way:

$$\tau_i = T - t_{i-1}$$

Therefore, the  $k=i$  number – it is obtained length of Markov chain object state and it means the rightness of Statement 2.

*Statement 3.* It is possible to model  $\tau_i$  duration of object state in  $S_i$  condition or under any (the most appropriate) law (uniform, normal, exponential, linear) or with the help of events flows (the simplest flow, Palm flow, Erlang arrival).

Actually for each distribution law and for all listed flows are known the formulas of  $\tau_i$  modeling on the base of basic random series.

### III. ALGORITHM OF MODELING MARKOV CHAIN OF CONDITIONS

Let's work out the modeling algorithm based upon statements above formulated when Markov chain of states is modeled and the durations of economic object state in a certain condition are calculated.

Step 1. Set of initial data for modeling:

- $k$  – number of experiences (Markov's chain length);
- $n$  – number of system's states;
- row vector of states probabilities in initial moment of time  $t=0$ :

$$(p_1(0), \dots, p_n(0)) ;$$

- transition probabilities matrix (1).

Step 2. Initial data input and organization of its storage in data base.

Step 3. Cycle organization according to experiments number ( $i = \overline{1, k}$ ).

Step 4. Modeling of  $z$  basic random value under one of the known algorithms.

Step 5. Line choice with  $i$  number from  $p$  transition probabilities matrix.

Step 6. Modeling of  $S_j$  following state with the help of modeling method of full events group using the probabilities table:

$$\begin{pmatrix} S_1 & S_2 & S_n \\ P_{i1} & P_{i2} & P_{in} \end{pmatrix}$$

Step 7. Homogeneous Markov chain formation:  $S_i \rightarrow S_j$

Step 8.  $\tau_i$  calculation under formula (2).

Step 9. Saving of experience results in data base on the next step

Step 10. Repetition of 4 – 9 steps until cycle under the experiments number will complete.

Step 11. Delivery of homogeneous Markov chain in the form of sequence of states:

$$S_i^0 \rightarrow S_{i+1}^1 \rightarrow S_{i+2}^2 \rightarrow \dots$$

and durations of  $\tau_i$  object stay in every state as well as transition moments of  $t_i$  object calculation from  $S_i$  state to  $S_{i+1}$ .

Step 12. Modeling interval calculation under the formula (3).

Step 13. Preparation and printout of the results for user.

### IV. NUMERICAL EXAMPLE

There was developed the software package "Modeling of random events, processes and flows" designed in Borland Delphi 7 where it is the Markov processes module in order to investigate economic objects behaviour. It is necessary to choose the object

of investigation under modeling Markov processes, the state of which will be the results of prediction. As such object was chosen reservation of grain crop in the granary. There were determined granary states S1 – S7 reflecting its readiness to work [2].

Design of data base structure for storage of necessary information under modeling is performed in DBMS Microsoft Access.

The granary states are modeled with the help of homogeneous Markov chain with discrete time. While modeling the main problem is correct set of probabilities states row vector at initial moment of time and transition probabilities matrix. Therefore in program package is offered prompt for user for choice of the most suitable probabilities values for each state of economic object.

At Picture 2 are given the results of experiment carried out inclusive of time factor under given length of Markov chain ( $n=15$ ) and chosen 4 states of economic objects. It is necessary to push the button Calculate time on tool bar for modeling of Markov processes inclusive of time factor [5].

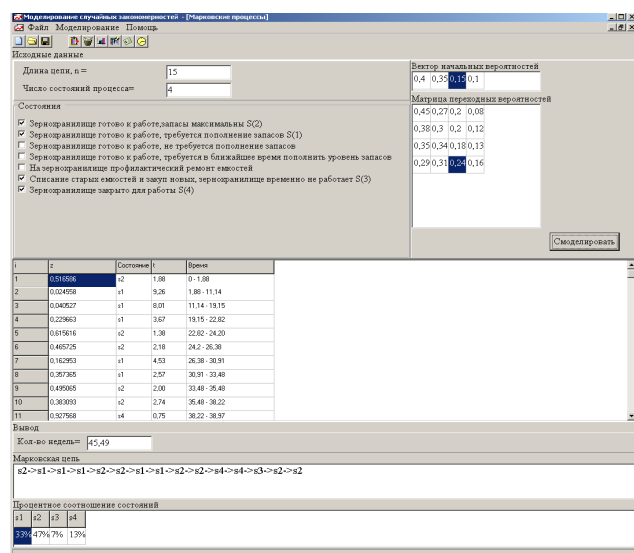


Figure 2. The results of Markov processes modeling experiment

As the result is modeled duration of  $\tau_i$  object stay in every state (in weeks) as well as  $t_i$  object transition moments (in weeks) from state  $S_i$  in  $S_{i+1}$  state under the given algorithm are calculated.

In the output window in the 1<sup>st</sup> column is pointed the number of experiment, in 2<sup>nd</sup> – modeled value of basic random value, in 3<sup>rd</sup> – modeled state of object, in 4<sup>th</sup> – calculated duration of object stay in this state, in 5<sup>th</sup> - moments of object transition from one state to another. The result is presented in window of Markov chain as formed chain of object states.

## V. CONCLUSION

The results of experiment show that program package allows model Markov chain of any length choosing the necessary set of states for investigating of economic object. In addition, percentage correlation of economic object stay in one or another state allows making of necessary administrative decisions for effective work provision of the investigated object.

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# Power unit based on supercapacitors and solar cell module

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**Abstract**—One of the main problems in all applications of wireless sensor networks is powering of the network elements. In this paper the supercapacitor based power unit is proposed. The power unit can be used together with renewable energy sources. Real world measurements of energy available from solar cell are provided as well.

**Keywords**- power unit; solar energy; supercapacitor

## I. INTRODUCTION

Wireless sensor networks (WSN) belong to the most popular technologies today. Technology advance in last decades allowed development of new, interesting applications of WSNs. In virtually every application of WSN we are encountering the same problem – how to supply energy to the basic element of the network – the node.

If we understand the life of the sensor node as the operation time without operator intervention and the node is powered by a portable power source, then its life is determined by the capacity of this source and power consumption of the node. It is clear that in this case life of the node can be extended by increasing the energy resource capacity, or by reducing device consumption. Another option is to power the sensor system using some kind of energy harvesting device [1].

Today we see microcontrollers (MCUs) with active mode consumption below 100  $\mu\text{A}/\text{MHz}$  @ 3V. The single battery with a capacity of 1000 mAh could power such processing unit for up to 1 year [2]. In real applications the microcontroller is often in sleep mode with the consumption approximately one hundred times lower than in normal mode. The limiting factor becomes consumption of the communication module and battery/supercapacitor self-discharge process.

The old-school way for powering WSN is a battery. Despite recent significant improvements in battery parameters, particularly energy density increase and self-discharge current reduction, batteries have strict lifecycle and therefore, they limit WSN performance and long term sustainability.

The second alternative that lately attracts the design engineers more and more are systems able to acquire energy from the environment (energy harvesting) in collaboration with supercapacitors.

The supercapacitor differs from a regular capacitor in having very high capacitance. This capacitance is rated in farads, which is thousands of times more than regular

electrolytic capacitor. The supercapacitor is ideal for energy storage that undertakes short and frequent cycles of charging and discharging at high currents [3].

There is a voltage limit for every single capacitor. The supercapacitor is designed to operate at 2.5 V to 2.7 V. Higher voltages can be achieved by linking supercapacitors in series, but this has disadvantages. This technique reduces the total capacitance. For example, two capacitors with the same capacitance connected in series act as one with quarter capacitance of the sum of both original capacitors. Additionally, series of more than three supercapacitors need voltage balancing in order to prevent any cell (supercapacitor) to run into over-voltage. Similar protection applies in lithium-ion batteries.

Comparing to Li-ion battery, which delivers steady voltage in the usable power band, the supercapacitor's discharge curve decreases linearly from full voltage to zero. This fact reduces the usable power spectrum and much of the stored energy is left behind.

TABLE I. SUPERCAPACITOR VS. LI-ION BATTERY

Property	Supercapacitor	Li-Ion Battery
Charge time	1 – 10 seconds	10 – 60 minutes
Cycle life	1 million or 30,000 h	500 and higher
Cell voltage	2.30 – 2.75 V	3.6 – 3.7 V
Energy	5 Wh/kg (typical)	100 – 200 Wh/kg
Power	Up to 10 kW/kg	1 – 3 kW/kg
Cost per Wh	€15 (typical)	€1.50 (typical)
Service life	10 – 15 years	5 – 10 years
Charge temp.	-40°C – 65°C	0°C – 45°C
Discharge temp.	-40°C – 65°C	-20°C – 60°C

The supercapacitor can be charged and discharged virtually an unlimited number of times. Unlike the electrochemical battery, which has a defined cycle life, there is little wear and tear by cycling a supercapacitor. Nor does age affect the device, as it would a battery. Under normal conditions, a supercapacitor fades from the original 100 percent capacity to 80 percent in 10 years. Applying higher voltages than specified

shortens the life. The supercapacitor functions well at hot and cold temperatures as well.

The self-discharge of a supercapacitor is substantially higher than that of an electrostatic capacitor and somewhat higher than the electrochemical battery. The organic electrolyte contributes to this. The stored energy of a supercapacitor decreases from 100 to 50 percent in 30 to 40 days. A nickel-based battery self-discharges 10 to 15 percent per month. Li-ion discharges only five percent per month. Advantages and limitations of the supercapacitors are summarized in the table II.

TABLE II. ADVANTAGES AND LIMITATIONS OF SUPERCAPACITORS

Advantages	Disadvantages
Virtually unlimited cycle life (can be cycled millions of times)	Low specific energy (holds an energy fraction of a regular battery)
High specific power (low resistance enables high load currents)	Linear discharge voltage (prevents using the full energy spectrum)
Charges in seconds (no end-of-charge termination required)	High self-discharge (higher than most batteries)
Simple charging (not subject to overcharge)	Low cell voltage (requires serial connection with voltage balancing)
Excellent temperature charge and discharge performance	High cost per watt

## II. SUPERCAPACITOR POWER UNIT

At the department of technical cybernetics we are dealing with different applications of wireless sensor networks [4], [5]. To provide power to the sensor network nodes we proposed the power unit circuit shown on Fig. 1. It consists of three main functional parts. The first part is supercapacitor circuit with two primary supercapacitors. The two resistors with 1 MΩ resistance serve as simple voltage balancing circuit to prevent any of the supercapacitors to run into over-voltage. The small 100 nF capacitor (C3) filters high frequency current peaks.

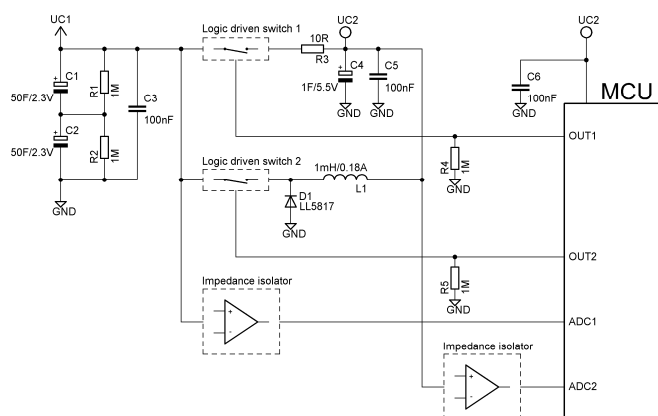


Figure 1. Power unit circuit

The second main part is MCU powering circuit (Fig. 2) with secondary supercapacitor. The 1 F capacitor (C4) is being charged via MCU driven switches. The first switch (Fig. 3) is always on when the MCU is inactive (in stop mode). As a result, during MCU inactivity supercapacitors C1 and C2 charge C4 capacitor. When MCU becomes active, the C4 capacitor is (or should be) fully charged to a maximum voltage

4.6 V (maximal voltage of series C1 and C2) and the MCU can close logic driven switch 1.

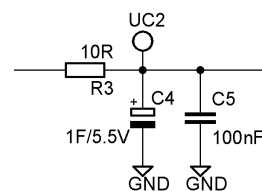


Figure 2. MCU powering unit

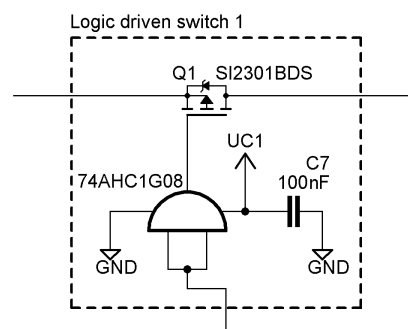


Figure 3. Logic driven switch 1

Logic driven switch 2 (Fig. 4) works as complementary switch to logic driven switch 1 when MCU is in stop mode. This means, all output MCU pins are in high impedance and the logic driven switch 2 is always off when MCU is inactive. If MCU is active, this switch works as fast charging switch for capacitor C4, which powers the MCU. The inductor L1 limits C4 charging current to prevent any damage.

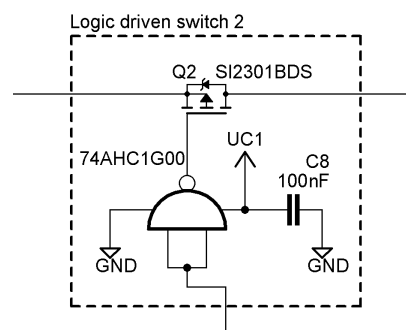


Figure 4. Logic driven switch 2

Impedance separator consists of an operational amplifier from Texas Instruments OPA2369. This part separates the analog to digital converter pins (ADC1 and ADC2) of the MCU from direct supercapacitor's voltage levels. This is due to potential very high currents that could flow from supercapacitors to these ADC pins. These high currents would cause quick discharge of either MCU powering capacitor C4 but also main supercapacitors C1 and C2. Common values of input impedance of an operational amplifier are very high. This particular, OPA2369 has input impedance 10 TΩ according to datasheet. Therefore, we can say that the input impedance is

practically infinite and its effect on energy consumption is negligible.

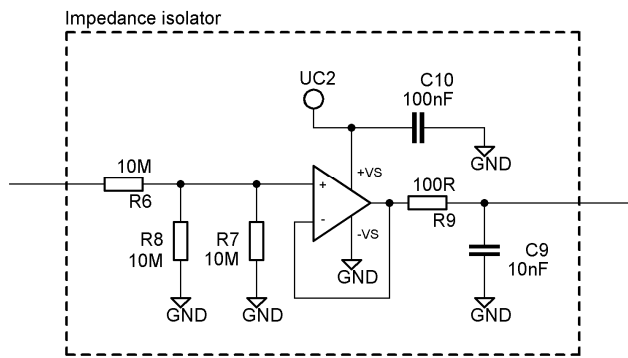


Figure 5. Impedance isolator circuit

MCU output pins (OUT1 and OUT2) drive the switches. These switches are basically responsible for charging C4 and energy balancing between C1, C2 and C4.

MCU's analog to digital converter pins (ADC1 and ADC2) are detecting the voltage levels on primary supercapacitors C1 and C2 (ADC1) and on secondary supercapacitor C4 (ADC2). When critical low voltage level is detected, the MCU can charge C4 to desired (when C4 is at low voltage level) voltage level from primary capacitors by switching logic driven switch 2 with PWM (Pulse Width Modulation) signal up to 10 kHz or MCU can run into sleep mode or even better stop mode and wait until solar cells charge primary supercapacitors and secondary supercapacitor to a desired voltage level (or full voltage).

### III. SOLAR CELL

The power unit can be driven with different kinds of renewable energy, such as solar energy, thermocouple or vibrations [6]. In this paper we focus on energy from solar cells, namely from SMH-8-0450. Its active area is about 23 cm<sup>2</sup>. Total energy that the primary supercapacitors can store is 264.5 J. Knowing that the supercapacitor's voltage varies between 2.2 and 4.6 V, the available energy is 204 J. This is also the maximum energy that can be used by the node during the time without the solar energy source.

The time required to charge the capacitor is as follows:

$$t = 1000 \cdot E / P_{MPP} \quad (1)$$

where  $t$  is time [s],  $E$  is the energy [J] and  $P_{MPP}$  is the maximum power of the solar cell under ideal conditions [mW]. According to the datasheet, the maximum power of the solar cell is  $418 \text{ mW} \pm 10\%$ . The time required to fully charge the supercapacitor will then be about 8 minutes and 8 seconds. It should be noted that these results apply only when conditions are ideal (i.e. when the power density of sunlight is  $1 \text{ kW/m}^2$ ). In Slovakia, such conditions occur only about two months of a year (June and July). We assume that extension of the supercapacitor charging time due to weaker solar radiation should not cause any serious problem.

We made several measurements to verify the ability of the selected solar panel to recharge supercapacitors. The solar cell

was placed in a horizontal position at a place that is not shielded by any object. Measurements were carried out on 14 to 18 March 2013 in town Prievidza. During the time there were different weather conditions: cloudy with moderate snowfall and sunny. Solar cell was loaded with a constant load of  $2.2 \text{ k}\Omega$ . The voltage generated by the cell was sampled once per second. Of course, constant load is not suitable to maximize the energy produced by the solar cell. To maximize its performance it would be necessary to use maximum power point tracking. However, it is possible to estimate the maximum energy generated by the cell using a solar cell model. Solar cells can be modeled in different ways. Perhaps the most commonly used is single diode model (SDM) [7]. The use of models is limited by the fact that manufacturers of solar panels do not provide the parameters necessary for these models. There are different approaches to derive the V-I characteristics of a solar cell only by the manufacturer provided parameters [8]. One option is to use an ideal single diode model (ISDM). This model neglects the influence of series and shunt resistances in the classic SDM. For our purposes, the accuracy of this model should be sufficient.

The Fig. 6 shows the maximum available power during two days with different weather.

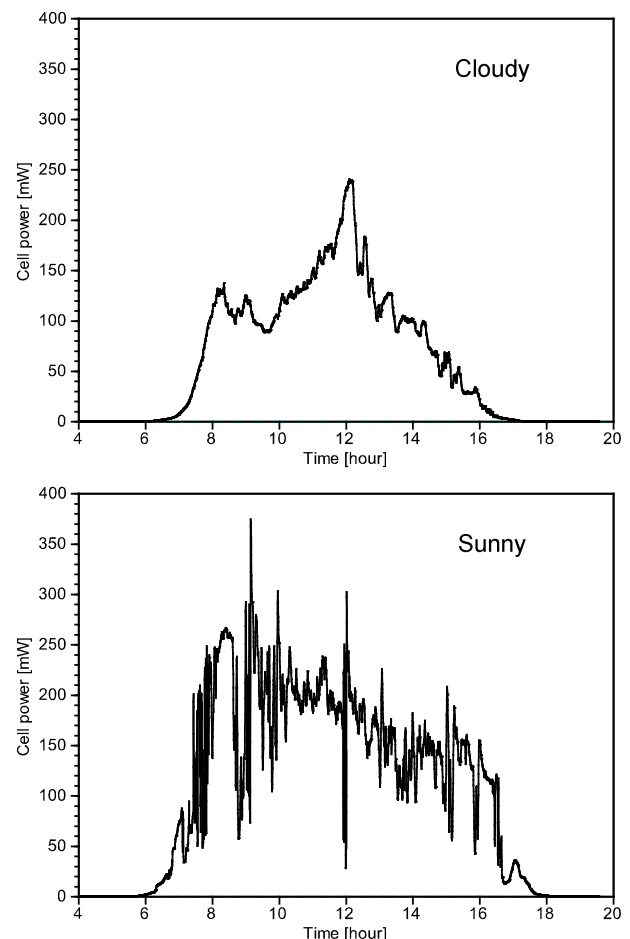


Figure 6. Power available from the solar cell

Table III shows the total energy produced by the cell per day and the average time required to recharge the

supercapacitors. Sunrise on both days was at about 6:00 AM and sunset at 5:50 PM (i.e. 11 h. 50 min of sunlight). The values obtained from the cell placed inside of the building about 30 cm from the large east-facing window are provided for comparison purposes.

TABLE III. PERFORMANCE OF THE SOLAR CELL

Wheather	Outside of building		Inside of building	
	Total energy	Recharge time	Total energy	Recharge time
Cludy	3 475 J	42 min	182 J	13.5 hours
Sunny	5 851 J	25 min	269 J	9 hours

It is clear that the solar cell inside the building is of limited use. The situation outside of the building is much better, but it should be noted that the calculated time required to recharge the supercapacitor would actually be greater, since the calculation does not include the power supply efficiency and also consumption of the node itself. Based on the measurements we assume that the solar cell will be able to charge the supercapacitor to the maximum even in winter months. Thus, the system should be able to drive the WSN nodes throughout the year. An open question is the impact of the snow, mud and dust on the solar cell efficiency. We do not assume that the solar cell will be completely covered with mud in the summer. However, in the winter it is more probable that the solar cell will be covered with a layer of snow or ice. In this case the cell will probably not be able to generate enough energy for continuous operation of the node and we will have to consider other options for its powering.

## CONCLUSION

The power subsystem is one of the most important parts of the node in wireless sensor networks. The functionality of the node depends on an adequate supply of energy. Node lifetime is often limited by the lifetime of its energy source. The use of non-renewable energy sources can significantly reduce the lifetime of the device. It is therefore important to focus on renewable energy sources such as solar energy. The proposed supercapacitor power unit can be used together with different kinds of renewable energy sources. Measurements of energy provided by the solar cell indicate the possibility of a continuous powering of the nodes using solely solar energy. The possibility of using such a system in the winter months is yet to be verified.

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# The evolution of web browser architecture

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**Abstract** - Web developers, who strive to maintain the high quality of its products, spend considerable amount of their development time on maintaining compatibility with currently popular web browsers. They need to insure compatibility with several standards; HTML, CSS, JavaScript and video. To insure quality, they need to allocate significant portion of their resources for maintaining cross browser compatibility. Resources used represent costs. This paper presents the concept of web browser architecture that could cut websites development cost, improve browsing experience for surfers. The paper explains concept advantages and potentials for global wide acceptance.

**Keywords** - web browsers, software architecture, software implementation, tire architecture

## I. INTRODUCTION

With current web technologies, web developers spend approximately 50% [1]–[3] of their development time for quality assurance and maintaining cross-browser compatibility. Overload in development and testing stages of projects implies financial costs.

Ensuring compatibility mean compatibility with current web standards; HTML, CSS, JavaScript, video and more, ensuring cross browser consistency of design and code so every visitor gets a coherent experience.

HTML, CSS and JS are separate technologies. Their standards are left to interpretation of browser vendors. The standards are complex and there is no strict testing process or certification such as ISO quality systems. Sometimes the interpretations of standards differ for the same version of web browser for different operating systems, if the same functionality was developed by different teams or if developers do not use the same versioning on different operating systems. The difference may arise because same features are developed by different people, or because of differences in the architecture and technical solutions of different operating systems.

Is it time for the web browser architecture evolution? The authors advocate this thesis and present the concept which could drastically lower costs of web development and simultaneously improve the browsing experience. After the intro chapter the paper reviews the current state of desktop and mobile browsers and the aftermath of a browser vendor wars. Some of the major consequences are the differences in interpretations of standards. Paper also covers a brief overview of compatibility tests for browsers and web pages as a very useful tool for websites quality assessment. Perils of modern web development are presented in the second chapter. The

solution for web developing problems is offered in the third chapter; its advantages are presented and possible obstacles in its way to acceptance are described. The fourth section provides an overview of scientific and professional papers. The fifth chapter brings conclusions.

During research, the following research methods were used: web surveys, observation method, analysis (content analysis, analysis of the results, business analysis and analysis of documents, data analysis and mathematical analysis), graphical and mathematical modeling and descriptive statistics. Authors also used methods and tools for web browsers testing.

## II. THE CURRENT STATE OF WEB BROWSERS AND WEB DEVELOPMENT

Every web browser vendor forms their own interpretation of web standards and there lie the immense costs of development for web developers. Cutting costs in web developing business means sacrificing compatibility with some browsers. Will something revolutionary happen in the near future and for example is W3C (World Wide Web Consortium) going to come up with a certification plan for browsers? An educated guess would be it won't happen because that would mean higher costs for browser vendors since they'll need to get in line with the certification requirements and let's not forget that all the vendors are W3C members.

### A. Web browsers: trends and actual market shares

At the start of website or application development, a web developer needs to make a choice what browsers will his product support, because supporting all existing browsers and their version is just not feasible. A starting point in this decision making are statistics of preexisting website that undergoes reconstruction or generic stats based on anticipated user base characteristics or geo location or what is the average age of the target audience, or maybe will the solution require intensive interaction with the user even when the user is away from the desktop (need for mobile web browsers support)?

Depending on the final solution, even functionalities and versions of virtual machines like Flash or Java have to be taken into consideration and sometimes even more exotic virtual machines like Unity3D, a 3D engine for the browser.

#### 1) Desktop web browsers

According to comparative tests of web browsers features, safety, speed, compatibility, the ease of use and the support of manufacturers [4]–[7], the best rated are Google Chrome and Mozilla Firefox. They are followed by Microsoft Internet Explorer, Opera and Safari in various proportions, but in the

almost same ranks. According to the rates of users - web pages visitors [7]–[9], the best rated browsers are classified at almost identical order: Google Chrome and Mozilla Firefox with over 33% of votes, Opera and Microsoft Internet Explorer with a little over 10% of votes and Safari with under 10% of votes. Even technologically dedicated websites such as [10] have almost identical ranking of web browsers. Some differences exist only in the order of the third and the fourth place, Microsoft Internet Explorer and Opera. However, according to the number of users [11]–[15], the most used are Google Chrome and Microsoft Internet Explorer (>30%), followed by Mozilla Firefox (20%) and Safari (<10%). Let's complete this statistical review about desktop web browsers with confirming data about trends and current state with statistics from StatCounter, which are most often used by secondary sources, shown at Fig. 1 (presenting five year trend) and Fig. 2 (presenting data on April 2013). Other sources mentioned have very similar data, but StatCounter is selected as their representative.

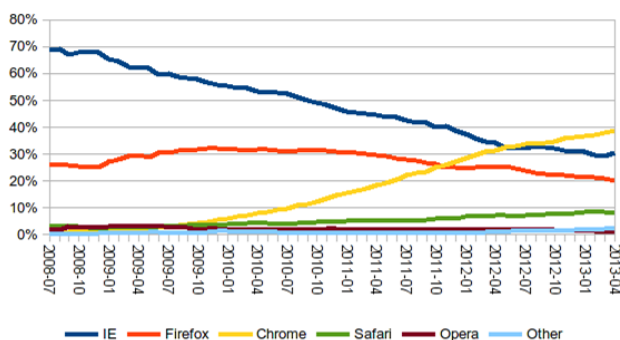


Figure 1. Top 5 Browsers from July 2008 to Apr 2013

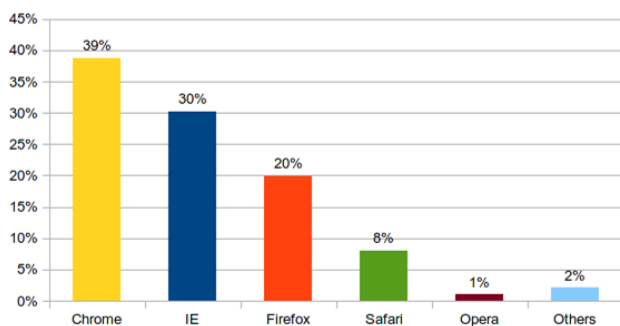


Figure 2. The market share of web browser on April 2013

In the period 7/2008 - 4/2013, a proportion of MSIE had fallen from 68.6% to 30.2%. Proportion of Mozilla Firefox was relatively stable: it grew from 26.1% to 32.2% (12/2009), after which it began falling to its current state of 19.98% (4/2013). Google Chrome was released in 9/2008 (beta version), and 12/2008 (stable version) and it grew from 0% to 38.8% which got him on the first place according to the number of users. The other two significant web browsers are Safari and Opera. Although very respected desktop web browsers, they aren't showing any big makings or losses, but they do have their own niche of users. Safari is respected on the iOS, Opera is thin on desktop but instead it's respected on all mobile platforms because it uses proxy which reduces the amount of data that

must be retrieved from the Internet and it adjusts web browser to the platform on which the content is reviewed.

There are over hundreds of desktop web browsers and a partial list (about 75 browsers) can be found on Webdevelopersnotes.com [8].

## 2) Non-desktop web browsers

Web browser versatility is further enhanced by the massive use of smart phones, tablets and all sorts of smart (TV) devices (Apple TV, Google TV and others) which users can and do access the web. The world of mobile web browser is even more crowded than the desktop one. In total, there is less browsers but the most represented have a smaller percentage than those on the desktop market (Fig. 3).

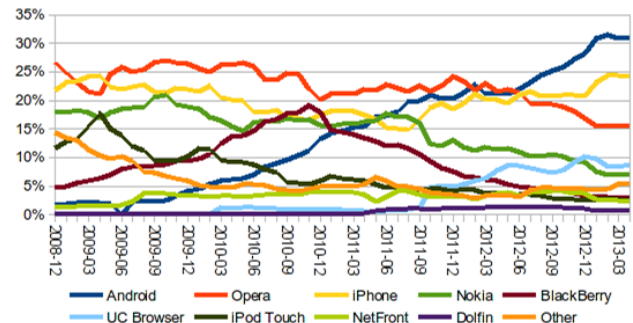


Figure 3. Top 9 Mobile Browsers from 12/2008 to 4/2013

In 3/2012, the three most widely used mobile web browser were used by less than 24% of users, all three were within the range of 4%: Opera, Android and iPhone. A few months later, in 12/2012, there was a significant change in the leading trio: Android became the leader with 27.4%, followed by the iPhone (20.9%), Opera (17.1%) and others. Since then, up to 4/2013 [16], Android has increased its primacy (30.93%), the iPhone has increased its share (24.06%), but Opera (15.35%) and all other significant mobile web browsers have reduced their share (Fig. 4).

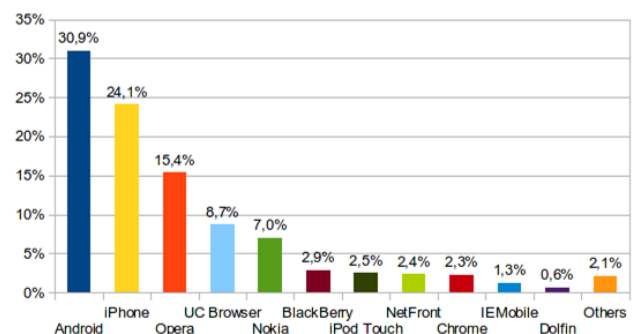


Figure 4. The market share of mobile web browser on 4/2012

Most of these mobile web browsers use the same basis (4/2013) [17]: over 75% WebKit Mobile [18] – an open source engine which was initially made by Apple for Safari, over 15% Opera mobile and rest share all others mobile web browsers.

## B. Considerations regarding the Browser Wars

On the free market every product fights for its share of users. Since the browsers are free, developers/owners have to

find some way to earn money to their company/project/organisation. They do that in a way to promote the name of the company or the project. When we say Internet Explorer, we know it's created by Microsoft, for Firefox we know it's an open source and that Mozilla works on it and so on.

In the early years of the Browser Wars, after promoting brands, the next step was to captivate users for their platform by their own upgrades of HTML/CSS/JS standards which led so far that Microsoft published their own version of Java virtual machine, their own web scripting language Vbscript and their version of JavaScript. The initial versions of HTML standard were rudiment, but the new tag which supported one browser didn't show itself as predicted on the other browser. The users were irritated because the competition of manufacturers resulted [19] in:

1. "Adding new features instead of fixing bugs.
2. Adding proprietary features instead of obeying standards.
3. Inadvertently creating security loopholes".

When the authority for management of web standards showed up, it was necessary to find a new source of income other than self-promotion and this is where search engines came. Search engines are the channel for promoting platforms for distributing web advertisement. The more visitors and the more advertisements on pages that use them, the more money is made. Of course, in that world, Google was interested to promote its search engine through other browsers as a default page and through search bars by which browsers became the directors of users and got money for the actual job. Therefore, a browser is strategic software for its company and, hidden from the view of users, makes money [20] based on the activity of users.

#### *C. If there aren't enough problems: Vendor Prefixes*

Even if most web browsers mostly respect web standards, some of their manufacturers are in a hurry with implementation of new specifications. Currently, CSS3 and HTML5 are tempting, even if they are not at Working Draft status [21] any more. The attempts of defining trends with new features are increasing in popularity, especially in the community of developers. In order to avoid drastic differences in sites of various browsers they agreed on a concept named Vendor Prefixes for CSS [22], [23]. Vendor prefix is an addition to CSS property which marks a feature in development, meaning: in experimental faze. Developers can use them, but their behavior in next versions could drastically change. In that way they distinguish new features from the standard. When the same or modified possibilities become standard from W3C, developers of web browsers should ignore standard Vendor Prefixes. This is just another attempt to control implementation of new possibilities.

However, the use of Vendor Prefixes has its downside [21], [24]–[27]. It turns out that massive use of WebKit as an engine on mobile web browsers and the use of its prefix has been brought to the point of web developers using more of those prefixes since the development team of WebKit wants to

impose as a trend setter and include more new options in the syntax. By that, they put pressure on other browsers because they want them to support their Vendor Prefixes.

As it can be seen, process of web development and web browser development are cyclic because most companies see that the only way of getting advantage in front of the competition is to lure users by standard solutions and then turning to nonstandard ones to gain advantages before the competition [28], [29].

#### *D. (In)compatibility Tests*

Web developers tried different ways to harmonize their websites with different web browsers and their versions on different operating systems, because a slight difference in the version of the same browser or the same browser on a different operating system can very differently show the same sites. Parts of HTML, CSS and JS code called hacks, were in the fight for compatibility. Developers had most problems with Internet Explorer browsers, especially until the version eight. Problems which become obvious in cases of intensively using JavaScript, are speed and consistency of implementation of JS engine even in the same browser. There are also some fundamental differences in ways that the JS walks through DOM and AJAX methods which brought Mozilla and Microsoft. Parts of engines incompatibility are also problems of various JS frameworks such as jQuery or YUI and their inconsistency.

"Compatibilisation" wastes a lot of time but it is necessary to some extent. While websites already exist for some time, the extent of supported platforms can reduce, due to the statistics of visits and information about versions of browsers and operating systems. To support as much platforms as possible and versions of browsers for each, especially a small company, a significant expenditure is needed so compromises are needed. There are more possible ways of compatibilisation.

One of the ways is opening sites on the same machine with more recent versions of web browsers; with the restriction that one web browser can be installed in only one version.

The second way is a subscription to some online service which is specialized to show sites in different browsers and different versions on different platforms [30]–[35].

The third way is multiplication of hardware, meaning having test machines – that is financial inefficient. The same output can be made by virtualised technologies on production machines, such as [36]–[40].

Besides compatibility with different versions of different web browsers for different platforms, web developers have to make effort to keep compatibility with accepted web standards [41]. In that, they get help by on-line tests.

ACID1, ACID2 and ACID3 are online web tests [42]–[44] sponsored by The Web Standards Project (WaSP) [45], "a grassroots coalition fighting for standards which ensure simple, affordable access to web technologies for all." ACID tests measure how much the browsers follow the CSS standard [46].

HTML5 Test is an online web test whose [5] "score is an indication of how well" ... "browser supports the upcoming

HTML5 standard and related specifications." HTML 5 updates whenever the HTML 5 specifications change. Therefore, this test is not complete and it won't be until the specifications are determined as a standard. Indeed, considering the word is actually about a collection of tests that are performed sequentially, there are often new components of tests added. Therefore, the maximum number of point's changes (increases) by adding new components to tests. In addition to compliance with standards and specifications of standards, browsers can be tested and be compared about speed [47], memory use [48], but also an umpteen of many other features. Those testings' usually come out of some online non-commercial services and earlier mentioned online services.

Web browser tests and their compliance with web standards are important to web developers in order to comply and optimize their work with requirements. Checking the compliance of their products – websites – with standards is important too. Some of the websites tests who are considered to be necessary in making websites (so called validators) are [49]: "Unicorn - W3C's Unified Validator, The Markup Validator - also known as the HTML validator, The Link Checker - checks anchors (hyperlinks) in a HTML/XHTML document and The CSS Validator - validates CSS stylesheets or documents using CSS stylesheets", ... The other, optional validators, are [49]: "Semantic Extractor - sees a Web page from a semantic point of view - extracts such information as outline, description, languages used, etc.; RDF Validator - checks and Visualize RDF documents; Feed Validator - checks newsfeeds in formats like ATOM and RSS; P3P Validator - checks whether a site is P3P enabled and controls protocol and syntax of Policy-Reference-File and Policy; XML Schema Validator" and two "human-centered test tools: the Mobile Test Harness is 'Web-based harness for browsers test suites, that offers users the possibility to record results on whether the browser they're using passes or not a set of test suites'; and MUTAT - an (older) human-centered testing framework developed in perl (code)".

### III. SOLUTION FOR WEB DESIGN NIGHTMARE

In a world where everyone wants to make money on the web, the differences in the implementation of web standards in some browsers come to the fore and developers have to adapt to it. The solution for web design problems and consistency of the user surfing experience is in web browser architecture evolution i.e. new web browsers architecture.

Every browser has a standard set of components: GUI, browsing engine, rendering engine, output renderer, networking interface, persistency engine and plug-ins. Rendering engine has its primary components: HTML, CSS and JavaScript interpreters, as shown on the Fig. 5: GUI, Display Backend, Browser Engine, Rendering Engine, Data Persistence, Networking and many possible modules, such as XML Parser, JavaScript Interpreter, Flash plug-in and others.

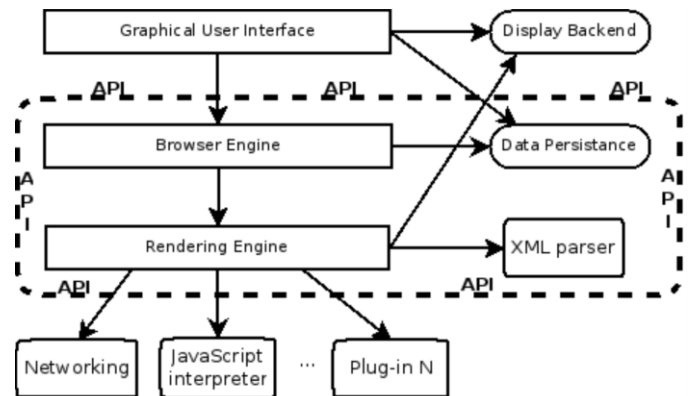


Figure 5. Web browser software architecture

What would happen if the HTML interpreter was declared as a plug-in? What if the same thing happens to the JavaScript engine? In that suggestion not only would the HTML and the JavaScript engine become user configurable components but that would give developers the power to choose main plug-ins which supports the objectives of their project even before the actual development. Also, in the heading of HTML they could define which engine they want for technology, specified to the smallest decimal version if it suits them. The solution showed on Fig. 5 is on the borders of objects which with the browsers next to them communicate through the standard interface defined through the API. The authors propose to add and define standardized interfaces (API's) in addition to the already defined software architecture browser [50], [51]. That would allow components to talk in a standard way and, interchangeability of components get possible and defined, i.e., that would allow the HTML to influence the selection modules that will be used to display the page and users would see only GUI. Every GUI would have a standard interface regarding primary plug-ins which it runs as needed. When surfers come to a specific website written in the HTML code, in the heading they take over the definition which engines were used. If they don't already have it in the repository of engine, it initiates the download of it and performs silent installations, followed by the download of HTML and other parts of the site, in a similar way how they downloaded Flash and Java virtual machines if they found content needing a new version.

Existing browsers use separate projects which make JS and HTML engines as their components. In most cases the HTML engine integrates the browsing engine which is closer to user interface, the CSS and XHTML interpreters and doesn't care about the standardization of interfaces with the outside world because every browser has its private GUI. The modularization of browsers should be going through stages where in every next stage browser have more and more components with standard interfaces which solve specific functions. In the first stage the rendering engine, the browsing engine and JS engine should be separated. The other components such as output, persistency and networking can stay connected on a nonstandard way. In the next stage, parts of the rendering engine could become modular so that the HTML, XML and CSS get their modules. In the third stage the persistency engine would also get modules. Bookmarking, file cache and web app user data storage is to be standardized and centralized so that

all other engines could use them and be unique on the system level. Now users already suffer transferring bookmarks from one browser to another on the same machine. The central file cache will reduce the space needed for it because it will no longer exist as many cache instances as there are installed browsers. When used HTML and JS engines (which interprets the site) changes, the user will still be able to see same information as before with including central web app user data store. In next stages, some subsystems for networking, for the visualization of sites should be singled out too, as well as managing the utility plug-ins which are mostly written in JS but aren't cross browser compatible. Regarding the sophistication of applications and websites which are served over the Internet and the level of sophistication of security threats, in one of the next stages there's a need to separate a security component in the subsystem for networking which would represent an additional proxy between network protocols and the rest of the system and will improve security. That proxy could have an API toward the proxy software of other manufacturers and toward other antivirus software. It would also be a proxy between the HTML engine and data persistency engine to secure that the web code doesn't compromise data in the user bases or the file system.

New iterations of the API standard would bring the support for sandboxed native applications which could be taken over from the internet without any rigorous installation procedures. Native applications would mean they are compiled for a platform of users, for example JS or C++ compiling. Around the sandboxes would also be a security layer and in architecture it would take place between the HTML engine and data persistency components. By bringing in applications it would be necessary to bring in an app store component which would take care of install/uninstall and monitor the appearance of new versions of applications and notify the user about it over GUI.

Possible candidates for modularization would be all SVG engines, handling micro formatting, printing pages or something else.

The suggested direction of development has big possibilities and its power is on the one hand in specialization of developer teams and essential components and on the other hand approaching developers to browsers, browser plug-ins and developers of web.

Clear definition of interfaces (the APIs) between components would enable various enthusiasts, specialists and companies to focus even more on their field and make quality specialized components. The most potentials for improvement is visible in JavaScript interpreters which are heavily (ab)used in the production of web applications and utilization in graphics for which JavaScript wasn't designed for. The APIs need to be defined as they must be unambiguous in a way to prescribe tests, inputs and outputs on which components can be marked as certified for some versions of API. For example, the hardware acceleration of graphics is made differently on Linux and on Windows platforms, as the first one leans to OpenGL and the second one on DirectX. In fact, the developers of rendering plug-ins would have a favor done and shouldn't get worried if under there it's an OpenGL or DirectX or the graphics related to the HTML and JavaScript because more of

3D is also pushing to that field and the websites aren't native applications. The subsystems for acceleration of graphics are a part of the operating system or separated projects in the open source community but someone who is developing a robustness JavaScript engine in most cases shouldn't be losing time or money on question such as the hardware acceleration of graphics which the JS can support.

#### *A. Advantages of suggested solution*

Development teams can choose plug-ins of various developers depending on their characteristics and performances and depending on work that need to be done. The time for testing functionalities of browsers, detecting differences and implementation or testing fixes which annul differences will decreasing. The times spent will also decreasing because the developing teams will focus on a specific version of HTML and JS engine. Eventually the only thing it might remain is testing the differences on various operating systems. If the developer of the plug-in doesn't subscribe a product parallel on different platforms, in the heading of HTML would be definitions for various operating systems.

Until now, developers could choose which monolithic browsers and their versions will support. Those browsers weren't specialized for their current business problem but for the universal solution which needs to cover a bigger number of user scenarios.

Engines which would be used would get referenced in the heading of HTML in a similar way as today Flash Player. References should be possible in the header of each web page which means that two different web pages on the same website can have references to different engines, as appropriate for each task.

Let's explain the consequence of accepting our suggestion on an example: let one site, let's call it A, be developed in 2012 for a WebKit version x.y and let it be visited by "our browser" with a WebKit x.y HTML/CSS plug-in in 2015: that site will look identical. Let the second site, let's call it B, be developed in 2013 with a new engine, for example the NN version t.z, considering that "our browser" has the NN plug in, and both sites are showing to users as the authors imagined.

Therefore, the proposed solution permanently removes the current problems of development and use of the website if the visitor has the engine that is needed. Of course, in the beginning most sites in the heading won't have a reference to plug-ins, but in the GUI we can have an option that one engine is used as a default choice. Modularization means decreasing work for development teams of module browsers. By that, maintenance is easier, especially when the HTML renderer is separated from the JavaScript engine. Focusing on a smaller amount of source code means decreasing potential attack surface for the development team which means they have a smaller amount of code for security testing.

GUI components would change slower than other components, so users would always have one acceptable interface which changes when they want, not when the changes are dictated by the components under. Currently the GUI browser and the arrangement of options differ significantly. The differences come through the life cycle of several browsers

where developers usually impose their vision of ergonomics. The GUI component would also take care of following versions of components so they could be warned about new security patches and with adequate architecture, new versions could be downloaded and used without restarting the whole browser. API between components contributes to easier standardization.

By everything stated, the time of developing websites/applications decreases, which decreases expenses, but it also facilitates the development of web browser components what cheapens their development, makes them have better quality, safety and compatibility with other browser components.

#### *B. Predicted barriers for accepting solutions*

There are a couple of barriers that we will discuss, concerning the standardization and earnings.

##### *Is the concept of standardization disturbed?*

The first logical question being asked is: who needs or can accept this new concept of developing web browsers?

Developers of browsers would rebel because they set up business strategies around their monolithic products which are their marketing tool and their source of earnings on the market of online search engines and advertising. However, on the market, customers and users have the last word. For them, this alternative might be the best news since the invention of web.

W3C could provide resistance because this suggestion brings in referencing vendors and versions in the heading of HTML and by that disturbs the neutrality of the source code. Yet, vendor specific references are nowadays present on Flash and Java VM.

The pressure needed for changes in the way of browser developers' thinking will have to be made by organized users and developers. Therefore, the concept should first be shown to web developers and to users. When they get loud enough, the W3C won't be able to ignore the trends and it will get involved in the definition of the API call among the components.

Developers and surfers are winners in these changes. The prospective losers, at least in the beginning of adaptation to new standards would be developers of the HTML engine which developers neglect for objective or subjective reasons.

Browser vendors will resist to new solutions because they are being forced to accept the APIs they didn't create.

Resistance would also be made by former contractors about the income from directing users to specific browsers because that means signing new contracts with developers of various components.

In those conditions, developers of the GUI components would have to sign contracts with browser component developers, for example, for statuses of default components but also for sharing income of browsers.

##### *Earnings through web browsers*

Companies earn money by using the mechanisms built into the web browser interface. Towards our suggestion, they could

keep earning in that way (imposing default search engines, gathering statistics of user surfing and so on), but if the opponents in browser development are considered mortal enemies, the question is how much would they be ready to approach work in developing plug-ins by the defined standard. Of course, everyone will defer the trend if, for example, someone makes a GUI by this proposal, and shapes the existing source of Firefox and Chrome into plug-ins. That project will then enable people to use both browsers through the same interface and Opera, MS and Apple for sure won't ignore it.

Leaders of new modular trends could be universities, therefore the academic community which is not strictly tied to terms of profitability or enthusiasm by starting new projects which grew out on the foundations of frustrations on current state.

Money will adapt to new trends and web search engines will still be interested in advertising through browsers [20], [52]. Therefore, there will be money for browser and web developers but with less spent time, which also means potentially bigger earnings or margins space in calculations.

#### IV. RELATED WORKS

Unfortunately, the problem and the nature of the relationship between web development on the one hand, and the concept of making and using a web browser on the other hand, has remained largely unnoticed among the scientific community and researchers. There is relatively small number of authors who deal with the software architecture of web browsers, but some works are inspiring. There are several authors mainly concerned with the architecture of web applications.

Windrum [53] brings interesting and quality analysis of the (first) browser war. Oshri and de Vries [54] explain the evolution of web browsers through the analysis of the competitive relationship between the main players.

Grosskurth and Godfrey are the most significant researchers who discuss the software architecture of web browsers. By studying the open source of web browsers they [52] developed a reference architecture for web browsers and in the conclusions noted that it could be different than the current one. The same authors [50] additionally widened gatherings of web browsers on which they combined the reverse engineering and by studying the source code determined their architecture: Mozilla, Konqueror, Epiphany, Safari, Lynx, Mosaic, Firefox by which they confirmed their referent architecture and defined key subsystems of listed browsers.

Li and Chen [55] propose an innovative Web browser interface called TopicBrowser, in which learners can make an Information Gathering plan with a hierarchical concept map in the context of learning.

Huang et al. [56] proposed a new type of middleware, which is embedded in web browsers and encapsulates reusable solutions for common problems to the composition of Web-delivered services.

Bohannon and Pierce [57] bring formal specification of the core data structures and operations of a web browser.

J. P. Espada et al. [58] proposed that web applications should be allowed to access context information in a simple and fast manner: "The proposed system consists of a modular web browser context aware and a set of specific XML tags that can be used on web applications."

M. Šilić et al. [59] find that modern web applications are demanding "a new web browser architecture design that will meet new security requirements arisen with Web 2.0." Authors are focused on web browser vulnerabilities; they analyze popular web browsers' architecture and present "how they cope with potential security threats".

## V. CONCLUSION AND FUTURE WORK

Results of research can and should be used in developing and optimizing web browsers, and implicitly websites. Dissatisfaction of current states or inertness in solving problems is motivator that cannot be neglected when deciding about changes. The number of surfers by far exceeds the number of browser developers and if the unique platform is ensured to them to show their dissatisfaction by current state of browsers, corporations and organizations which think of browsers as their strategic products will start paying attention. They will start paying attention if the developers are also given a platform on one global place to show their dissatisfaction. Therefore, even before anyone invests money in lobbying or in the development of alternative solutions, the attention could be drawn by feedback information from those who use browser for consuming information and everyday fun and by feedback information of those who use browsers as media for distributing content and solutions.

If anyone "dare" to make a browser by the suggested concept, no matter how much money would be spent on modifying an open source code of existing open source browsers, return on investment would be guaranteed. Imagine offering developers a platform which various versions of HTML and JS interpreters treat as plug-ins without problems of coexistence of various version on the same instance of operating systems. Such a piece of software would be virally promoted in the development community. The commercial would bring users to browsers and in time profitable contracts with search engines which are associated with markets of web commercials.

By reducing time needed for the development of cross browser compatible webs and time needed for testing the same ones, developers, the people and business customers who orders web projects and web users/visitors would become happier.

The authors advocate that users obtain browsers which have IE, FF, Chrome and Opera engines in one interface. To make this possible, it would be necessary to make the API that all the engines would follow so that the GUI can communicate with them in a consistent manner. Modularization is great, but it is clear that current browsers are not built with such a dose of modularity in mind, which means that it will take iterations to define standards and compatible solutions. However, the basic components of web browsers architecture stay the same. The

difference proposed is in standardization of communication between components so they could be changeable on the user side.

The next step is promoting the idea (raising awareness) on the Internet and the attempt of getting people with the same thinking in the developers' branch but also in the web browser development branch.

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# SECTION 22.

*Transport and Logistics*

# Gini Coefficient, Dissimilarity Index and Lorenz Curve for the Spanish Port System by type of goods

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**Abstract—** This paper shows the Gini Coefficient, the dissimilarity Index and the Lorenz Curve for the Spanish Port System by type of goods from 1960 to the year 2010 for business units: Total traffic, Liquid bulk cargo, Solid bulk cargo, General Merchandise and Container (TEUs) with the aim of caracterizar the Spanish port systems in these periods and propose future strategies.

**Key words-Spanish Port System Gini Coefficient, Dissimilarity Index Lorenz Curve**

## I. INTRODUCTION

One of the main issues in port logistics or other related freight transport engineering fields is the general forecast of those parameters related to space, means, and resources requirements, as well as their optimisation. Physical and equipment parameters related to a container terminal (i.e. stocking surface, necessary berthing length, dock cranes number,...) represent a high investment and are characterised by important social, economical or environmental impacts.

Therefore, a correct forecast of these parameters and of the actual surface requirements (least possible geographical impact, thus its least modification), leads the performed research to provide a highly useful tool to any planning agent, so it can anticipate and/or forecast its space and means needs, way before strategic, marketing or planning decision making.

Up to this date, port planning has been rather based on empirical, analytical or simulation models. Empirical methods are based on productivity average indicators issued by planning agents. These indicators set a relationship between the main activities of a subsystem and the total annual production. These methods are thus very useful when dealing with new terminals planning or master plans development. The reference indicators have been constantly studied and updated by different authors over the years [1], [2], [3], [4], [5], [7], [8]. Analytical methods use mathematical concepts and formulas, based on the queuing theory and requiring large databases. These methods have been studied by several authors ([1], [2], [9]). The study

of [10] emphasized it in his paper "Port and container terminals modelling". The paper mention several studies (i.e.[11], [12], [13]), based on different aspects of the berthing system planning, as the occupation ratio, port congestion percentage, minimum waiting time, total port system costs, optimal number of berthing points and dock cranes, the optimal ratios berthing points/terminal or dock cranes/berthing points, etc. As indicated by UNCTAD<sup>1</sup> [2], simulation techniques use models to represent complex processes, whose mathematical description is not performable due to random behaviour and non-linear characteristics of the process. A detailed description of the method and the results of its application to the Casablanca Port is included in a paper published by UNCTAD [14].

The USA, [15] published a paper that performs a revision on the literature related to the capacity factors, focused on port planning. Other paper has been issued in Singapore [16] dealing with strategic planning issues.

Spanish bibliographical references start back in 1977, [1], with a paper stating the basics of port planning. And [3] would publish later on a comparison between exploitation conditions in several Spanish ports, using empirical methods. More recently, paper [17] presents the parameters and processes to be considered in a container terminal planning. In 2007, in his PhD thesis [18], determinates the characteristic parameters and ratios of the port operation, obtaining their values for each container port terminal. Other papers on logistical planning could also be mentioned [1].

The Artificial Intelligence, concretely the neural networks, is meant to significantly improve the ports' planning. There are practically no papers on neural networks' application in transports' planning, mainly because of the Artificial Intelligence recent release. The origins are set back in 1943 [19], facing a rather difficult start and lack of interest among

<sup>1</sup> UNCTAD: United Nations Conference on Trade and Development ([www.unctad.org](http://www.unctad.org))

the researchers. Higher interest for the artificial intelligence has been shown since 1982, when John Hopfield [20] has stated the Backpropagation algorithm.

Nowadays, well known universities (Boston, Helsinki, Stanford, Carnegie-Mellon, California, and Massachusetts) are developing research programs on neural networks, as well as some private societies in Japan, USA or Europe.

Neural networks' application in transports planning is illustrated in a paper published by Cadiz University, dealing with forecast techniques in road traffic [21].

More recent studies (2010) perform a container traffic forecast in Bangkok Port, using neural networks to explore their applicability to predict future container traffic needs and – through this – to estimate future investments in port extensions [22]. Other studies perform a comparison between traditional and neural networks based forecast techniques used to predict container traffic in the same port [23].

Other studies are issued in 2011 [24], analysing the advantages and/or differences between purely statistical methods and neural networks, in terms of transport research. Cited study deals with the particular suitability of the neural networks to represent non-linear phenomena and with their learning capacity.

There are also papers dealing with neural networks application in short term planning processes; these techniques have been applied to traffic parameters (i.e. flux or occupation) prediction [25], to traffic flux, speed and occupation [26], transportation general problems [27], [28] or to short term train passengers demand [29]. All of them have produced reliable results and promising feedbacks for the future use of the neural networks.

## II. GINI COEFFICIENT, DISSIMILARITY INDEX AND LORENZ CURVE

The Gini coefficient was developed to measure the degree of concentration (inequality) of a variable in a distribution of its elements. It compares the Lorenz curve (figure 1) of a ranked empirical distribution with the line of perfect equality. This line assumes that each element has the same contribution to the total summation of the values of a variable. The Gini coefficient ranges between 0, where there is no concentration (perfect equality), and 1 where there is total concentration (perfect inequality).

The Lorenz curve is a graphical representation of the proportionality of a distribution (the cumulative percentage of the values). To build the Lorenz curve, all the elements of a distribution must be ordered from the most important to the least important. Then, each element is plotted according to their cumulative percentage of X and Y, X being the cumulative percentage of elements and Y being their cumulative importance. For instance, out of a distribution of 10 elements (N), the first element would represent 10% of X and whatever percentage of Y it represents (this percentage must be the highest in the distribution). The second element would cumulatively represent 20% of X (its 10% plus the 10% of the first element) and its percentage of Y plus the percentage of Y of the first element.

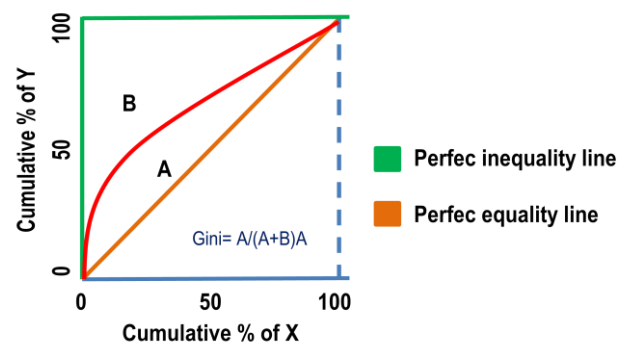


Figure 1. The Lorenz Curve

The Lorenz curve is compared with the perfect equality line, which is a linear relationships that plots a distribution where each element has an equal value in its shares of X and Y. For instance, in a distribution of 10 elements, if there is perfect equality, the 5th element would have a cumulative percentage of 50% for X and Y. The perfect inequality line represents a distribution where one element has the total cumulative percentage of Y while the others have none.

The Gini coefficient is defined graphically as a ratio of two surfaces involving the summation of all vertical deviations between the Lorenz curve and the perfect equality line (A) divided by the difference between the perfect equality and perfect inequality lines (A+B).

Geographers and many others have used the Gini coefficient in numerous instances, such as assessing income distribution among a set of contiguous regions (or countries) or to measure other spatial phenomena such industrial location. Its major purpose as a method in transport geography has been related to measuring the concentration of traffic (figure 1), mainly at terminals, such as assessing changes in port system concentration. Economies of scale in transportation can favor the concentration of traffic at transport terminals, while other considerations such as accessibility to regional markets can be perceived as a countervailing force to concentration. So, the temporal variations of the Gini coefficient reflect changes in the comparative advantages of a location within the transport system.

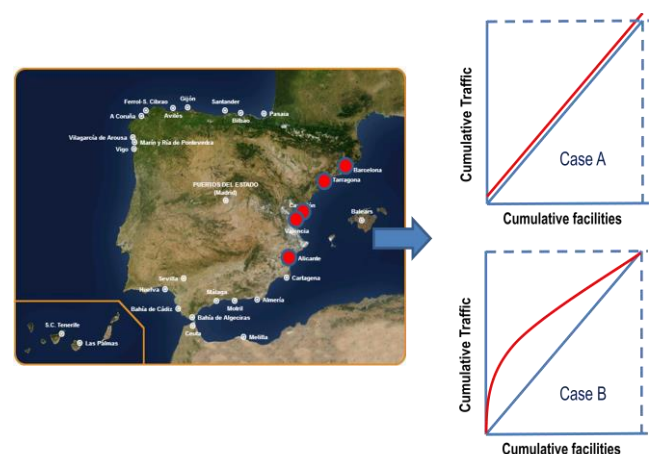


Figure 2. Traffic Concentration and Lorenz Curves

The figure 2 represents a simple system of 5 ports along a coast. In case A, the traffic for each port is the same, so there is no concentration and thus no inequality. The Lorenz curve of this distribution is the same than the perfect equality line; they overlap. In case B, there is some concentration of the traffic in two ports and this concentration is reflected in the Lorenz curve as it is different from the perfect equality line. Case C represents a high level of concentration in *two ports* (for example Barcelona and Valencia) and the Lorenz curve is significantly different from the perfect equality line.

The dissimilarity index is the summation of vertical deviations between the Lorenz curve and the line of perfect equality, also known as the summation of Lorenz differences. The closer the ID is to 1 (or 100 if percentages are used instead of fractions), the more dissimilar the distribution is to the line of perfect equality.

$$ID = 0.5 \sum_{i=1}^N |X_i - Y_i| \quad (1)$$

Where X and Y are percentages (or fractions) of the total number of elements and their respective values (traffic being the most common). N is the number of elements (observations).

The Gini Coefficient represents the area of concentration between the Lorenz curve and the line of perfect equality as it expresses a proportion of the area enclosed by the triangle defined by the line of perfect equality and the line of perfect inequality. The closer the coefficient is to 1, the more unequal the distribution.

$$G = 1 - \sum_{i=0}^N (\sigma Y_{i-1} + \sigma Y_i) (\sigma X_{i-1} - \sigma X_i) \quad (2)$$

Where  $\sigma X$  and  $\sigma Y$  are cumulative percentages of Xs and Ys (in fractions) and N is the number of elements (observations).

### III. CALCULATION OF THE GINI COEFFICIENT, THE DISSIMILARITY INDEX AND THE LORENZ CURVE FOR THE SPANISH PORT SYSTEM BY TYPE OF GOODS

In order to characterize the Spanish Port System calculates the Gini coefficient, the dissimilarity index and Lorenz curve from the years 1960-2010 for the following business units (table I).

TABLE I. BUSINESS UNITS

Business units
• Total traffic
• Liquid bulk cargo
• Solid bulk cargo
• General Merchandise
• Container (TEUs)
• Fresh fish
• Provisioning
• Interior traffic
• Ships

In this paper we will present only the results for: Total traffic, Liquid bulk cargo, Solid bulk cargo, General

Merchandise and Container (TEUs). In Figures 3 through 12 show the Dissimilarity index and the Gini Coefficient of this type of goods.

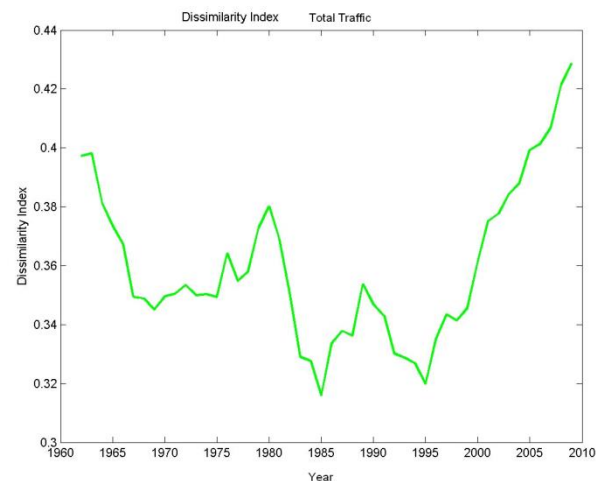


Figure 3. Dissimilarity Index. Liquid Bulk Cargo. Total Traffic

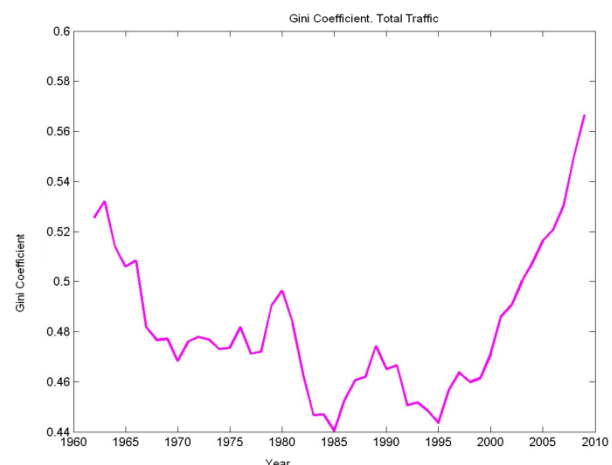


Figure 4. Gini Coefficient. Total Traffic

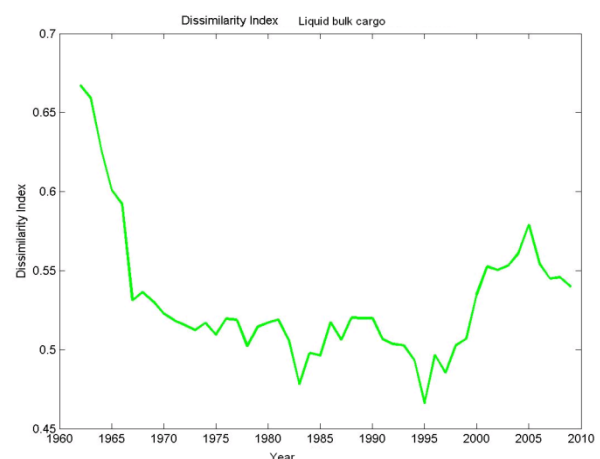


Figure 5. Dissimilarity Index. Liquid Bulk Cargo.

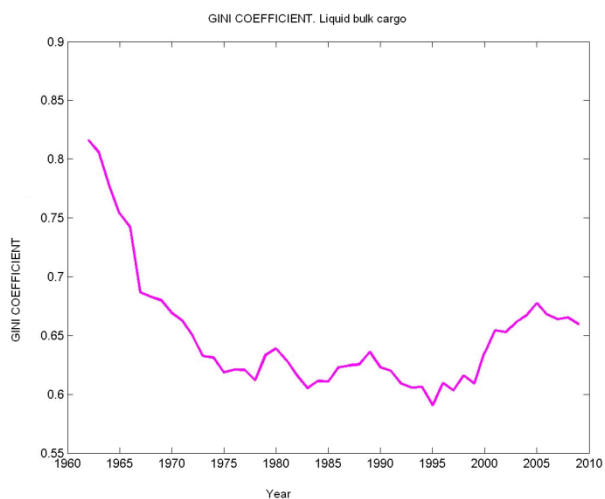


Figure 6. Gini Coefficient. Liquid Bulk Cargo

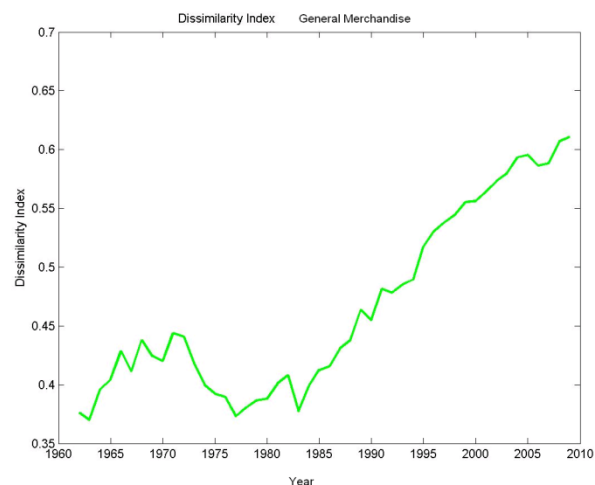


Figure 9. Dissimilarity Index. General Merchandise

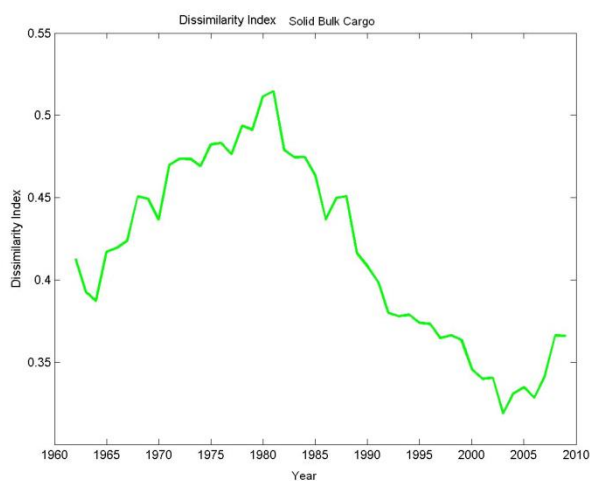


Figure 7. Dissimilarity Index. Solid Bulk Cargo

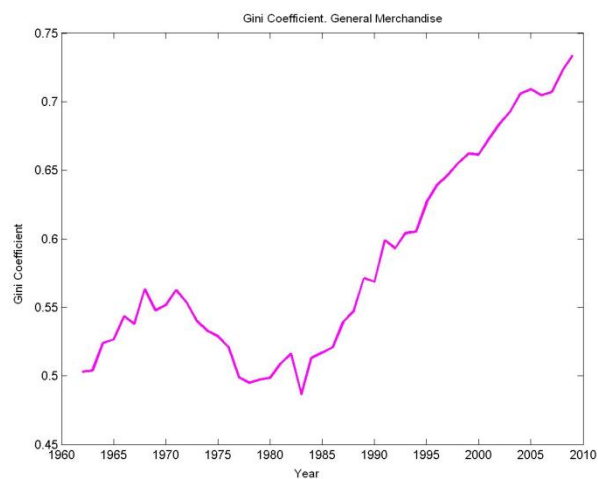


Figure 10. Gini Coefficient. General Merchandise

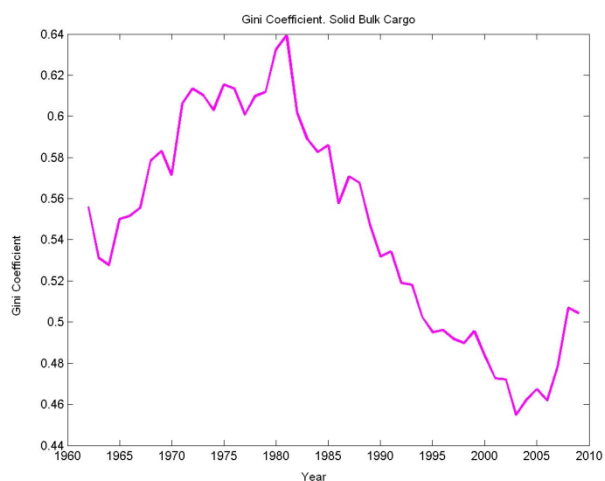


Figure 8. Gini Coefficient. Solid Bulk Cargo

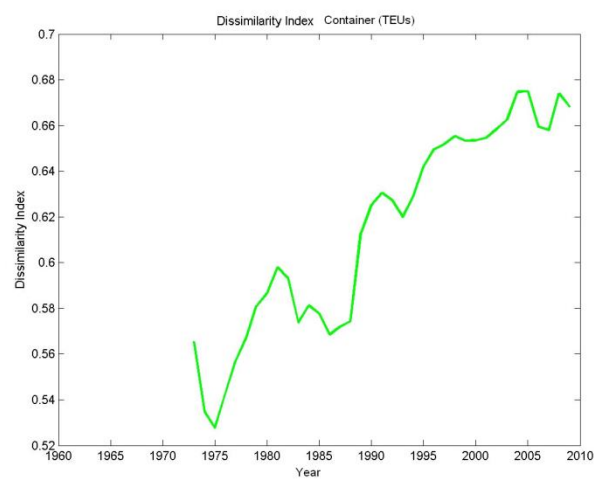


Figure 11. Dissimilarity Index. Container (TEUs)

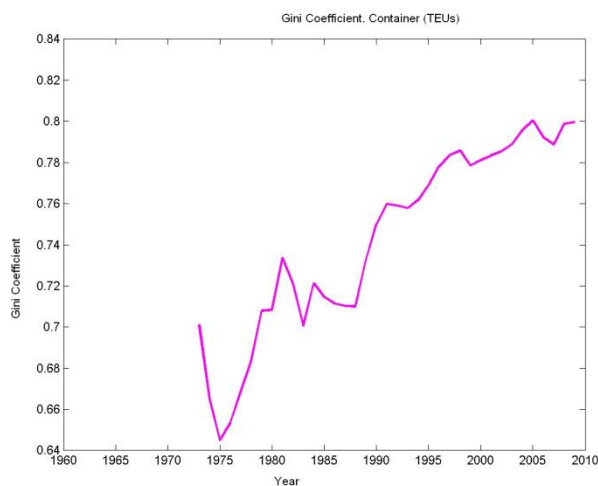


Figure 12. Gini Coefficient. Container (TEUs)

For each year of study and each type of merchandise is estimated Lorenz curve, below are some examples in the figures 13, 14.

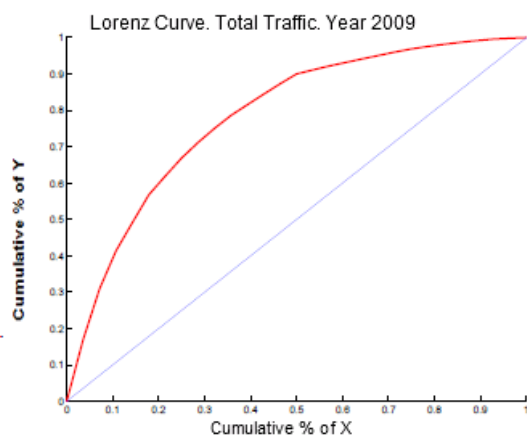


Figure 13. Lorenz Curve. Total Traffic. Year 2009

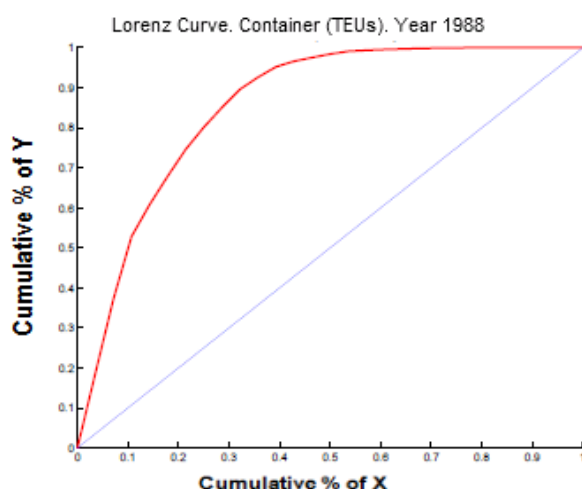


Figure 14. Lorenz Curve. Container (TEUs). Year 1988

## IV. CONCLUSIONS

### Total Traffic:

Both DI and GC exhibit pronounced peaks (closer to 1 greater tendency to inequality in the distribution, merchandise is concentrated in a few ports) in the years 1963, 1975, 1980, 1990 and 2009, which coincides with the first and second crisis oil (1975 and 1978), and after the current crisis is a tendency to concentrate on efficient ports merchandise. The valleys appear in 1985 and 1995 after the following industrial restructuring (1983) where it is close to perfect equality and after the crisis to Latin America in 1994.

### Liquid Bulk Cargo:

Both DI and GC have the same type, but the GC with more pronounced peaks and valleys. The peaks are more pronounced in 1963 and 2005, after the invasion of Iraq, and the valleys in 1983 and 1995 after the Iran-Iraq war (1981) after the crisis with Latin-America in 1994.

### Solid Bulk Cargo:

Both DI and GC have the same type, but the GC with more pronounced peaks and valleys. The peaks are more pronounced in 1979 and 2009 and troughs in 1965 and 2003. The peaks appear after the second oil crisis in 1978 and after the onset of the current crisis. And the valleys after the attacks of 11-S in Madrid and the invasion of Iraq.

### General Merchandise:

Both DI and GC exhibit pronounced peaks (closer than 1 greater tendency to inequality in the distribution, merchandise is concentrated in a few ports) 1965 to 1975, before the oil crisis and 2009 after the start of the current crisis. The valleys are presented between 1977 and 1979 between the first and second oil crisis.

### Container (TEU):

Both DI and GC have the same type, but the GC with more pronounced peaks and valleys. The peaks seen in 1980 and 2005 after the oil crisis and the invasion of Iraq and the valley in 1975 and 1983 after the Iran-Iraq war.

We conclude that for the Spanish port system, the oil crisis tendencies have resulted in concentrating the goods in little more efficient ports and went after the invasion of Iraq. By contrast, the Latin American crisis and the Iran-Iraq War was a tendency for the distribution of goods in all ports of the Spanish port system.

This indicates that as long as the crisis scenario the tendency will be to present both GC, DI as pronounced peaks, closer to 1 indicating greater tendency to inequality in the distribution, and is concentrated in a few ports merchandise.

Regarding the study of the Lorenz curve shows that the total traffic tends to perfection inequality line, more prominent in the case of container traffic.

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# An Econometric Model for the Analysis and Forecast of Rail Passenger Demand

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**Abstract** — An econometric model for the analysis and the forecast of passenger demand of Greek railways is presented in the paper. First, the various parameters affecting rail passenger demand are analyzed: rail fares and fares of competing modes, population, income per capita, frequency of services, travel times, car ownership index and cost of fuel. The new model is developed and calibrated following the General to Specific Approach. The appropriate statistical and diagnostics tests (such as the statistical test of F, the first degree correlation test to residuals through Durbin's-h statistics, residual correlation, heteroscedasticity and normality test, model stability test, skewness and kurtosis, etc.) verified the validity of the model, which proved to have a very satisfactory coefficient of correlation ( $R^2=0.90$ ). The validity of the model has been also corroborated through the study of elasticities. Finally, the forecasting ability of the model through both the Predictive Failure Test and the Theil's Inequality Coefficient proved to be very satisfactory.

**Keywords** – Railways, Econometric model, Forecast, Elasticities.

## I. MODELLING OF TRANSPORT DEMAND

In modern society, transportation problems are increasingly present in everyday life. The significant effects of transport, such as congestion, air and noise pollution, energy consumption and accidents, have caused increasing social and financial concerns. Therefore, public authorities, urban planners, infrastructure and operation managers, are faced with complex operational, design and management challenges. As pure intuition and stochastic approaches are no longer sufficient to elaborate global solutions, the need for dedicated models is essential, in order to help understand the complex mechanisms of interrelations of the transportation system, as well as to quantify and evaluate the impacts of several policies and decisions [1].

A model is a simplified description of reality, designed to yield hypotheses about human behaviour that can be tested. A model can be defined as a *simplified representation of a part of the real world (the system of interest) which concentrates on certain elements considered important for its analysis from a particular point of view* [2]. In this context, the representation is built from mathematical equations that are claimed, under some assumptions, to reproduce a part of reality, (Fig. 1). Transportation problems can be approached from at least two different viewpoints: supply and demand [1, 2]. Supply models focus on the impact of infrastructural improvements on the

aggregate performance of a transportation system. These improvements range from modifications to the network, mainly analyzed through equilibrium assignment techniques, to an efficient use of advanced telematics. On the other hand, understanding, analyzing and forecasting of transportation demand is difficult, mainly because of two reasons [1, 2]:

- the demand for transport is derived, it is not an end in itself. With the possible exception of leisure trips, people travel in order to fulfil a need or to perform an activity.
- the complex nature of human behaviour introduces uncertainty, unpredictability and randomness in the choice process.

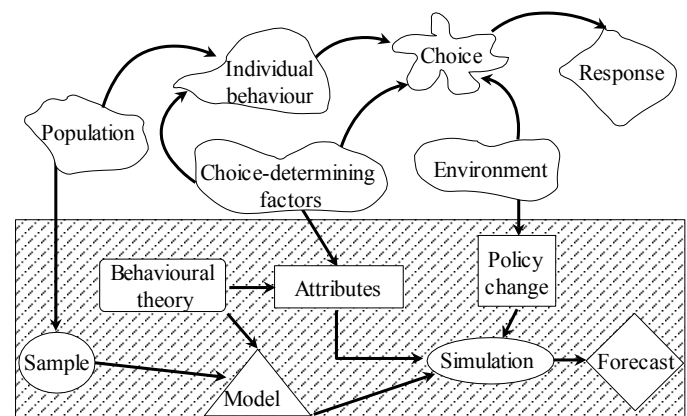


Figure 1. The modelling of transport demand, [2].

## II. REVIEW OF EXISTING ANALYSES ON RAIL PASSENGER DEMAND FORECASTING MODELS

Rail passenger demand has been the object of a number of analyses and papers. Jones and Nicholas adapted a time-series model for traffic between 17 English cities and London using data of the period 1969÷1977 [3], while Fowkes, Nash and Whiteing adapted a similar model for traffic between English cities excluding London [4]. The independent variables of the model were the boundary distance of 160 Km, the employment ratio, the revenue, the fare and the car ownership index. Wilson, Domodaran and Innes described the adaptation of an interurban traffic model in Canada [5]. The analysis developed a trip utility relationship relative to travel time, trip distance, ser-

vice frequency and household income. The model produced good results comparing cars to airplanes, two transport systems with discrete differences concerning travel times and other service quality characteristics. However, results concerning comparison of bus and rail systems were less satisfactory, since the two modes present similar characteristics (travel times and service frequency).

A typical interurban rail demand multivariable regression model is that proposed by Tyler and Hassard [6], who specialized a model commonly known as MONICA (Model for Optimizing the Network Activities of InterCity Activities), predicting rail passenger demand in London. The model included several variables, among which population, rail fare, average speed by rail and road, number of hotel beds, percentage of workers in various production sectors and percentage of workers in various transportation sectors. The coefficient of determination of the model was  $R^2=0.91$ .

A model including four variables (rail fare, car ownership index, employment ratio, the percentage of high speed rail tracks going through London) was proposed for the forecasting of the London rail passenger traffic development. This model had a coefficient of determination  $R^2=0.83$  [7].

Regianni and Stefani developed a multinomial logarithmic model [8]. Trips on the Bergamo–Milan axis by car, bus and rail were studied. A trip utility relationship relative to household income and trip conditions (weather conditions, strikes, etc) was developed.

The French Railways quantified TGV (the French high-speed train) demand using data for the period 1970÷1990, adapting econometric models which had as independent variables the rail trip cost, the household income available for consumption and the cost of fuels [9].

A discrete choice model for cars and rail was adapted on the Lyon–St. Etienne axis [10]. The variables used were the income per capita, the trip cost, the travel times and the service frequency.

A multinomial logarithmic model was adapted for the car and rail for 22 city pairs in the USA [11]. The independent variables used were travel time and trip cost as well as the rail service frequency. The forecasting ability of the model was found to be unsatisfactory, fact attributed to poor statistical data quality.

A similar model was developed in Italy. The model was adapted to 277 zones and included the following transportation modes: car, bus, airplane, conventional trains, intercity trains and night trains [12].

The impact of changes in road travel time on the demand for rail was analyzed by Bela [13], who specified an explanatory model to evaluate the impact of travel time changes on interurban rail demand. The analysis confirmed the explanatory power of changes, in the intermodal structure, of travel times and proved the need to introduce the impact of these changes when studying the demand for interurban travel.

Wardman [14] calibrated a model for forecasting railway demand concluding that the key drivers (independent variables) of rail passenger demand was the Gross Domestic Prod-

uct, the fuel costs, the car ownership and the population. The estimation made use of two large data sets obtained from recorded ticket sales and from travel surveys and the proposed models are in use within the rail industry in Great Britain and have been able to successfully predict rail demand growth since 1998.

Johnson and Nash [15] simulated the effects of introducing competition on a long distance international rail passenger as a way of reducing costs and raising rail demand and Batley et al. [16] developed a dynamic model of rail demand, at the market-level, yielding short- and long-run elasticities with respect to lateness and reliability. They concluded that, whilst rail travellers show considerable disdain for experiences of lateness, such experiences will not necessarily dissuade them from travelling by train.

### III. THE PROPOSED NEW ECONOMETRIC MODEL

An aggregated econometric model for the analysis and forecast of passenger demand of Greek railways will be proposed. The period of analysis spans over the years 1960÷2010, (Fig. 2).

Variables expressed in monetary units have been deflated according to the annual consumer price index. All variables refer on a yearly basis and are incorporated into the model as indexes that have the value 100 for the year 1985 (median year for the period of analysis).

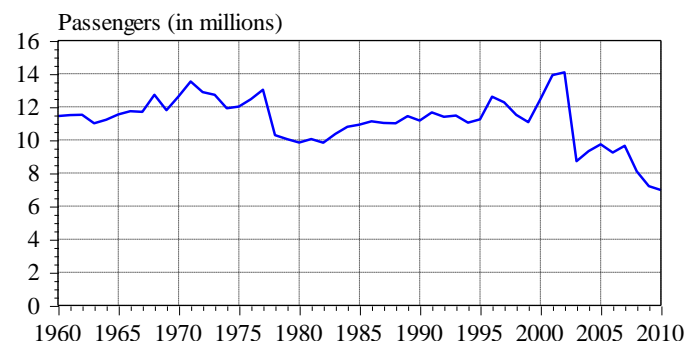


Figure 2. Annual passenger demand of Greek Railways for the period 1960÷2010.

The dependent variable ( $R_d$ ) and the independent variables that will be investigated are:

- $R_d$  : rail passenger demand / population,
- $R_{d,p}$  : average rail passenger travel distance (in km),
- $C_r$  : unit cost of transport by rail (€ per passenger-km),
- $I_{CO}$  : car ownership index,
- $B_w$  : number of busses working in interurban routes per year,
- $B_{d,an}$  : total bus vehicle-kilometres travelled in interurban routes per year,
- $B_{d,av}$  : average bus vehicle-kilometres travelled in interurban routes per year,

$B_{b,p}$  : average bus passenger travel distance (in km),  
 $C_b$  : unit cost of transport by bus (€ per passenger-km),  
 $C_{b,r}$  : competition variable, expressed as the ratio of unit cost by bus to the unit cost by rail,  
 $C_f$  : cost of fuel (€ per litre),  
GDP : Gross Domestic Product of Greece per capita,  
 $d_{78}$  : dummy variable for the year 1978, when Greek railways changed the on-train ticket-buying passenger number estimation method.

Hendry's General to Specific Approach [17] was used for the adjustment of the appropriate demand analysis and forecasting model, (Table I). According to this method, the initial model includes all explaining (independent) variables. The addition or rejection of explaining variables to or from the model is based on the statistical check of the F and the t criterion. The use of a logarithmic model was selected for the immediate determination of constant elasticities [17].

The proposed model's equation is:

$$\ln R_d = -0.356 \cdot \ln C_r - 0.152 \cdot \ln I_{co} + 0.084 \cdot \ln C_f + 0.145 \cdot \ln GDP + 0.743 \cdot \ln R_d(-1) - 0.203 \cdot d_{78} + 2.501$$

where

$R_d(-1)$  : a time lag dependent variable. The use of a time lag depended variable is common in cases of aggregated models of transport demand analysis and represented habitual inertia and constraints on supply (service frequency, rail capacity, services in stations and on trains, etc). As passengers use rail service and acquire an experience of the rail product, they exhibit (or do not so) the tendency to use rail again in the future for their trips. Moreover, travel by rail (as indeed with any other transport mode) comprises a travelling experience, which is usually passed along by *word of mouth*. These factors affect the transport mode's demand much faster than the supply of a rail service [18].

Fig. 3 illustrates the econometric model's results compared to the real number of passengers. A satisfactory model adjustment to real data can be observed, as well as the model's flexibility at transport demand curve inclination change points (turning points).

#### IV. STATISTICAL TESTS FOR THE VALIDITY OF THE MODEL

The model's adjustment to real data is satisfactory with a coefficient of correlation ( $R^2$ ) equal to 0.90. The model's validity is tested by means of statistical and diagnostic tests, which are [17, 18, 20]:

TABLE I. HENDRY'S GENERAL TO SPECIFIC APPROACH FOR THE ADJUSTMENT OF THE APPROPRIATE MODEL.

Variable	General model (adjusted $R^2 = 0.93$ )			Specific (Final) Model (adjusted $R^2 = 0.90$ )		
	Coefficient of variable	Standard error	t-ratio	Coefficient of variable	Standard error	t-ratio
Const. c	-91.618	73.832	-1.24	2.507	0.672	3.73
$R_{d,p}$	-0.223	0.128	-1.75			
$C_r$	-20.217	16.013	-1.26	-0.356	0.081	-4.41
$I_{co}$	-0.262	0.071	-3.67	-0.152	0.029	-2.41
$B_w$	0.060	0.026	2.33			
$B_{d,an}$	-0.055	0.027	-2.05			
$B_{d,av}$	0.054	0.023	2.33			
$D_{b,p}$	0.002	0.002	1.03			
$C_b$	19.821	16.001	1.24			
$C_{b,R}$	19.727	16.005	1.23			
$C_f$	0.063	0.083	0.76	0.084	0.056	1.70
GDP	0.183	0.217	0.84	0.146	0.139	1.45
$d_{78}$	-0.137	0.061	-2.26	-0.203	0.683	-2.97
$R_d(-1)$	0.502	0.098	5.13	0.743	0.092	8.06

— Actual demand — Fitted by econometric model

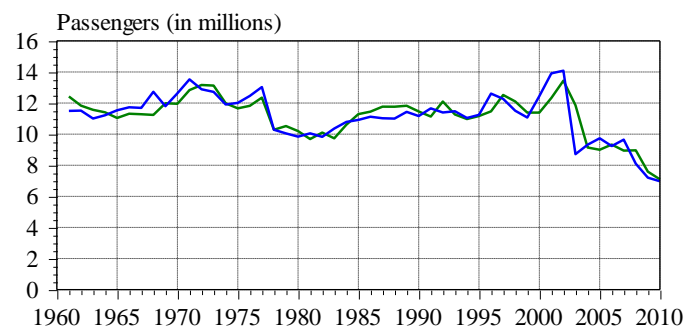


Figure 3. Actual and fitted, by the proposed econometric model, passenger demand of Greek Railways for the period 1960÷2010.

- Collinearity test of independent variables.
- Test of the F-Statistics.
- Statistical test of the standard error.
- First degree correlation test to residual through Durbin's - h statistic.
- Residual correlation test.
- Residual normality test.
- Residual heteroscedasticity test.
- Model function form test.
- Check of residuals in relation to standard error.
- Model stability test.
- Model stability check through Chow's statistical test (Predictive Failure Test).

Prerequisite for the using of the independent variables in a model is the absence of high correlation between the independent variables. In Table II, the correlation matrix of the variables of the econometric model is given. We can remark the low correlation between the independent variables and the high correlation of independent variables with the dependent variable of the econometric model.

F-statistics (6, 43) was found to have the value 79.84, which is sufficiently greater than the critical value of the F-distribution (2.34 for  $n = 40$  and 2.29 for  $n = 50$ , [19]), so that the null hypothesis (for  $\alpha=0.05$ ) that all the explaining variables do not contribute to explaining the dependent variable is rejected. Another positive point regarding the model's adjustment is its low standard error (Regression standard error = 0.063), in relation to the dependent variable's average (4.626).

The absence of model residual first degree self-correlation is also satisfactory. Durbin's-h statistic has the value of 1.48, which is within the space  $+1.96 \div -1.96$ . Due to the presence of the dependent variable's as an explaining variable with a time lag ( $R_d(-1)$ ), the Durbin Watson statistic is not the appropriate for the self-correlation test [20]. The lack of residual self-correlation is confirmed by the appropriate check presented in Table III.

TABLE II. CORRELATION MATRIX OF VARIABLES OF THE MODEL.

Variable	$R_d$	$C_r$	$I_{CO}$	$C_f$	GDP
$R_d$	1.000	0.627	-0.744	0.673	-0.720
$C_r$	0.627	1.000	-0.551	0.519	-0.564
$I_{CO}$	-0.744	-0.551	1.000	-0.364	0.795
$C_f$	0.673	0.519	-0.364	1.000	-0.222
GDP	-0.720	-0.564	0.795	-0.222	1.000

TABLE III. ECONOMETRIC MODEL RESIDUAL DIAGNOSTIC TESTS.

Test	Degree of freedom	$X^2$ Statistic	Critical value
A: Serial correlation	1	1.178	3.841
B: Functional form	1	1.027	3.841
C: Normality	2	0.817	5.991
D: Heteroscedasticity	1	0.165	3.841
E: Predictive Failure	2	0.637	3.841

A: Lagrange multiplier test of residual serial correlation.

B: Ramsey's RESET test using the square of the fitted values.

C: Based on a test of skewness and kurtosis of residuals.

D: Based on the regression of squared residuals on squared fitted values.

E: A test of adequacy of predictions (Chow's second test).

Error self-correlation test is based on the Lagrange Multiplier principle (LM) and is approximated by the  $X^2$  distribution. According to the first test, with a time lag for residuals,

the equation does not suffer from self-correlation, (Table III). Self-correlation order check was extended beyond one (self-correlation order=2, second-order stationary process), whereas results do not reject in all cases the null hypothesis.

The diagnostic test which examines the pattern of distribution and its parameters (residual regularity) does not reject the null hypothesis that residuals are in accordance to the normal distribution. The  $X^2$  distribution is equal to 0.817, whereas the critical value for two freedom degrees and a significance level of  $\alpha=0.05$  is 5.991 [19].

Residual heteroscedasticity test showed that residuals have a standard fluctuation (homoscedastic error fluctuation) as the  $X^2$  distribution's value is 0.165, whereas the critical value for one degree of freedom and an significance level of  $\alpha=0.05$  is 3.841 [19].

A final residual check is given in Fig. 4. It is observed that all errors are within the predefined limits set by the standard error bands.

In what regards the model's stability and its robustness, the entire selected time period of the sample used for the model's adjustment is checked regarding its importance on the model's form through recursive regressions. In order to establish the degree in which the model has been appropriately specialized, the Cumulative Sum check (CUSUM), (Fig. 5), and the Cumulative Sum Squared check (CUSUMQ), (Fig. 6), were implemented. The figures present the two checks with the critical bounds for a 5% significance level. If any of the two measurements exceeds the critical bounds for a 5% significance level, then the null hypothesis that the model has been appropriately specialized is rejected.

However, the presence in the proposed econometric model of the dependent variable (through a time lag) causes doubts for the reliability of the Cumulative Sum and the Cumulative Sum Squared check, because there have been reported cases in which the ability of the two tests to detect the models' stability was unsatisfactory [20]. Therefore, Chow's second test must also be implemented, whereas the model's robustness is tested through the Predictive Failure Test, (Table III). The test was used for the period 1961÷2008 for which the F-statistics (2,42) value was equal to 1.637. This value is lesser than the corresponding table's critical value (3.18 for 50 periods: years 1960÷2010, [19]), which means that the null hypothesis for the model's stability cannot be rejected.

## V. RAIL PASSENGER DEMAND ELASTICITIES

The model's validity is corroborated, besides the diagnostic checks, by the signs of the coefficients of the independent variables, which in fact represents the elasticities of independent variables:

- ♦ For the variable  $C_r$  (unit cost, per passenger kilometre, of transport by rail) a negative sign was correctly calculated, since an increase in a mode's use cost has a negative effect on its demand.

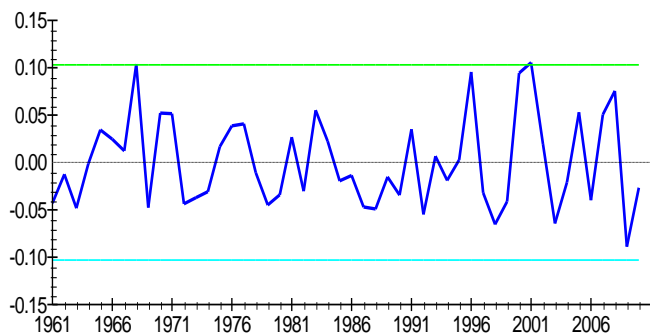
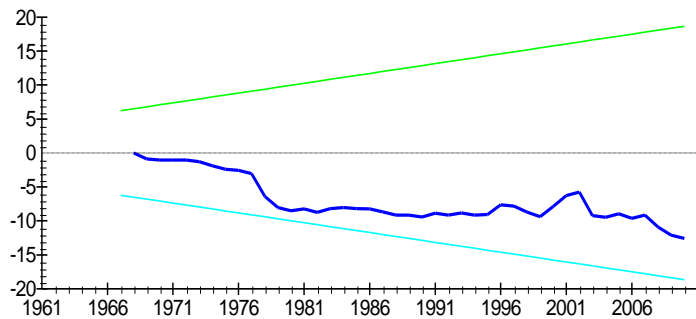
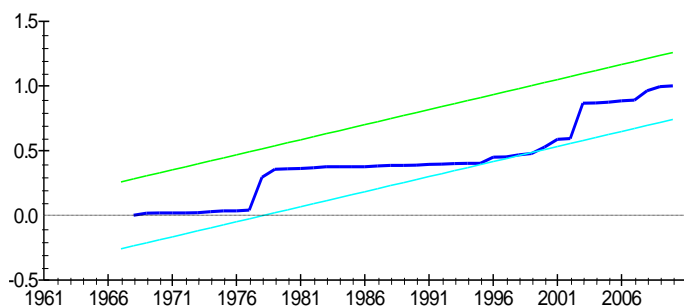


Figure 4. Residuals of the econometric model



The straight lines represent critical bounds at 5% significance level

Figure 5. Cumulative Sum check of recursive residuals (with critical bounds) for a 5% significance level



The straight lines represent critical bounds at 5% significance level

Figure 6. Cumulative Sum Squared check of recursive residuals (with critical bounds) for a 5% significance level

- ◆ For the variable  $I_{CO}$  (car ownership index) a negative sign was correctly calculated since an increase in the car ownership index has an adverse effect on mass transport modes' demand.
- ◆ For the variable  $C_f$  which expresses the cost of fuels, a positive sign was calculated, which can be interpreted as that an increase on the cost of fuels, which especially affects the cost of use of private cars and interurban bus services, has a positive impact on rail's demand. The low value of the coefficient (0.084) shows that fuel price not only affects the demand of other transport modes, but it also affects the demand of railways.
- ◆ For the variable GDP (Gross Domestic Product per capita) a positive sign was calculated, since an income

increase is expected to have a positive effect on rail demand. The low value (0.146) of the coefficient of the specific independent variable suggests that rail transport is considered a regular good (as opposed to high values which reflect luxury goods) and therefore its demand is not heavily affected by economic conditions.

- ◆ The variable on which we should probably emphasize is the  $R_d(-1)$ . Besides its high importance in the explaining of passenger demand ( $t$ -ratio=8.06), it also has the highest value of all independent variables (0.743). If Greek railway services (transport quality, employee behaviour, cleanliness, reliability) could be quantified, it could be said that a 1% increase in them would lead to 0.743% increase of rail demand.
- ◆ The importance of the constant  $c$  ( $t$ -ratio=3.73) and its high value (2.507) suggest that rail is an important transportation mode at the consumer's disposal and regardless the evolution of other factors affecting rail demand, there will always be a minimum demand for rail travel.

## VI. FORECASTING ABILITY OF THE PROPOSED MODEL

The forecasting ability of the proposed model is tested with the Theil's Inequality Coefficient, which allows the examination of residuals and the appraisal of the forecasting ability of proposed models, providing a measure of how well the time series of the estimated (fitted) values compares to the corresponding time series of the actual (observed) values. Theil's Inequality Coefficient, also known as Theil's U, is defined as [21]:

$$\text{Theil's } U = \frac{\sqrt{\frac{1}{n} \sum_{t=1}^n (Y_t^f - Y_t^a)^2}}{\sqrt{\frac{1}{n} \sum_{t=1}^n (Y_t^f)^2} + \sqrt{\frac{1}{n} \sum_{t=1}^n (Y_t^a)^2}}, \quad (t = 1, 2, \dots, n)$$

where:

- $n$  : total number of time series data (annual arrivals),
- $Y_t^f$  : fitted, by the econometric model, values of depended variable for the year  $t$ ,
- $Y_t^a$  : actual values of dependent variable for the year  $t$ .

When Theil's Inequality Coefficient is calculated equal to zero, then the model's forecasting ability is perfect, whereas when Theil's Inequality Coefficient is calculated equal to one; the model lacks any forecasting ability. In practice, values of 0.55 or less are accepted [21, 22].

The Theil's Inequality Coefficient for the proposed econometric model was calculated equal to 0.0076, very close to the ideal value, which, as explained earlier, is zero.

## VII. CONCLUSIONS

The paper suggests an aggregate econometric model for the analysis and forecast of passenger demand of Greek railways. Based on the classical econometric theory, we selected, after trial and error efforts, the critical explanatory (independent) variables, which influence the development of the railway passenger traffic.

The calibration of the econometric model shows that the independent variables, which explain the rail passenger demand in Greece, are the rail fare, the cost of fuel, the income per capita, the car ownership index and a variable which represented habitual inertia and constrains on supply (service frequency, rail capacity, services in stations and on trains, etc).

Finally, the forecasting ability of the proposed econometric model was tested with the Theil's Inequality Coefficient, the value of which was calculated equal to 0.0076, very close to the ideal value of zero.

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# Delphi-SWOT as a strategic tool of planning for the Port of Manta

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**Abstract—** The ports become very important in multimodal logistics in Latin America, they compete to capture as much of port traffic within its hinterland and foreland. However, despite the converging forces of countries that want to excel within the port system, it can be argued that only a few ports enjoy the technology, infrastructure, modes, terminals, natural and geostrategic advantages for a perfect integration. This paper analyzes the Port of Manta, located on the west coast of Ecuador, the methodological tools are based on a comparative analysis SWOT in collaboration with DELPHI Expert Group in order to provide an analytical framework to understand how it is possible to convert Manta hub port, it is shown in the conclusions that the application of an offensive strategy predicated on the advantages of the Port of Manta over other American ports and with a pulse based on consensus proposals can position it in the multimodal logistics chain in Latin America.

**Keywords-** port; multimodal transport; logistics; SWOT analysis; Delphi

## I. INTRODUCTION

Ecuador, officially the Republic of Ecuador, is a country located in the northwestern region of South America. Ecuador is the third fastest growing economy in Latin America and is currently one of the countries that has the lowest unemployment rate in America and around the world. The economic dynamism that is achieving the country is reflected in economic growth of 5.2% year on year, according to data from the Central Bank of Ecuador. It features a high growth in the aquaculture sector, which is also reflected in a significant increase in employment in the fisheries sector. Ecuador is one of the countries with greatest biodiversity and mineral resources in the world, with unique plant and animal species and the only one in the world that has in its constitution the right to environment [1].

Seaports are a remarkable point in trade and tourism, that is why its modernization in recent years has allowed to ports like Manta can reach large cruise and cargo ships and others. Another port of great importance is that of Posorja in the Gulf of Guayaquil, mostly cargo. Port Bolivar in Machala is mainly for agricultural exports such as bananas, shrimp, cocoa, etc. Port of Esmeraldas is mainly for industrial export of oil, gas and petroleum products [2].

The Port of Manta can be integrated into multimodal logistics in Latin America, but requires action strategy Manta

Port Authority should take the opportunity to have again to operate the Port of Manta, to make it a transfer port.

It is imperative that as a precursor to investment by the state are made proposals Analysis methodology grounded in being vital tools for planning, is the reason why this study become important and has attracted interest from the Port Authority of Manta, being the only one who has been interested in expert judgment involved directly with the port for their proposals and exchange views allow positioning the port of Manta among the most important in the region [3].

## II. METHODOLOGY

The methodology used in this study gives us a general view of the state of the Port of Manta and recognize the strategies proposed to achieve integration into multimodal logistics in Latin America [4].

Continuing the investigation in this issue will present the results of the application of the methodology

In a systematic and summarized way it will outline the methodology.

The methodology consists of four major blocks

- Determination of the job scenario: SWOT Matrix
- Assigning weighted grades: Delphi Panel
- Descriptive statistical analysis of weighted grades
- Decision making: Strategy

Figure 1 shows a synthesized form each of the blocks that form the methodology, they allow obtaining proposals for the integration of the Port of Manta in multimodal logistics in Latin America from completing a SWOT analysis by an expert panel (DELPHI).

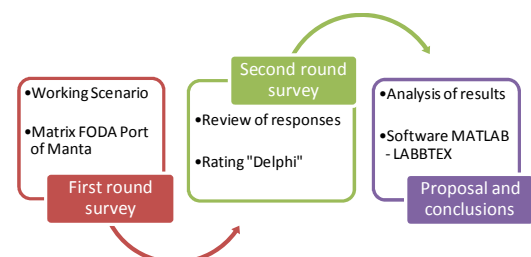


Figure 1. Methodological process

### A. Determination of the stage of work: SWOT Matrix

Of the four Ecuadorian ports, the working stage where it will be applied the SWOT matrix is the Port of Manta, the interest is that it is located in the city where I live, has a favorable condition to become hub port in Latin America and I think it can be exploited to its maximum potential through research with real data in order to develop proposals and strategies to put it into the main ports of navigable routes from Asia to South America.

In this year the Port of Manta faces great challenges as a millionaire public investment, foreign investor visits, the administration of the Port Authority in autonomous regime, projected to be part of the Manta-Manaos multimodal corridor that connects the Pacific Ocean with the Atlantic Ocean; all these combined to supply its hinterland and foreland. All this makes it necessary to undertake studies as proposed by planning tools that allow the Port of Manta position as a hub port in the multimodal logistics in Latin America.

#### 1) Analysis SWOT

The technique used to estimate the strategy to take decisions regarding the Port of Manta is the SWOT, which allows identification of strengths, weaknesses, opportunities and threats of the Port of Manta, in Figure 2 shows the parameters involved in this analysis.

Before taking any strategic decision, it is essential to diagnose the Port of Manta. SWOT analysis is the most simple and effective method to decide on the future. It will help us raise the actions to be put in place to take advantage of opportunities and to prepare the port detected threats being aware of their weaknesses and strength [5].

The main goal of a SWOT analysis will help the port meet their critical strategic factors, for once identified, use them and support organizational change: consolidating the strengths and minimizing the weaknesses, taking advantage of opportunities, and eliminating or reducing threats. The SWOT analysis is based on two pillars: the internal analysis and external analysis of the port.



Figure 2. Parameters involved in the SWOT analysis

For a better understanding of the application of SWOT analysis, the major Strengths, Weaknesses, Opportunities and Threats of the Port of Manta will be described.

Strengths of the Port of Manta are special abilities, controlling resources, possessing skills, activities developed positively and thus has a privileged position compared to the competition regarding the shipping and logistics potential [6]. Its comparative advantages are associated with having an open sea access to 25 nautical miles from international maritime traffic route, without natural channels, with depths of 12 meters at the lowest tide, allowing the entry of big ships 24 hours a day, 365 days a year, with no time standby, making it an attractive investment port.

Opportunities are those factors that are positive, favorable, exploitable, that should be discovered in the environment in which the port of Manta operates, allowing to obtain competitive advantages over nearby ports. Currently the most significant opportunity for the port of Manta is the national government's commitment to build the deepwater port, the public investment will reach \$ 106 million.

Weaknesses: are those factors that cause an unfavorable position against the competition with regional and international ports, lacking resources of the port, skills which does not possess in port logistics, activities that do not develop positively, in short, everything what has prevented the port integrates multimodal logistics in the region. It has been identified as a weakness of the Port of Manta burden not having own, except seafood, but are shipped through the Port of Guayaquil, due to lack of shipping frequencies [7].

Threats: are those situations from the environment of the port and can reach even attempt against the permanence of it. In the present study, it is recognized as a national competition threatens the port of Guayaquil and international ports like Callao in Peru.

#### 2) Development SWOT Matrix

The aim of the analysis phase is to establish an information system, build the schema SWOT (Table I), the basis for planning and identify critical factors for success. This requires:

- Identify the stakeholders
- Analysis Internal / External on questionnaire EFQM (European Foundation for Quality Management)
- Identify the competition
- Establish a monitoring system
- Establish an information system
- Identify key processes

TABLE I. MATRIX OF DIAGNOSIS SWOT

	O1	O2	O3	O4	O5	A1	A2	A3	A4	A5	total
F1											
F2											
F3											
F4											
F5											
					1					2	F1+2
D1											
D2											
D3											
D4											
D5											
					3					4	D3+4
total					O1+3					A2+4	

The SWOT matrix is composed with the strengths, weaknesses, opportunities and threats identified in the Port of Manta, these parameters have been identified after an extensive literature review and supplemented by expert judgment by members of the UPM Department of Civil Engineering and Transport, of the research group LET&GO.

Strengths and Weaknesses vs. Opportunities and Threats are confronted in this matrix, that allows us to recognize the scenarios offensive, defensive, adaptive and survival facing the Port of Manta.

Offensive strategies are the ideal position: rapid growth and achievement of the objectives. The port of Manta is prepared to deal with threats. If your service is no longer considered a leader in multimodal logistics chain, you must highlight what differentiates you from the competition, for example their access to open water 25 miles nautical without channels and with natural depths of 12 meters in the tidal low.

Defensive strategies are to face the threats. Manta, as transfer port, must adopt a strategy of growth [8]. When Puerto strengths are recognized by shipping agencies and international investors.

Orientation strategies when opportunities arise as to benefit, but there is no adequate preparation. At this time the Port of Manta has a unique opportunity with the investment commitment by the Government to increase to \$ 106 million, but the port itself has no charge, no shipping frequency, small administrative and technical staff that allows absorb this investment. It will require new hires and diversify existing port services because they are not giving the expected results.

Survival strategies are used to combat threats when you do not have the necessary strengths. The port of Manta faces external threats such as competition with ports in the region and international terminals like Callao - Peru, without internal forces needed to deal with the ports that are in the same path of international maritime traffic. It is advisable to leave things as they are until they are seated changes that will occur with the new state investments. [9].

#### B. Weighted grade Assignment: Delphi Panel

The objective of the Delphi group in this study is the achievement of a consensus based on the discussion between experts involved with the Port of Manta, as well as external consultants, they will give weights in a survey to the relationship between parameters: Strengths vs. Opportunities, Strengths vs Threats, Weaknesses vs. Opportunities and Weaknesses vs Threats.[10].

In a matrix as in Table I, strengths and weaknesses are confronted with opportunities and threats listed in Table II, the group of experts Delphi will respond to a survey consisting of a matrix, we choose the score with range of 0-5 (5 being the highest relationship between parameters).

TABLE II. PARAMETERS THAT MAKE SWOT MATRIX

	STRENGTHS		OPPORTUNITIES
F1	Location geostrategic	O1	State investment in the Port
F2	25 nautical miles to the International Maritime Route	O2	Transfer Port concession
F3	Port facilities	O3	Creating Pacific Refinery
F4	Logistics cluster	O4	Project Manta- Manaus
F5	Multipurpose port	O5	Settlement of Industries in the city
F6	Port Authority Autonomy		
F7	International Safety Certification		
F8	Natural Draught 12 m		
	WEAKNESSES		THREATS
D1	Location within the city	A1	Centralization of Management port in Guayaquil
D2	Lack own load	A2	Law ports on modification process
D3	Lack of shipping frequencies	A3	Customs exhaustive inspections
D4	Road connections	A4	Competition Peruvian ports (Callao)
D5	More time in port (131,89 Hrs / ship. For hours ship)	A5	Limit the rehabilitation of existing port facilities
D6	Lack of technology		

Questions to ask the expert before assigning a score between parameters: What score deserves the relationship between these two parameters?, Does it affect a lot or a little?

There will be two rounds of survey to the Panel of Experts, at the end of the first round, after receiving the information, it returns to conduct another survey based on the above to be answered again, is justified as a feedback process to the same experts as part of a survey next round (next-round). Then experts revalued their views in the light of this information, and group consensus tends to emerge.

#### 1) Selection of expert panel

A careful selection of experts has been made, so that the results are as attached to the reality of the Port of Manta.

The Expert Panel is composed of two groups: practical and theoretical (Figure 3). Experts theoretical are composed by researchers and consultants (universities, consultants), while practical experts consist of managers and port stakeholders (shippers, trade chamber, Port Authority).

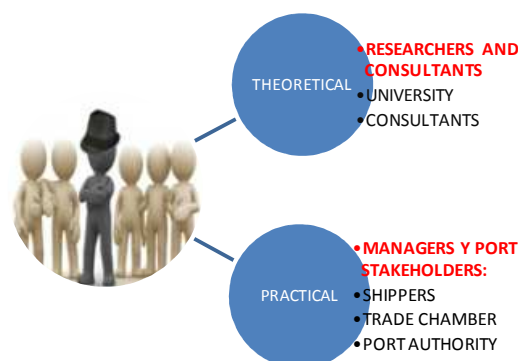


Figure 3. Delphi Group Members

It's really interesting to compare the views from both perspectives; within the results the most relevant will be reported.

It should be noted that this survey is only enabled for the group "Delphi", this is possible from a virtual platform that is accessed through a link to give their score and allow it to feed the database.

### C. Descriptive statistical analysis of weighted rankings

At the time of having all the data, conclusions will be drawn up from the statistical exploitation of the data obtained, there will be the support of programs Matlab ® and LABBTEX [11]. Toolbox for LaTeX reporting for Matlab ®. LABBTEX is a software developed by Team H3lite within the Department of Civil Engineering, Transport, School of Civil Engineering of the Polytechnic University of Madrid

#### 1) Detailed study of SWOT Matrix

The shape of the survey based on SWOT analysis allows the detailed study in quadrants so they can be compared: offensive, defensive, adaptive and survival, in order to define which quadrant have receive the highest score from the DELPHI panel. In addition there will be a study confronting theoretical expert opinion with practical experts, with a final study full expert panel.

#### 2) Descriptive statistics study

The descriptive statistical study allows to know the result of consensus of the expert panel DELPHI, to see ratings trends, to recognize the strategic quadrant on which the proposed strategies will be focus, in addition to notice the best opportunity and the worst strength. It is very thorough analysis which includes the following studies shown in Figure 4:

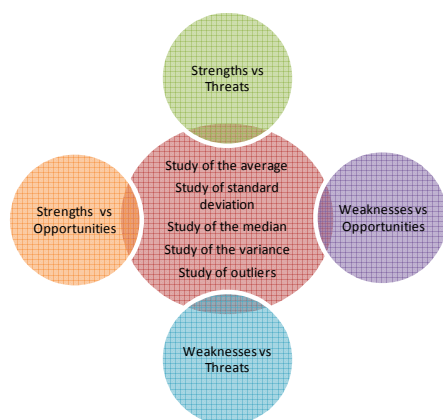


Figure 4. Descriptive statistics study SWOT matrix

The representation of these data will be done by quadrants according to a statistic parameter, they will be distinguished by the intensity of colors, being redder tones which reach highest score and the most blue which correspond to a lower score.

To improve visualization and understanding of the results, they are presented in 3D graphics with the respective quadrant scores and DELPHI Expert Panel.

## III. RESULTS

In this first round of surveys the results of the study of the average of the weights of the SWOT matrix will be present in quadrants. These are the following results:

### A. Quadrant 1. Study of the average for Strengths vs Opportunities

The relation with the highest score is the Strength 2: A 25 nautical miles from the International Maritime Traffic Route with Opportunity 3: Creating Pacific Refinery, and the lowest is the Strength 6: Port Authority Autonomy with Opportunity 3: Creation Pacific Refinery.

Scores are shown in Table II and 3D graphical representation in Figure 5.

TABLE III. STUDY OF THE AVERAGE FOR STRENGTHS VS OPPORTUNITIES

F/O	1	2	3	4	5
1	3.95	3.35	3.85	4	4.15
2	3.4	3.5	4.25	3.85	3.85
3	3.7	3.35	3.05	3.15	3.25
4	3.2	3.25	2.8	3.7	4
5	3.5	3.45	3.55	3.6	3.95
6	2.65	2.7	2.1	2.65	2.25
7	3.2	3.3	3.2	3.25	3.2
8	3.15	3.9	3.8	3.85	3.1

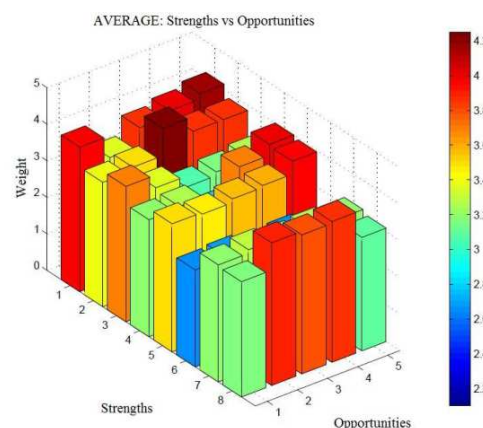


Figure 5. Study of the average for Strengths vs Opportunities

### B. Quadrant 2. Study of the average for Strengths vs Threats

The Strength 1: Location geostrategic with Threat 4: Competition with Peruvian ports (Callao), is the ratio of parameters with the highest scores obtained from Delphi expert panel, while the lowest is the Fortress 8: Natural Draught 12 m with the Threat 3: Customs Inspections exhaustive.

Scores are shown in Table III and 3D graphical representation in Figure 6.

TABLE IV. STUDY OF THE AVERAGE FOR STRENGTHS VS THREATS

F/A	1	2	3	4	5
1	1.85	2	1.25	3.05	1.75
2	1.65	1.35	1.3	2.9	1.45
3	1.35	1.95	1.95	2.9	2.7
4	2.45	1.65	1.95	2.6	2.55
5	1.85	1.85	1.9	2.7	2.8
6	2.05	2.85	2	2.2	1.8
7	1.35	1.4	1.85	2.65	1.85
8	1.1	1	0.6	2.3	1.95

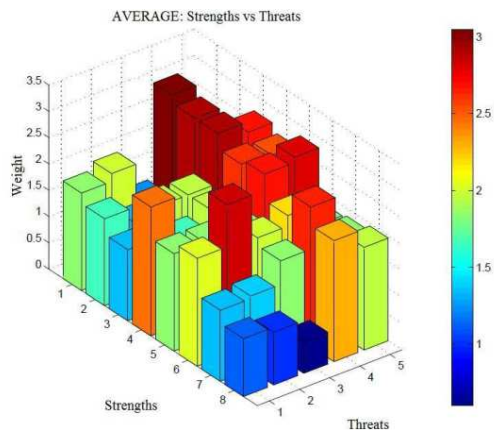


Figure 6. Study of the average for Strengths vs Threats

#### C. Quadrant 3. Study of the average for Weaknesses vs Opportunities

DELPHI panel considered in the first round of surveys that Weakness 6: Lack of technology with the Opportunity 1: State investment in the Port, have the highest ratio, being the lowest Weakness 5: Increased time in port (131, 89 hrs / Buq. hourly ship) and Opportunity 3: Creating Pacific Refinery.

Scores are shown in Table V and 3D graphical representation in Figure 7.

TABLE V. STUDY OF THE AVERAGE FOR WEAKNESSES VS OPPORTUNITIES

D/O	1	2	3	4	5
1	2.6	2.15	1.95	2.45	2.8
2	2.25	3	2.05	2.55	2.7
3	2.85	3.05	2.15	2.6	2.75
4	2.9	2.25	2.35	2.75	2.95
5	2.25	2.65	1.85	2.35	2.2
6	3.4	2.7	2.25	2.5	2.3

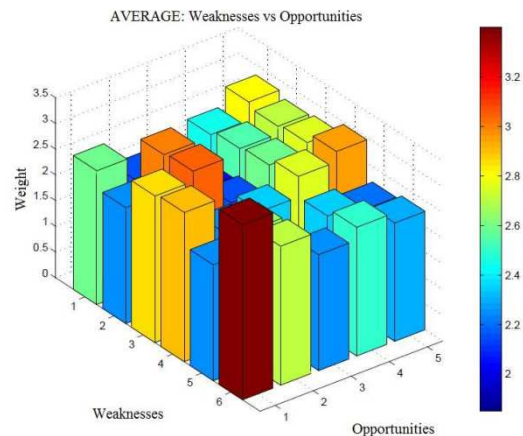


Figure 7. Study of the average for Weaknesses vs Opportunities

#### D. Quadrant 4. Study of the average for Weaknesses vs Threats

Highest scores by the expert group rests on the relationship of parameters Weakness 2: Lack of own load versus Threat 4: Competition with Peruvian ports (Callao), while the least score is for the ratio of Weakness 4: Connections vials and Threat 3: Customs Inspections exhaustive.

Scores are shown in Table V and 3D graphical representation in Figure 8.

TABLE VI. STUDY OF THE AVERAGE FOR WEAKNESSES VS THREATS

D/A	1	2	3	4	5
1	2.25	1.75	1.65	2.05	2
2	3.2	2.25	2.3	4.05	3.3
3	3.35	2.3	2.55	3.8	3
4	2.35	1.65	1.5	3.15	2.05
5	2.6	1.65	2.25	3.25	2.5
6	3.3	2.2	2.35	3.95	2.8

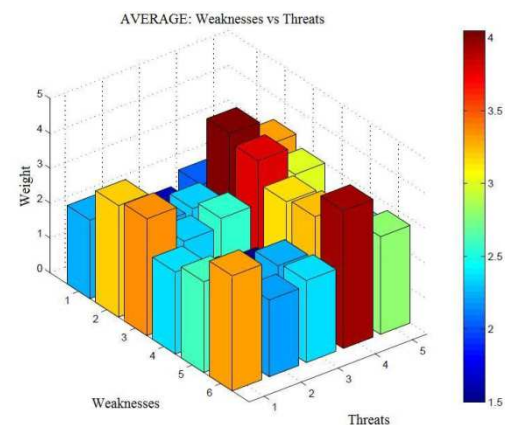


Figure 8. Study of the average for Weaknesses vs Threats

Within the expert criteria, Figure 9 shows the score in the first quadrant of theoretical group, and Figure 10 shows the group score practical.

The first quadrant: Strengths vs. Opportunities, with a rating of 99.6 is chosen by the theory group as the best, while

the worst is quadrant 2: Threats vs. Strengths, with a rating of 67.5

For theoretical group the best strength is F1: Geostrategic Location and the best opportunity is O2: Transfer Port Award, while the worst strength is the F6: Autonomy Manta Port Authority and the worst opportunity is the O3: Creating Pacific Refinery.

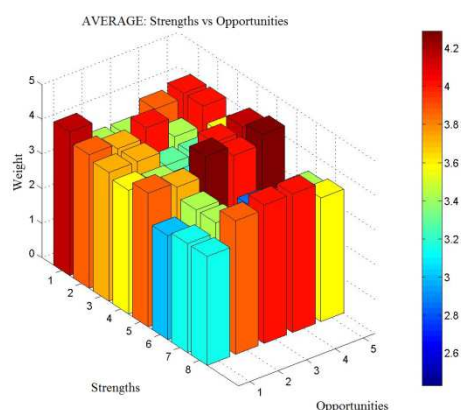


Figure 9. Study of the average in the first quadrant Theoretical Group

The practical group gives the highest score 105.6 to quadrant 1: Strengths vs. Opportunity, and the lowest score 55.42 to quadrant 2: Threats vs. Strengths.

For practical group, the greatest strength is the F5: Multipurpose Port and the best opportunity is the O5: Settlement of Industries in the city, while the worst strength is the F6: Autonomy Manta Port Authority and the worst opportunity is the O3: Creation Pacific Refinery.

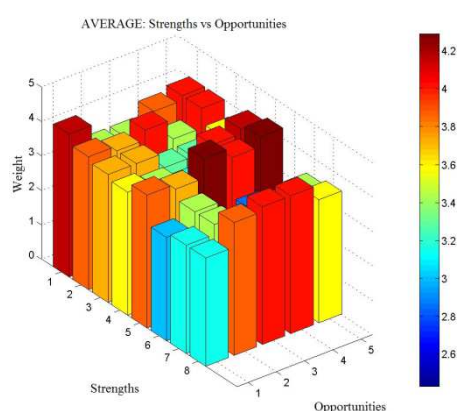


Figure 10. Study of the average in the first quadrant Practical Group

In the first quadrant chosen by both groups of experts as the best, most relevant results of the study about the standard deviation are featured; the lowest strength is F3 and the lowest opportunity is O2, in these parameters experts have rated values closer to the average.

In F1 and O4 their centralization mean or median is the highest with a value of 4, while F6, O1 and O3 have a lower median with values ranging between 2.5 and 4

The F3 and O2 in the statistical analysis of variance are the least dispersed parameters in relation to the mean, while F6 and O5 are the most dispersed.

The most dispersed parameters of the rest of values outliers are F6 and O3, while the least dispersed are F2 and O5.

#### IV. CONCLUSIONS

The SWOT methodology has proven to be a useful tool to know internal and external factors which benefit and affect the Port of Manta, as a first conclusion, within the scope of the planning this study was conducted in a participatory manner, joining the plurality representatively point of view of Delphi expert panel within the SWOT matrix. It was also possible to obtain a complete analysis to the decision-making strategies to follow based on consensus, all this after approaching the methodological process orderly.

With regard to the results which have been shown by the statistical study of the scores of DELPHI Expert Panel within the SWOT matrix applied particularly to the Port of Manta, the most relevant to be shared at this conference are:

The scores of the four quadrants were summed to know the highest score and lowest score, in the order from highest to lowest the quadrants, the following position was obtained: Strengths- Opportunities, Weaknesses-Threats, Weaknesses-Opportunities, Strengths-Threats, this was the first step to estimate where the strategy and objectives should be focused.

For the study of the Port of Manta is clear that the strategy to implement is Offensive which promotes the strengths to take advantage of opportunities, as mentioned above this approach is key this year because the Port of Manta faces major challenges as opportunities to be taken, such as a million-dollar public investment, foreign investor visits, the administration of the Port Authority in autonomous regime, projections to be part of the Manta-Manaos multimodal corridor that connects the Pacific Ocean with the Atlantic Ocean, all these combined to supply its hinterland and foreland [12].

Within the quadrant Strengths-Opportunities, strength with the highest score is the F1, the expert panel considers its geo-strategic and privileged location, along the Pacific Ocean, makes it the focal point and integration of foreign trade South America with the rest of the world, while the strength with less score is F6, the Autonomy of Manta Port Authority, this shows that the administration by public entities of Ecuadorian ports has been little successful, losing credibility, but this may change if Manta Port Authority shows an efficient management whenever the National Government has given power to do so.

In the first quadrant the highest scoring opportunity is O4, experts conclude that with the impulse and consolidation of the Manta-Manaus project, a high development of sea, land and river will be reached to benefit the Ecuadorian manufacturing sector; with the lowest score is O3: The Pacific Refinery requires a reception and mobility capability to handle a volume of about 400 000 tonnes projected to arrive since the end of 2015, it is assumed that this project will need its own port or a port closer to their facilities therefore not represent a greater volume of cargo for the Port of Manta.

The quadrant with the lowest score is the Strengths-Threats, its defensive character invites to reinforce strengths in order to minimize threats, it is concluded that the port of Manta has as its objective current its internal structure under the Port

Authority Administration, consolidated from the inside out, therefore not focused on external threats, but in the short term will have to do it because in the competitive market of port logistics it cannot forget that other ports are capturing their foreland. One way to improve this quadrant is to rediscover the strengths that make it unique to the Port of Manta against its competitors and to promote it nationally and internationally.

Also from Delphi panel scores it is possible to conclude that practical experts scored much higher quadrant 1, researchers and consultants who make up the theoretical group are more conservative, as well as they score much worse the second quadrant both expert groups.

From the perspective of both groups, they agree that the worst Fortaleza is the F6: Autonomy Port Authority and the worst opportunity is the O3: Creating Pacific Refinery, however differences in the best strength and opportunity are shown, for the theoretical group the best strength is F1: Geostrategic Location and the best opportunity is O2 Transfer Port Concession, however for practical group the greatest strength is the F5: Puerto Multipurpose and the best opportunity is the O5: Settlement of Industries in the city.

For the theory group composed of researchers and consultants, the standard deviations of the averages are lower, it is demonstrated that there is more consensus than on practical group consisting of managers and actors.

The best combinations of parameters for the theory group is F5: Puerto multipurpose with O5: Settlement of Industries in the city and F5: Puerto Multipurpose with O3: Creating Pacific Refinery; for practical group is F2: 25 Miles Nautical International Maritime Traffic Route with O3: Creating Pacific Refinery. The worst combination for the theory group of experts is F6: Port Authority Autonomy with O6: Settlement of Industries in the city and for the practical group of experts is F6: Port Authority Autonomy with O3: Creating Pacific Refinery.

Within detailed statistical study it is concluded that within the first quadrant chosen by both groups of experts as the best, it is observed that:

The strength that comes closest to the mean "standard deviation" is F3: Ports Facilities and O2 Transfer Port Concession, while the furthest from the average values are F6: Port Authority Autonomy and O5: Settlement Industries in the city.

The highest median or measure of centralization are F1: Geostrategic Location and F4: Logistic Cluster with values higher than 4, the lowest value are F6: Port Authority Autonomy, O1: State investment in the Port and O3: Creating Pacific Refinery with a score between 2.5 and 4.

The F3: Ports Facilities and O2 Transfer Port Concession in the statistical analysis of variance, are the least dispersed parameters in relation to the mean, while F6: Port Authority Autonomy and O5: Settlement of Industries in the city are the most dispersed.

The most dispersed parameters of the rest of outliers values are F6: Port Authority Autonomy and O3: Creating Pacific Refinery, while the least dispersed are F2: A 25 nautical miles of Route International Maritime Traffic and O5: Settlement of Industries in the city.

Meanwhile it is possible to conclude that the port of Manta is on the right path towards integration of multimodal logistics in Latin America that projects as port and gateway Ecuador Hub Asia to South America, with connections to the Atlantic via the route Manta-Manaos.

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# Pitfalls of controlling in corporate logistics

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**Abstract—** This report is devoted to the issue of controlling and its application in the logistics and the methods that are used to manage the performance of company logistics. The aim of the company shouldn't be just a quick response to changing conditions in the highly competitive markets, but primarily creating the value-added products and satisfying the needs of final customers. If the company wants to achieve truly the superior performance, it's necessary to use the best methods for its measurement and management. The report is developed on a theoretical level and includes the characteristics of controlling and monitoring the performance of business logistics, as well as the related problems.

**Keywords -** logistics, logistic controlling, measure logistic performance, indicators of performance, benchmarking

## I. INTRODUCTION

Generally, the controlling system of rules conducive to the achievement of the strategic objectives of the business. Thus, there is an ongoing comparison of planned values for the parameters with their current values, helps controlling early detection of adverse deviations. Subsequently, the management company may carry out effective interventions to realignment activities desirable direction. This direction is determined by the business plan and the image of the state, which the company wants to achieve. The core activity of controlling a desired state then compare with the actual situation, which can be seen from corporate accounts. Controlling help identify room for improvement in many business activities and for planning contributes to setting realistic goals. (Mann, 1992, pp. 15).

## II. CONTROLLING AND SUPPORT IN BUSINESS MANAGEMENT

Managing a business can be defined as the sum of functions that must be performed to the system as a whole was able to hold an interim balance. By this phrase we can imagine a certain sequence of dynamic equilibria, which at the time of disruption and renew equilibrium is reached. The system therefore does not return to its original state, because it would imply a certain rigidity, which in comparison with the dynamic external environment can easily lead to failure. Management should thus seek to balance control in the manufacturing, financial, human resources and information area. (Eschenbach, 2004, p 35).

There are many ways and institutions that can provide support in the management of the company. The institutions undertaking is noteworthy example. crews, supervisory board or owners. They carry out the function of providing

information, assistance in the preparation of decisions, accelerating or slowing down processes and oversight function. For each of the following institutions and functions, however, are inspected so that they provide separate contributions to the fulfillment of the tasks of management, but they lack the overall concept that would integrate them. In broader perspective on the issue of providing support corporate governance is therefore offered controlling concept that embodies a truly integrated approach to complement the development and management of a healthy company.

The need for controlling it by Eschenbach (Eschenbach, 2004, p 35) exerted by the environment as well as the plant itself. In the first case the need arises from that business is an open system and is constantly interacting with the complex and dynamic environment. From the internal perspective of the enterprise implies the need for controlling the pressure on profitability and multifunctionality like. differentiation of the internal structure or width range. In these difficult circumstances, the undertaking must be directed to the external and internal harmonization, which places high demands on coordination of activities.

## III. OBJECTIVES OF CONTROLLING

Controlling objectives can be distinguished on the immediate and mediated.

- immediate objectives - also called direct or in kind, define the scope of controlling tasks. This may be only a support function controlling, procurement of information, coordination or management participation also. The immediate objectives of contributing to the maintenance of viability.
- mediated goals - the goals of the company, which has a controlling compliance support. These objectives are based on the requirements of the major stakeholders, ie capital providers, employees and the environment. Do business environment can include customers, competitors, suppliers etc.

### A. Key features of controlling

Controlling the company performs four basic functions:

- planning function - each phase of the planning cycle plays an important role in the planning process. Their lengths are dependent on factors, such as. size of the business or industry in which it operates. In the initial phase, the objectives

- and the question is answered, the company would like to achieve. Consequently, it created a plan that provides the best and most efficient way to achieve their objectives. Implementation of the plan is then monitored and last phase consists in the evaluation of the results achieved and their causes. (Žurková, 2007, page 12.)
- securing a documentary feature - This feature supports the collection and storage of relevant information in order to operate a performance analysis. These documents are then available to management and various business services.
- analytical and control functions - filling this function is to control and manage costs, but it can also be monitoring all processes in the company, their analysis and detection of deviations.
- Reporting - this is the submission of information by the so-called. reports, t. j. and reports to external entities (parent companies, affiliates, offices) as well as to intro-users - individual departments, management and business owners. Presentation of reports by graphs or tables can usually clearly illustrate the situation in the company and inform the responsible person.

#### B. Use of controlling in Logistics

The combination of slow economic growth and increased competition forces companies in every industry to focus on the powerful and efficient allocation of logistics resources. The result of such efforts is the creation of new positions or whole departments in the organizational structures of enterprises engaged Logistics Control. The work of the following services is directed estimation of the distribution of available resources, continuous monitoring and comparing current performance of enterprise logistics with the expected values and control to

The increasing complexity of logistics systems and pressure to reduce costs, which are incurred for logistics activities are forcing businesses to planning objectives, management, control and coordination of all logistics segments. Controlling enterprise logistics and performed tasks associated with continuous control performance by comparing planned and actual costs and benefits and on the acquisition, processing and provision of information to support decision-making logistics management.

Controlling logistics tasks, which are indicated Schulte (Schulte, 1994, p 257):

##### Creating a logistics information management

- Creation of logistics information system,
- Analysis and interpretation of existing information in terms of logistics goals,
- coordination of information needs and use of information in logistics,
- provision of information to the posts logistics section, other company departments and external users.

#### Impact on the production logistics plan

- ensuring consistent, formalized system of logistics planning,
- processing of the results of analyzes to determine the objectives of logistics policy,
- coordination of the objectives of enterprise logistics,
- examination premises plan for compliance with the objectives,
- develop optimal logistics plans,
- development of methods of logistics planning with the support of information systems.

#### Logistical control

- determine the actual status indicators
- determine the degree of achievement of objectives based on internal comparisons,
- analysis of the causes of deviations,
- elaboration of proposals for remedial action
- implementation of an external company benchmarking.

Monitoring of enterprise logistics performance is still devoted more effort. Is there an effort to improve the quality of information that the company management to measure, benchmark and manage logistics performance. In most companies need to create new ways to track the performance of enterprise logistics or at least modify an existing form of reporting so that it can benefit from the use of computer-aided control systems. Instead of the traditional report on the status and trends of today's managers need a flexible system providing information on demand, which would help to quickly react to obstacles and opportunities happening in the market at any given time.

#### IV. METHODS FOR MONITORING LOGISTICS PERFORMANCE

Methods for measuring the performance of enterprise logistics can be defined as internal and external. Internal (internal) monitoring the performance of ongoing in-house research and that can be further divided into categories relating to costs, the level of customer service, productivity, profitability and quality. The achieved results are compared with past data or objectives to be firm in the field to achieve over time. This measure is commonly used because management understands the source of information and data can be relatively easily obtained.

Equally important is monitoring and evaluating the performance indicators of external business logistics. A simple reason is to focus on customer requirements. Usually, a company in accordance with its vision and strategy, a plan of logistics, where you determine what level should reach customer service. In order to have maximum satisfaction of customer needs, it is more appropriate to the level of the external power measurements to check and ask the customers to their satisfaction respectively. dissatisfaction, reflect on the improvements that can be done in customer service. A typical

report includes measuring customer satisfaction regarding the availability of information, willingness to solve any problems or service after the sale. External performance measurement can be performed directly by the plant itself, intermediary services and consulting various agencies.

### BENCHMARKING

One of the possible methods of measuring the power of a comprehensive enterprise logistics is benchmarking. More and more businesses are using this technique to compare their activities carried out not only with competitors, but also with non-competing businesses from various industries. Benchmarking is used mainly in strategic areas such as instrument control logistics operations. Focus on indicators, activities and processes carried out by undertakings with which it is compared. The result is a report that shows key performance indicators and as you can map the level of past and current performance of the business logistics.

Due to the fact that the method is applied in many areas of business activity, the definition is not completely uniform. Benchmarking nature is well illustrated by the following definition: "Benchmarking is a continuous and systematic comparison of own performance in productivity, quality and production process with businesses and organizations representing excellence." (Drahotský - Reznicek, 2003, p. 170).

Benchmarking can be divided into external and internal. The first option A systematic comparison with other companies. The second option then compares the factories, offices and warehouses within the company.

Benchmarking methodology described in the literature in several steps each. Although their numbers by various authors differ, in principle, it is only a different division of the same activities. Pernica chose seven steps leading to successful benchmarking (Pernica, 1998, p. 509):

- At first lays down the criteria for the comparison of businesses. It is useful to know the cost and time data and characteristics, which are then arranged in the questionnaire. The least problematic is obtaining data from publicly available databases and press reports, because the implementation of large-scale questionnaire surveys and in-depth interviews in other business, it is almost feasible. Consequently, it is necessary to consider where you can acquire new knowledge and business move as it can help. Questionnaire, which occurs in the first phase, to be completed in-house in order to verify the availability of data, their complexity and cost.
- The second step is carried out so. internal analysis. Information obtained in their own business will be analyzed and may howl or modified by criteria that were considered unsatisfactory. Here you can start preparing for external benchmarking.
- For comparison, it is necessary to choose a top firm in their own or another field, not a direct competitor. Benchmarking is done between two companies, each at least one characteristic shows better results, so the comparisons benefited both partners.

- Followed by obtaining data on comparisons of enterprise and best practices. For inquiries about the company shall be conducted exhaustive research for example. with customers or suppliers. It is also appropriate representation of experts and a thorough review of publicly available sources.
- Analysis and interpretation of the data, where the emphasis is mainly on the expression of its own apart from the comparison company and unveiling its causes. This assessment is appropriate to invite both internal and external experts from related fields.
- The results are then transformed to the objectives to be achieved in the future. These goals should exceed the level that achieves compared undertaking, but must be realistic to be a motivational nature for employees own business. The purpose of determining the level of such objectives is to bring the comparator company and thus it easier to overtake.
- In the last step, the objectives transformed into concrete actions and strategies to improve a project plan is developed.
- When obtaining data and data businesses usually use one of the following methods. You can use logistics data that are readily available in periodicals, academic research or professional publications. Although this data is readily available from the public nature that are rarely able to provide the required competitive advantage.
- The second option is to perform benchmarking privacy with respect to non-competing undertakings in the same or a similar field. This bilateral approach while providing deep knowledge, but does not offer too wide perspective. The third method is an alliance of organizations that share data. Although this requires more effort in terms of maintenance of a, but provides much more information than the other two methods.

### V. COMPUTER SUPPORT IN LOGISTICS CONTROL

To manage the entire logistics process used logistics information systems (LIS). The logistics information system as well as any management information systems, enables data acquisition for the purposes of controlling, as well as for performance measurement and evaluation of variations.

In larger enterprises are quite commonly used by some of the SCEM (Supply-Chain Event Management) systems. According to a study Bodendorf and Zimmermann, 2005 (Bodendorf - Zimmermann, 2005) to meet current SCEM systems mainly function monitoring and alerting. In other features, which should manage these systems are fully like. simulation, control and measurement, the authors see room for improvement. The main shortcoming of the current SCEM systems are considered particularly lack of proactive data collection and the possibility of automatic analysis and interpretation. To address these shortcomings, the proposed use of proactive SCEM system based on the technology of software agents.

Another way to manage and track the performance of logistics in the Transport Management System (TMS). According to surveys conducted among 140 managers TMS has been identified as top of mind technology solution currently, along with WMS (Warehouse Management System), the use of RFID (Radio Frequency Identification) system and voice-controlled operations. This software is designed to manage all operations related to transportation, there are modules to monitor and control every aspect of vehicle maintenance, fuel costs, training routes, warehousing, EDI implementation, etc..

In the area of logistics operations are also implementing new technologies. To the ERP system (Enterprise Resource Planning) may be introduced such. voice-controlled system of operations that can be used in completing shipments, inventories in warehouses and distribution centers, or just by topping up the goods. Information system is controlled dialogue between itself and the warehouse workers. Leads to the elimination of manual data entry, accelerate and refine the various operations, increase productivity, while paper documents are removed. In terms of controlling leads to cost savings, increased operational potential workers. It can monitor their performance and consequently reduce the so-called. loss of time. The system of voice-controlled operations coupled with automatic identification using bar codes are a great addition to ERP systems in logistics.

#### VI. THE PROBLEMS ASSOCIATED WITH MONITORING THE PERFORMANCE OF LOGISTICS

The use of systems of logistics indicators shall meet with the Board issues that often complicate their use and limits. If a situation arises that is watched too many indicators can quantify their costs exceed revenues from their ability to express. It is also necessary to establish standards that the underlying data used to create variables were compared over time and always inaccurate results do not lead to wrong decisions. Problems with evaluation may also occur if not enough indicators are consistent and mutually contradictory. The last limitation is the requirement that the value of the variable has been directly or indirectly influenced. As an indicator reveals a deficiency that any action can correct or indirectly, is not likely to be such an indicator to watch. (Schulte, 1994. 295)

Difficulties in monitoring the performance of enterprise logistics often arise because of undefined responsibilities and

improper arrangement of the organization. If there is only responsible for conducting leading logistics process, this may lead to logistical tasks assigned to each section are regarded as merely ancillary activities and they are not given sufficient attention. Moreover, the coordination of logistical decisions performed complicated. Furthermore, the organization may result in conflicts between different sections in obtaining scarce resources resulting from different approaches to solving the tasks to be fulfilled. The authors of books dealing with issues of this article agree that it is appropriate to introduce logistics departments whose activities are highly structured and are used the most advanced technology and computing devices. (Schulte, 1994. 229)

If technological devices in the enterprise imperfect in many cases prevent certain types of monitoring indicators. Decision, or is economically useful and specific indicators to watch, just depends largely on the possible automating the monitoring process. In the case of manual data processing by creating a mismatch and information might be available too late.

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# Setting of weighting factors influencing the determination of the location of Dry Ports using a DELPHI methodology

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**Abstract**— Dry Ports are designed as a solution to increasing road congestion, lack of open spaces in port installations and the significant environmental impact of seaports, due to the complexity of the transport sector and the increased volume of transported goods. In addition, Dry Ports are also presented as an opportunity to strengthen intermodal solutions as part of an integrated and more sustainable transport chain for transporting goods by rail. However, not all of its potential is used because there is no planning methodology to help decision-making. The aim of this research is to gather all the factors influencing the determination of the location of Dry Ports and set the weighting of each factor using DELPHI methodology. The results give greater importance to the aspects considered in the classical theories of industrial location. However, setting the most appropriate location to place a Dry Port is a geographical multidisciplinary problem, with significant economic, social and environmental implications.

**Key words**—Logistics; Intermodal Transport; Sustainability; Dry Ports; Industrial Location

## I. INTRODUCTION

The global economic structure, with its decentralized production and intake entails increased cargo flows and transport distances which complicate freight transport [1]. Therefore, shipping has become the most suitable and cheapest way to meet the needs generated by mobility of goods over long distances. Thus, ports are configured as nodes with capital importance in the logistics chain as a link between two transport systems, sea and land [[2] and [3]].

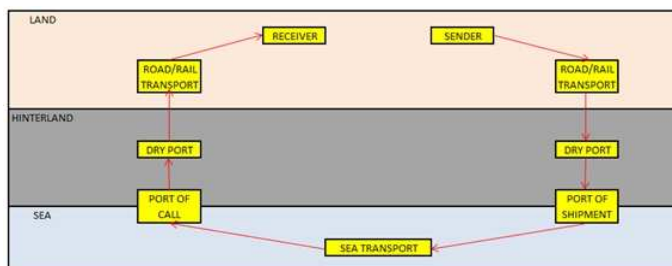


Figure 1. Dry Port in the transport chain [4]

In this sense, implementation of logistic platforms offers the opportunity to discretize each of the links of the transport chain. This allows for more polluting means of transportation which have a lower transport capacity to make several itineraries on the road which are as short as possible. Also, they could be used to transport goods with high added value [5].

For flows of incoming and outgoing goods, the Dry Port acts as the first level of a functional hierarchy of the transport chain within the country [6]. Fig. 1 shows the role played by dry ports within the integrated transport chain, both in receiving and sending products.

As the transport market is becoming increasingly competitive, has lower profit margins and the pursuit of efficient and high quality services for the user seems to be the most adequate way to achieve greater participation of the most sustainable transportation modes. Some authors, like [7], suggest that Dry Ports are an adequate intermodal solution to relieve traffic congestion in seaports and provide on-site service to different transportation modes that therefore can be used in the most competitive segments. Consequently, the choice of their location is a decisive strategic element which determines the success of the logistics function.

## II. TERRITORIAL PLANNING AND INFRASTRUCTURE PLANNING MODELS

The decision between purely technical considerations and the project costs has traditionally been made by means of Cost-Benefit Analysis [8]. Since the last decades of the 20th Century, the environmental variable has gained importance in the planning and construction of transportation [9]. Therefore, an Environmental Impact Assessment was later added to the Cost-Benefit Analysis, which contributed decisively to the formalization of a decision-making system based on the use of multi-criteria analysis systems [10]. A complementary assessment which is not as structured and is not formalized and which is linked to territorial effects is gradually taking shape. While some of these effects are sometimes included within the Cost-Benefit Analysis or contained within the Multi Criteria

Analysis, is a lack of systematic analysis [8]. The effects on the territory therefore become the most uncertain aspect of major transport infrastructure.

There are also some newer techniques that attempt to solve the problems of localization. The most important which have been implemented are: Cluster analysis, classification trees and Decision, Future Scenario Analysis (Simulation), DELPHI, Expert Systems (Bayesian Networks and Neural Networks) and Geographic Information Systems [11]. This research has selected the DELPHI method in order to establish the weights of each of the factors that have an influence when deciding on the location of a dry port. Its foundation is the analysis of the ideas of a group of experts who are specialized in a field of knowledge in search of a consensus of opinion [12].

In the field of industrial location using the DELPHI methodology, MacCarthy and Atthirawong [13] present a wide range of factors that can influence the determination of a location by consulting an international panel of experts. The five main factors identified that may strongly influence international location decisions generally were cost, existing infrastructure, job characteristics, political factors and economic factors. The factors identified have implications on the management of the company that intends to settle in a particular place and on the formulation of policies of local governments.

### III. INDUSTRIAL LOCATION

The optimal location for any industrial activity is the place that gives the maximum benefit to the company, or, for a given income, involves minimal cost [14]. Thus, industrial location therefore has implications for the levels of economic growth and social welfare at the territorial level. As a result, it changes environmental conditions and therefore one should not speak about optimal points, but rather satisfactory points [15].

The diversity of the factors involved in the location of industry has caused a number of economists in the last century to build theories and models that attempt to explain the complexity of the real world by necessarily simplifying it and using some factors as constants and others as variables. The different visions of the theory have been evolving and increasingly complex, in relation to changes in economic theory. We understand each step of this theory in its historical context, without being able to separate from the social context in which they are part [16]. For [17], the main objective when deciding on the location for any industry is to reduce the production costs and, in particular, transport and labor costs. Subsequent studies [[18], [19], [20] and [21]] include the presence of competitors, access to the greatest number of competitors possible, the minimum demand in order for the location to be profitable, location interdependence between the competitors, and the relationship between population size and type of industry. [22] also introduces the concept of "subtracted value" which consists of the negative effects that must be considered against the positive effects and that might create negative externalities.

In recent years, [23] has rescued articles by various authors and theoretic schools, according to which a core-periphery system tends to consolidate, which results in the region with

the greatest advantages to attract economic agents at the expense of less desirable locations. Therefore, a peripheral situation generally prevails in industries, reaching an agreement between urban land use (tertiary, transport, residence) and rural uses (agriculture). If several companies conclude that, they can save money, for example on production costs, and if they work together they will relocate to the place where the savings exceed the additional transportation charges [24].

According to [25], there is the need to achieve a situation that has the best accessibility to and from the centers of origin and destination of the various flows, which is achieved by means of the connection with the transport and communication systems. Therefore, industries are generally located near the centers of transport. It can be said that accessibility increases around major urban centers and decreases as the distance increases. In addition, facilities must have the least impact on citizens, with minimum disruption, and minimizing lifestyle changes, always seeking the welfare of the community. A good planning should first understand the idiosyncrasies of the place, integrating cultural values and customs of the place, which allows rapid and deep acceptance [26]. So, this planning process requires consideration of the possible impact on the territory [27] and the possible synergies between the other components of the logistic system, including the population and social aspects [28]. As [29] noted, by incorporating not only economic criteria, but also environmental and social criteria in the planning process, it is moving towards a sustainable territorial development which aims to "achieve long-term balance between economic development, environmental protection, efficient use of resources and social equity".

### IV. DRY PORT LOCATION

Following the literature review summarized in the preceding sections, it is possible to determine the factors that influence the determination of location of Dry Ports in terms of their characteristics and assess the constraints faced by its location planning. The variables used in location problems may respond to the "carrying capacity" or "use restriction" of the location. Furthermore, as proposed [30], in the design of a methodology for the location of an unwanted plant, a series of steps is carried out:

- Exclusion phase: defining a set of exclusion criteria, whose application determines the elimination of zones in which the location of this kind of installations is not acceptable.
- Definition phase: the definition of a set of factors that allow us to measure the adequacy of the different places that have passed the previous restriction criteria.
- Selecting assessment phase: selecting the most suitable alternative from the different territorial areas which were found adequate for the location of the installation by means of applying endpoints.

In this paper we only consider factors related to the use restriction which correspond to the phases of exclusion and definition. These factors are presented in Table 1.

TABLE 1. FACTORS RELATED TO THE USE RESTRICTION.

no.	Factor name	Observations
*	Environmental Protection table	Binary variable automatically discarded protected areas
1	Noise on natural environment	Noise level measured in dB (A) on the natural environment
2	Noise on urban environment	Noise level measured in dB (A) on the urban environment
3	Hydrology	Presence of vulnerable areas such as rivers, streams or lakes
4	Land price	Measurement of investment to make
5	Hosting municipality range	Considering the size of the municipality, the future development of urban centers and centers nearby and the demographic and economic potential
6	Accessibility to the rail network	Accessibility to freight and passenger transport networks
7	Accessibility to high capacity roads	Accessibility to high-capacity motorway networks
8	Accessibility to airports	Accessibility to air cargo terminals
9	Accessibility to seaports	Connection with one or more Seaports
10	Accessibility of supplies and services	Accessibility to communication networks and the electrical grid and any other necessary utilities such as water, sanitation, etc
11	Weather	The climate's appropriateness for the activities the greatest number of days per year.
12	Orography	Topography of the land on which the facility is located
13	Geology	Mechanical characteristics of the land on which the facility is located
14	Distance to other logistics platforms	Overlap between hinterlands and the agglomeration of industries according to the principle of Spatial Justice [31]

Source: Based on information gathered by the author

## V. QUESTIONNAIRE

The DELPHI questionnaire consists of two rounds. It has selected a wide range of experts from the different disciplines that come together in this research: logistics, sustainability, environmental impact, transport planning and geography. The first round consists of a table with the selected factors which the experts were asked to order from most to least important and give a weight. After analyzing the information provided in the first round of the questionnaire by all the experts that made up the DELPHI panel, a second round is was performed. In the second round, they were asked to review the weightings for the first round due to the differences between their responses and those of other experts. In this second round, the weight could be the same as each expert proposed in the first round or different if their opinion varied depending on the findings contained in the annex to the questionnaire. The aim of this second questionnaire is to try to achieve a consensus among experts, and to highlight the convergence of views.

## VI. RESULTS

For the analysis of the data the arithmetic mean, median, first quartile, third quartile and the interquartile range are selected.

We used mean and median simultaneously to exploit the potential of each. The arithmetic mean is very intuitive for the expert group, being the measure of central tendency which is used most. However, it is very sensitive to the presence of outliers. Hence, the median was used for rigorous statistical analysis of the data. Interquartile range is selected as a measure of variability of the data. This is used to measure the consensus as it offers a very intuitive data deviate from the median.

The descriptive analysis of the data from the first round is done using box and whisker diagrams, which provide an overview of the symmetry of the distribution of the data and permit locating the presence of outliers.

Fig. 2 shows the box and whisker diagrams obtained after the first round of the questionnaire.

As shown in Fig. 2, in the first round there is almost complete agreement that Dry Ports need to be accessible by rail and road, as well as well-connected with seaports. There is also agreement on the importance of the availability of services and facilities and the influence of the distance to other logistics platforms. For other variables, the interquartile range shows that there is some dispersion in the answers. These factors also have a minor accordance with the views expressed by the expert group.

Although the theoretical formulation of the DELPHI method itself comprises several successive stages questionnaire shipments, drain and operation, this study is limited to two stages, which nevertheless does not affect the quality of the results as shown by the findings of similar studies [32].

The box and whisker diagrams obtained after the second round of the questionnaire are summarized in Fig. 3.

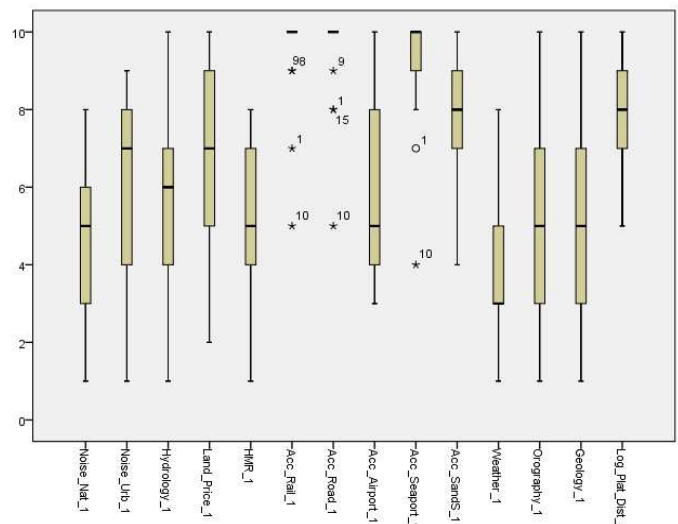


Figure 2. Box and whisker diagrams obtained after the first round of the questionnaire. Source: Based on information gathered by the author.

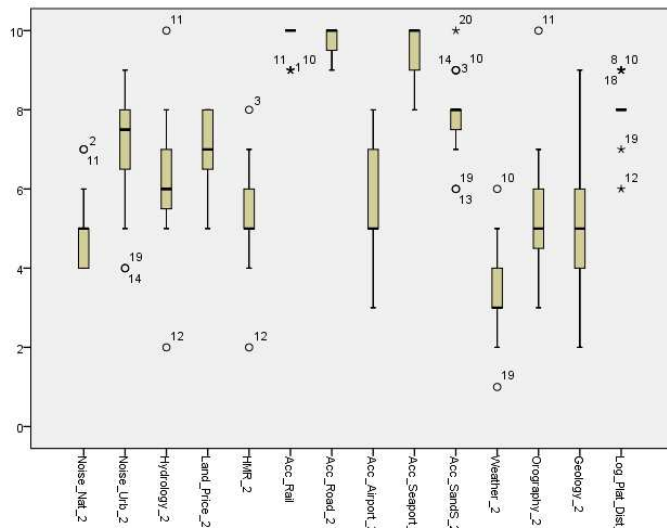


Figure 3. Box and whisker diagrams obtained after the second round of the questionnaire. Source: Based on information gathered by the author.

## VII. CONCLUSIONS

The DELPHI Questionnaire results show the importance of several variables that this study proposed for the exclusion and definition phases of the problem of Dry Port location.

Comparing the results of the first and second rounds has shown a significant decrease in interquartile ranges for all variables. The mean values of these ranges in the second round are good enough to stop the process of consulting experts here. Fig. 4 shows this decrease graphically.

Fig. 5 shows deviations above the mean, median and interquartile range of the results obtained in the first and the second round. There is an adjustment of the mean, while the median is fairly constant, except for the noise in the urban environment that fits only 0.25 units.

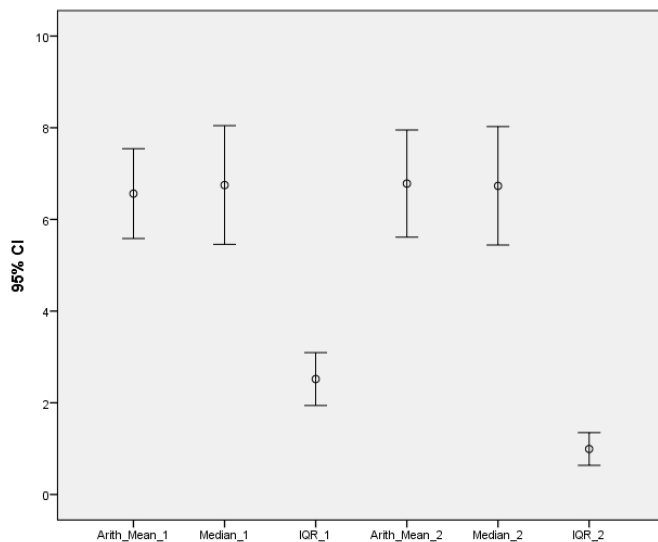


Figure 4. Mean value and 95% CI deviation on weights Arithmetic Mean, Median and Interquartile Range of the first and second rounds. Source: Based on information gathered by the author.

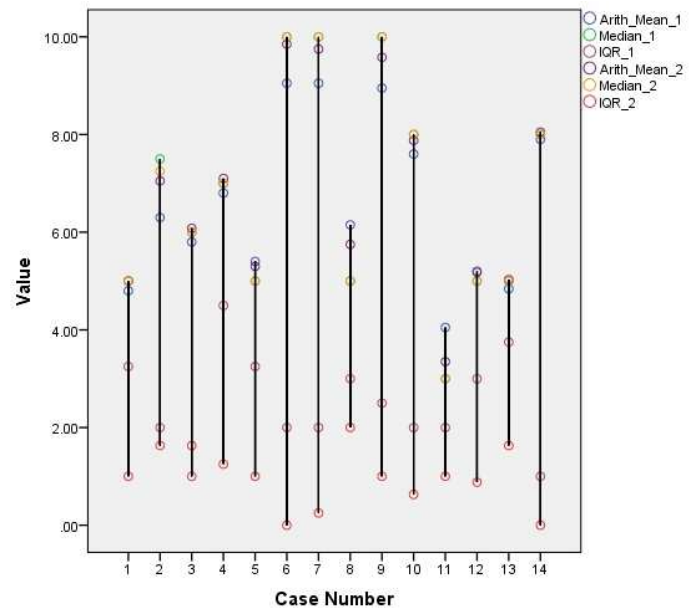


Figure 5. Deviations above the Arithmetic Mean, Median and Interquartile Range comparing the results of the first and second rounds. Source: Based on information gathered by the author.

Fig. 5 also shows that the most important factors indicated are related to the accessibility of the facilities, and present a near-consensus. In particular, the most important factors considered by the expert panel are: accessibility to the rail network, accessibility to high-capacity main roads and accessibility to seaports. However, accessibility to airports was hardly given any importance. Also, the experts reached least agreement on this factor after the second round. This is because air travel is a form of transportation of goods which is still used little and which is very specialized in urgent transport of quickly perishable goods (flowers, newspapers, etc.) and live animals.

The fact that the factors related to accessibility are given greater importance confirms, as proposed by [25], the need to find a situation that has maximum accessibility to and from the centers of origin and destination of the various flows.

These results also confirm the possibility offered by Dry Ports to increase the efficiency of transport modes, both individually and in the context of intermodal integration to achieve an optimum and sustainable use of resources which passes through a modal shift to increase the contribution of freight by rail, such as exposed [5] [5].

By contrast, the factor that is given least importance is the climate. Undoubtedly, this is because almost all the experts of the group are Spanish and the country's good climate leads them to think that this will not affect the operation. It is conceivable that if there were more experts from other nationalities this result would be different.

The interquartile range of each factor showed in Fig. 5 demonstrates that the factor which underwent the greatest decline between the first and the second round is the price of land. By contrast, the factors which were reduced least were accessibility to the rail network (because of the near-consensus

reached in the first round) and accessibility to seaports and hydrologic condition.

As shown in Fig. 3, in fact, the lack of consensus on some factors responds primarily to the presence of outliers which are far away from the mean which greatly alters the value of the interquartile range, rather than the lack of convergence in the opinion of most experts on the panel.

Moreover, the presence of these outliers can be explained in all instances by the experts' specialism. For example, experts on issues related to the environment and sustainability in the study have been the most reluctant to change their opinion about the noise in the environment, hydrologic affection, orography and geology, because of environmental costs involved in earthmoving (excavation, landfill, leveling and grading of construction sites).

A surprising result of the study is that less importance is attached to noise in the environment than to noise in the urban environment, while in many countries the law establishes much more severe noise limits in environmentally protected areas than in cities. In any case, this indicates a concern for inconvenience which can be generated in the city by any industrial installation and hereby it is confirmed by [23][23] and [24] [24] that peripheral location prevails on the core location.

In this article we have tried to convey the idea that the determination of the most appropriate location to place various types of facilities is a geographic and multidisciplinary problem, with economic, social and environmental repercussions. Although the results show a greater importance in the search for the location of a Dry Port to the aspects considered in the classical theories of industrial location, we should not lose sight of the other aspects, since no weighting factor is so unimportant as to be removed. In this sense, the results help to achieve sustainable development as quoted by [[27] and [29]].

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# Forecasts of container terminal capacity in a crisis scenario using Neural Networks

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**Abstract—** Artificial Neural Networks (ANN), can be of great assistance to port planning. The research focuses on the analysis of neural network performance in port planning in container terminals and - in particular - in the study of their capacity in a crisis situation as we are facing. The issue of what traffic can be managed in these terminals can be assessed without new investments. The Polytechnic University of Madrid has developed a tool called NNtex based on Artificial Neural Networks.

**Keywords-** Containerised traffic (trade), artificial neural networks, planning, forecast, crisis, port capacity.

## I. INTRODUCTION

Since the origin of the global crisis in 2008 until today, overall investments have decreased in a drastic way [20]. This situation has also been noted in the investments oriented to port terminals expansion. This crisis has shown stronger in developed countries such as Japan, USA, Hong Kong, Canada, Spain, Singapore, Chile, but has also been noticed in emerging countries like Mexico and China [15]. The high price of raw materials, particularly oil, food materials, industrial metals, copper and derivate products, reduce the maritime traffic and affect therefore the container traffic

Container terminals are key areas within the raw materials traffic and therefore a clear exponent of the economic situation; container traffic is an indicator of the current crisis.

Having detected the general problem of the economical environment, the research process carried out by the Polytechnic University of Madrid on the possible application of Artificial Neural Networks in the port area and more specifically in container terminals planning focuses on how this situation affects specific container terminals within the global maritime traffic. This research continues the work previously developed by different authors [24], in this field.

The capacity of a containers terminal depends on a number of key factors such as physical and operational characteristics, as well as the composition of the traffic using the infrastructure. The main factors defining the capacity are

broadly defined in terms of commodity, by the berthing length, the mooring places and storage areas [3]. The physical parameters, such as storage space, number of cranes, dock length, affect the terminal capacity and depend on investments that generally represent an important financial contribution. It is therefore essential to analyze this element – particularly necessary during these times of economic crisis – from a practical and necessary point of view, and not as an instrument of unnecessary growth of the facility.

Up to this date, port planning has been rather based on empirical, analytical or simulation models. Over the years, as reflected in [24], although port planning studies have been developed, these do not deal with potential crisis context and do not propose its study or forecast using artificial neural networks.

Regarding the importance of the capacity study in port planning activity, there are interesting publications in the U.S.A. [16], that perform a review of the capacity factors related literature and specifically on their importance in port planning. Other paper has been issued in Singapore [10], dealing with strategic planning issues. Several Spanish publications on container terminals capacity, issued since 1977, can also be cited [23], [3], [11].

The Artificial Intelligence, concretely the neural networks, is meant to significantly improve the ports' planning. The literature on artificial neural networks applied to transport planning is rather poor, mainly due to the recent emergence of the artificial intelligence in our society. The origins are set back in 1943 [30], facing a rather difficult start and lack of interest among the researchers. Higher interest for the artificial intelligence has been shown since 1982, when John Hopfield [12] has stated the Backpropagation algorithm.

Nowadays, well known universities (Boston, Helsinki, Stanford, Carnegie-Mellon, California, Massachusetts or Madrid Polytechnic University) are developing research programs on neural networks, as well as some private societies in Japan, USA or Europe.

Back in 2010 Gosasang [27], performed a container traffic forecast in Bangkok Port, using neural networks to explore their applicability to predict future container traffic needs and – through this – to estimate future investments in port extensions.

Other studies perform comparisons between traditional and neural networks based forecast techniques used to predict container traffic in the same port [28]. Others [19], [21], [22] and [31] performed similar studies using neural networks, obtaining more promising results.

In Spain, neural networks' application in transports planning is illustrated in a paper published by Cadiz University, dealing with forecast techniques in road traffic [18], as well as in other papers dealing with port planning. [24], [25].

Other studies are issued in 2011 [14], analysing the advantages and/or differences between purely statistical methods and neural networks, in terms of transport research. Cited study deals with the particular suitability of the neural networks to represent non-linear phenomena and with their learning capacity.

There are also papers dealing with neural networks application in short term planning processes; these techniques have been applied to traffic parameters (i.e. flux or occupation) prediction [29], to traffic flux, speed and occupation [7], transportation general problems [8], [4], transportation general problems [6] or to short term train passengers demand [26]. All of them have produced reliable results and promising feedbacks for the future use of the neural networks.

Finally, other studies [1], [2], [5], [8], [9], [13], [22], [23], [24], [25], [32], show that Artificial Neural Networks are a very promising alternative tool for this type of studies.

## II. METHODOLOGY

The methodology developed in this research allows us to determine the future capacity and saturation level of different ports worldwide in a crisis scenario characterized by no investment, i.e. without performing any change in the physical parameters (berthing, surface, cranes...).

This analysis is performed by a random generated multiple comparison scheme through the working tool called NNtex [31], based on Artificial Neural Networks (ANN).

The Artificial Neural Networks (ANN) are inspired by the human brain's biological neural networks. The main characteristics reproduced by the artificial neural networks can be reduced to the following three concepts: parallel processing, carried out by artificial neurons, distribution by a layers complex, and adaptation through learning from experience and minimizing the error [17].

The artificial neural network model is composed by a number of inputs ( $x_j(t)$ ); synaptic weights ( $w_{ij}$ ) representing the communication degree between neurons  $j$  and  $i$ ; a propagation rule  $\sigma_i(w_{ij}, x_j(t))$  which determines the interaction potential between neuron  $i$  and the  $N$  neighbouring neurons; an activation function  $f_i[a_i(t-1), h_i(t)]$  associated to the neuron  $i$ , determining the neuron's activation state, based on the resultant

potential  $h_i$  and the neuron's previous activation state  $a_i(t-1)$ ; and an exit function ( $F_i(a_i(t))$ ) representing the answer of the neuron  $i$ , given by the following formula:

$$y_i(t) = F_i ( f_i [ a_i(t-1), \sigma_i(w_{ij}, x_j(t)) ] ) \quad (1)$$

Thus, the learning process of a neural network can be seen as the adjustment process of the network's free parameters. Starting from a random synaptic weights set of values, the learning process searches a set of values that would allow the network to correctly develop a specific task. The learning process is therefore an iterative sequence that will refine the solution until a sufficiently good operation level is reached.

The following methodological stops have been developed:

### A. Phase I: Data acquisition, clasification and discretisation of the values obtained from the terminals

This first phase performs a diagnosis of the containers terminals actual state within a wide variety of geographical conditions; data to be processed are also acquired, classified and arranged. Dealing with a neural network, the number of variables to be considered can be practically infinite. Databases sizes can be considerable, as well as the fields' number.

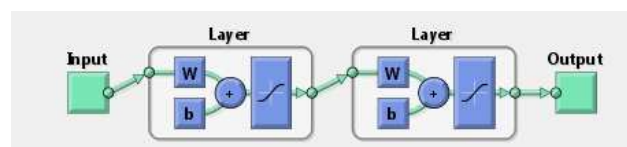


Figure 1. Network architecture scheme

Terminals values are processed during the correspondent number of years.

Databases can be generated during the process, to relation different variables like number of berthing points, stocking capacity, crane time, waiting time, berthing number and time, dock length, terminal surface, total cranes number or equipments to be used, optimum stocking areas occupation, operated containers quantity, terminal and its subsystems capacities, etc.

### B. Phase II: Building th artificial neural network

The artificial neural network is built using the NNtex [31] application, creating a multilayer perceptron network through a learning algorithm backpropagation with adaptable learning speed. Training method is a momentum descending gradient. Once created, and alter an initial simulation process, the network is trained using known inputs and outputs, representing real container terminal data, aiming that the network adjusts its outputs through modifying the weights and threshold values, in order to minimise the errors.

### C. Phase III: Network functioning and obtained results analysis

Before any process, one has to define the training percentage to be considered. This comes to show what part of the data will be used for training and what part for the test, in order to verify model's effectiveness.

The number of epochs, in other words, the number of times real data have been compared to model's outputs to perform connections' weights adjustments.

The following variables, obtained from the neural network training process, will be used to analyse network's functioning:

- Correlation coefficient (C), that allows the comparison between two different observations of the same or different variables that quantifies the relation degree between real data and network's forecast.

This variable can be written as:

$$C = \frac{\sum_{i=1}^N (O_i - \bar{O})(P_i - \bar{P})}{\sqrt{\sum_{i=1}^N (O_i - \bar{O})^2 \sum_{i=1}^N (P_i - \bar{P})^2}} \quad (2)$$

were;

$O_i$ , is the real value

$P_i$ , is the forecasted value

$N$ , is the number of data

- Average squared error (MSE), that measures system's error, and can be defined as:

$$MSE = \frac{1}{N} \sum_{i=1}^N (O_i - P_i)^2 \quad (3)$$

During the training phase, output variables or real values are compared to the forecasted ones. This process allows the estimation of network's approach based on training data, as shown by the graph below.

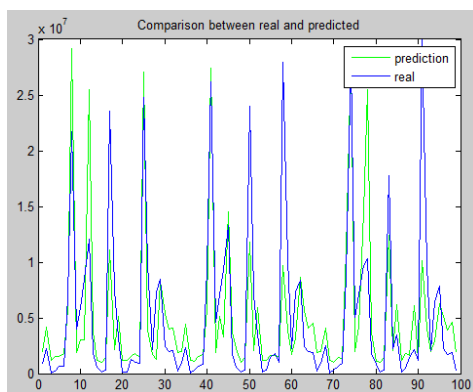


Figure 2. Approach comparison between real and forecasted values

#### D. Phase IV: Neural network validation

Once verified that network's outputs after the training process, are within the accepted range of parameters values (Correlation coefficient, Average squared error, etc), the

network can be validated, estimating its suitability for a real case application.

#### E. Phase V: Scope of the study.

In the last phase, once validated the neural network, we performed a detailed study of the various ports, assessing the state of saturation based on the facilities and equipment. This study was subsequently moved to the area and country wide.

### III. RESULTS

Data series and values of 33 ports in developed countries like Japan, USA, Hong Kong, Canada, Singapore, Chile, and also in developing countries such as Mexico and China, among others. The time period of the study, centers for 6 consecutive years with the highest incidence of the current crisis.

Network algorithms considered as included the application are:

Algorithms	
Training:	Gradient Descent Backpropagation with Adaptive Learning Rate. (traingdm)
Performance:	Mean Squared Error (mse)

Figure 3. Network algorithms considered

Network's parameters:

- Input layers: 3
- Hidden layers: 5
- Output layers: 1
- Epoch: 1000-3000
- Learning rate: 0,3
- Momentum: 0,6

The number of processed data or variables is 1584 registers.

The variables used by the neural network have been basically the initial values of parameters like dock length, terminal surface or number of dock cranes, considering as forecasted value the operated containers number or TEU's.

As can be seen in the graph below, the neural network prediction is very successful, obtaining values of:

$$\begin{aligned} \text{MSE:} & \quad 8.2743 \cdot 10^{-12} \\ \text{C:} & \quad 0.9238 \end{aligned}$$

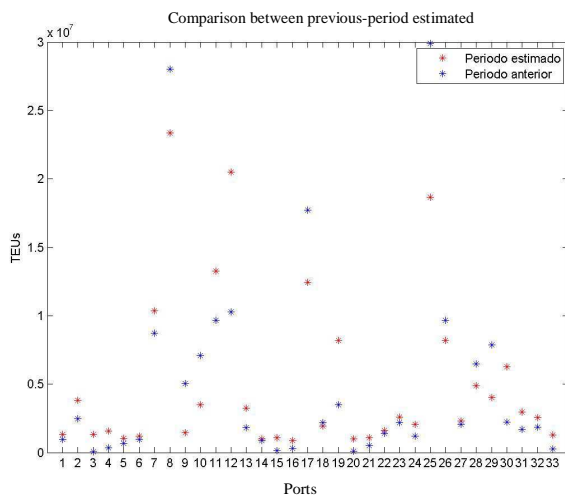


Figure 4. Graphical comparison between the prediction of TEUs to move through the network and for the last period analyzed in each port.

#### A. Study by ports.

The data handled by the network belong to the ports indicated in the following table:

TABLE I. PORTS ANALYZED WITH ANN

Reference	Name	Country
1	Brisbane	Australia
2	Vancouver	Canada
3	Antofagasta	Chile
4	Iquique	Chile
5	San Antonio	Chile
6	Valparaiso	Chile
7	Qingdao	China
8	Shanghai Total	China
9	Xiamen	China
10	Tianjin	China
11	Yantian	China
12	Busan	Korea
13	Kwangyang	Korea
14	Guayaquil	Ecuador
15	Acajutla	El Salvador
16	Puerto Quetzal	Guatemala
17	Hong Kong KCTY	Hong Kong
18	Hong Kong RTT	Hong Kong
19	Yokohama	Japan
20	Ensenada	Mexico
21	Lazaro Cardenas	Mexico
22	Manzanillo	Mexico
23	Balboa	Panama
24	Callao	Peru
25	Singapore	Singapore
26	Kaohsiung	Taiwan
27	Keelung	Taiwan
28	Long Beach	USA
29	Los Angeles	USA
30	Oakland	USA

Reference	Name	Country
31	Seattle	USA
32	Tacoma	USA
33	Portland	USA

The network is operated with data from the ports above, taken for 6 consecutive years of crisis, obtaining values of the actual ports' state and the state they could reach with their existing facilities, without performing any investment.

The following table shows those ports that could reach saturation with their actual infrastructures.

TABLE II. PORTS REACHING SATURATION WITH EXISTING FACILITIES

Reference	Name	Country
7	Qingdao	China
8	Shanghai Total	China
9	Xiamen	China
10	Tianjin	China
17	Hong Kong KCTY	Hong kong
18	Hong Kong RTT	Hong kong
25	Singapore	Singapore
26	Kaohsiung	Taiwan
29	Los Angeles	USA

The relationship between network predictions and last year data shows a saturation state prediction and therefore the potential for increased traffic with the existing facilities. This is represented as shown below.

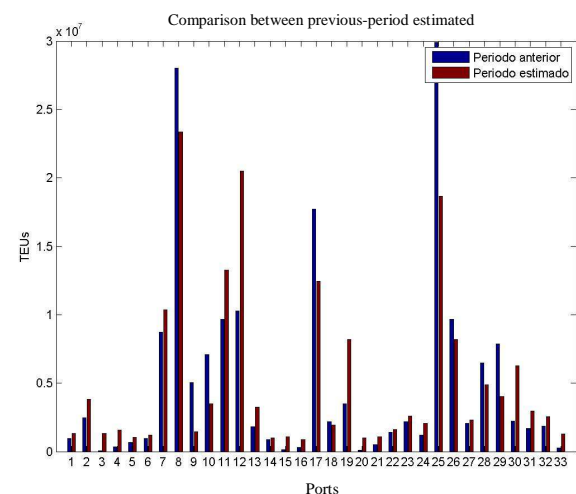


Figure 5. Traffic expected for the different ports in a scenario without infrastructures investment with ANN prediction.

The research results show that Asian terminals are the most saturated, since they already reach saturation levels in present circumstances, assuming investments in infrastructure; however the American terminals, especially the South Americans, meet the ability to increase their traffic without new investments in the short term.

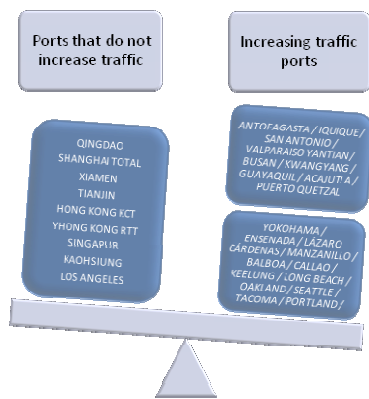


Figure 6. State of the ports analyzed in a scenario without infrastructure investments.

Similarly, other ports that could even double their current traffic with current facilities and resources are the following terminals:

TABLE III. PORTS THAT COULD DOUBLE TRAFFIC WITH CURRENT INFRASTRUCTURE

Reference	Name	Country
3	Antofagasta	Chile
4	Iquique	Chile
15	Acajutla	El Salvador
16	Puerto Quetzal	Guatemala
19	Yokohama	Japan
20	Ensenada	Mexico
21	Lazaro Cardenas	Mexico
30	Oakland	USA
31	Seattle	USA
33	Portland	USA

On the other side are situated the ports with saturation state increasing degree: Shanghai Total, Los Angeles, Hong Kong RTT, Kaohsiung, Qingdao, Hong Kong KCTY, Singapore, Tianjin and Xiamen.

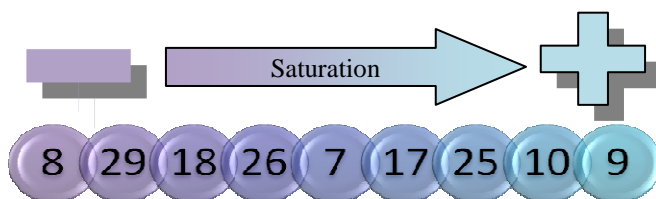


Figure 7. Ports growing scale higher saturation represented by their reference.

#### B. Study by country.

The results obtained from the different container terminals analysis in a hypothesis of not investing, leads us to suggest that those countries that should invest in increasing the capacity of the container terminals are located in Asia and North America, a fact noted with the traffic growth during the recent years. All this, considering the terminals studied.

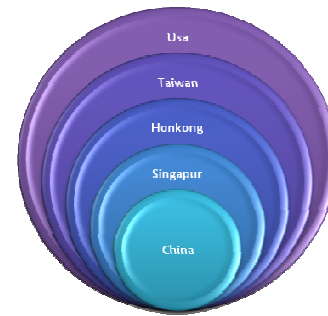


Figure 8. Countries with ports saturated or near saturation.

The other level is integrated by countries that could possibly increase or even duplicate the container traffic with the existing facilities, such as Chile, El Salvador, Guatemala, Japan and Mexico.

#### IV. CONCLUSIONS

The analysis of the obtained results shows that artificial neural networks can be used to model the port planning process related to container terminals, using consistent series of historical data.

Research results show that Asian terminals are the most saturated in actual circumstances; they have practically already reached saturation levels. However, the American terminals, especially the South Americans are oversized and can even double current traffic through their available facilities.

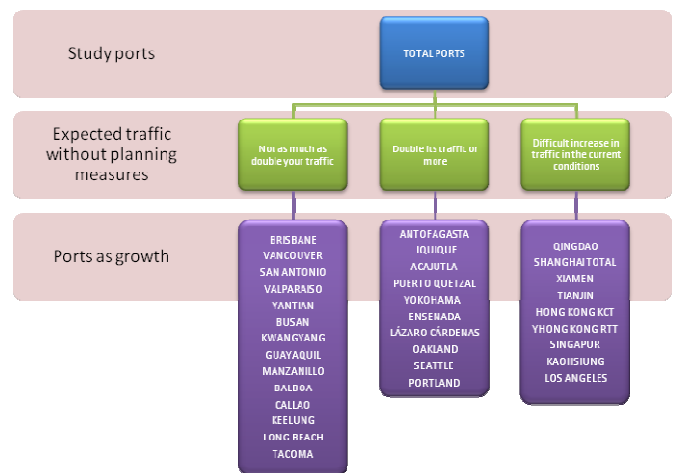


Figure 9. Key findings of the research.

It is noteworthy that countries like Panama, although right now experiencing an investment growth, would still be capable to withstand increased traffic. Although these particular or punctual events can sensibly influence studies like this one, this research should be expanded for the years subsequent to the commissioning of new channel. This area – including neighboring countries – due to expected traffic growth on the new infrastructure, even if the results are correctly considered, may require new extensions because of this “call effect”. This

consideration would be subject to further study or research, once the data obtained in these terminals.

The developed study used the following fixed or variable parameters: dock length, terminal surface, number of dock cranes and operated container quantity. This research can be extended in the future using the same network, to involve other parameters related to the terminal planning and operation, and validating its suitability for a future possible use.

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# THE IMPACT OF LOGISTICS ON ORGANIZATIONAL COMPETITIVENESS

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**Abstract** – The scientific objective of the research paper is determining causation in the logistics and ensuring competitiveness of organizations. In addition, the supply chain is considered as a complete structural formula of planning, coordination, implementation and control of all activities related to a single supply chain.

The core of this concept and thus defined supply chain to ensure efficiency in procurement and increase the organizational competitiveness. Chain of procurement incorporates all transfers of tangible and intangible resources necessary to produce a product or service then evaluate the market by customers. In scientific community there are some differences associated with differences between managing the supply chain and logistics. According to some authors, these terms are synonymous, while in others they are two different concepts, although there are some overlaps. Generally, logistics means a term broader scope.

Despite these differences, the management of any organization in managing the supply chain must take account of: the network configuration (suppliers, scheduling of production facilities, distribution cantri, warehouses and customers) strategy distribution (centralized or decentralized, direct or indirect distribution), information flow (integrating information systems); managing inventory (quantities and locations of raw materials, semi-finished and finished products), cash flows, organizational structure and design (delegating authority and responsibilities within the supply chain).

From this research and many years experience of working with small and medium organizations in Macedonia, confirming that logistics represents one of the key components that provides mutual competitiveness of the organizations, and the total Macedonian economy internationally.

**Keywords** - *logistics, supply chain, organizational competitiveness.*

## I. INTRODUCTION

Products or services produced by the organization must "come" to customers or end users. Because it is a material (physical) production of intangible goods and manufacturing services, the problem of "distribution" is treated with appropriate to the final product. In terms of material production, opera-raids distribution include transportation of physical product to the customer (consumer purchaser). Unlike products, services are created and isporachuvat in the presence of the client, so that the majority of services are determined by establishing direct contact, the term "distribution" gives a completely different meaning. As it comes to managing physical distribution, the focus is on products.

Logistics management is an extension of the physical distribution and typically refers to managing the flow of materials, services and information within a distribution channel. Often the end of the distribution channel is a store for retail. But with increasing direct delivery to customers (especially for innovation and internet based retail outlets), the logistics chain can be extended to the customer, bypassing the conventional way associated with distribution outlets. The term logistics of third - party indicates that logistics is carried out by a specialized organization.

Transport is a "movement" of the product from one location to another, or "movement" of goods at the beginning of the supply chain to the end customer (consumer). Transport has a key role in the supply chain, because 40% to 50% of total costs. Another important feature is its transportation entities: suppliers (chipper) and carriers (carrier). Along with costs, these entities are crucial, because depending on the costs that these entities produce change and deciding factors in transport. The main objective of the supplier is to minimize the total cost consisting of: transport costs, costs related to inventories, assets th, processes and services, and thereby to meet all customer needs for delivery. On the other hand, the main goal of the carriers is to maximize revenues from the assets invested by the optimicazija: cost of vehicles, fixed operating costs, transportation costs, costs to produce the quantities that are transported, as well as general overhead costs whether it is:

- Air (airline) transportation;
- Road transport;
- Rail transport;

- Transport by sea;
- Transport through the pipeline;
- Delivery of packages;
- Mixed transport.

In terms of operations management, it is important to know basis-inspired goals and features of different transport modes, listed below.

**Air transport.** The main objective of air transport is to maximize daily flight time and increase revenue per unit of travel. Achieving this goal is challenging, having in mind the characteristics of this type of transportation:

- High fixed costs for equipment (aircraft) and infrastructure (airports, terminals ...).
- Variable costs for current operations and fuel.
- Management focused on revenue passengers.
- High speed transport.
- Benefits - when it comes to transport things that have a high unit value and short transit time.

**Truck transport.** The main feature of this type of transport is great flexibility. Usually used for transporting products that are sensitive to reloading and additional manipulations. There are two types of truck transport. The first is called the transport full truck (TL - full truck load), where the total costs vary depending on the length of road, fixed costs are lower and the goal is to achieve a lower cost for larger shipments. The second is called incomplete transport freight truck (LTL - less than truck load). The main characteristic of this type of transport is that the price is determined by two factors: the amount being transported and along the road. For this kind of transport, fixed costs are high and there is an evident need for suitable sites for transshipment and distribution.

**Rail transport.** The main objective of rail transport is to maximize utilization of engine and mechanical personnel and to replace non-profitable lines with profitable lines. The main negative features: long during transport and high fixed costs and low positive that variable costs stimulate transport large volumes over long distances.

**Transport by sea.** Transport by water is naturally limited transportation. It is the slowest, but also the cheapest, so prevalent in global trade.

**Piping.** Pipelines are characterized by high initial costs of construction, and their optimum utilization is 80% -90% of capacity.

**Delivery of Packages.** This type of transport is established in order to provide fast and reliable delivery. Known more as a delivery "door to door". Use all previously known modes of transport. Its main characteristics are: high cost, limited (small) size of packets delivered, need places for consolidation package, timely delivery and reduces the costs associated with keeping inventory.

**Mixed transport.** This kind of transport combines different modes of transport in order to provide a unique relative price - service that can be offered by any other form of transport. Although more used vehicles, this form of

transport is developing very quickly, thanks to the development and implementation of the global container trade.

**Transport networks.** The transport network is a set of routes (paths precisely defined) and locations in which the product is transported. Well projected transport network provides a high degree of satisfaction of customer needs and low cost. There are three basic types of transport networks: direct transport network, delivery via distribution center and mixed (tailored) transport network.

## II. RESEARCH METHODOLOGY

### A. Research design

According to a survey character development, do some action that will disrupt the normal workflow of the company, and can lead to improvement.

### B. Intention (purpose and objectives)

To improve the management of logistics companies. This will provide an increasing number of customers, market expansion and market segments and increase profits through maximization of revenues from the assets invested by: cost of vehicles, fixed operating costs, transportation costs, costs that produce quantities transported and general overheads.

### C. Hypothesis or research question

Managing logistics will increase revenue based on invested assets through optimization of total cost.

### D. Variables and their measurement

Independent variables: managing logistics  
Dependent variables: income firms

### E. Procedures and instruments for data collection

The research procedures and instruments, and to obtain reliability (safety), ie providing actual data to be used:

- survey;
- observation;

### F. Analysis of the data

The data obtained will be analyzed qualitatively and quantitatively.

### G. Methods of scientific knowledge

The interpretation of the data and information from the moment of their collection, to the process of generalizing the research findings are based on more scientific methods of working, including:

- basic procedure of scientific working
- analysis;
- remedial procedures scientifically work;
- comparative analysis;
- synthesis;

## H. Resources

- Staffing Plan: actors, roles and scope of engagement
- owners of firms
- employees in firms
- Customer service

## I. Research Results and analysis

This research is realized in 52 companies in the region, of which 30 companies from the manufacturing business activity, and 22 of the service activity.

In this research conducted in 2013 as research instruments were used: questionnaires for all levels of managers, monitoring protocol in logistics processes and analysis of documents in companies.

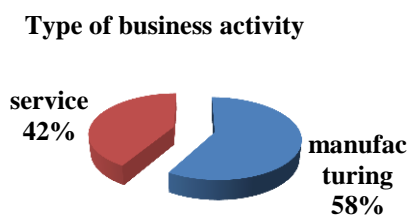


Figure 1. Type of business activity

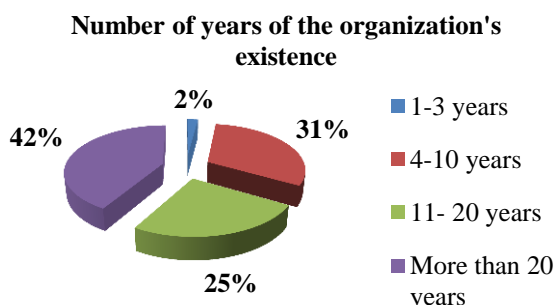


Figure 2. Number of years of the organization's existence

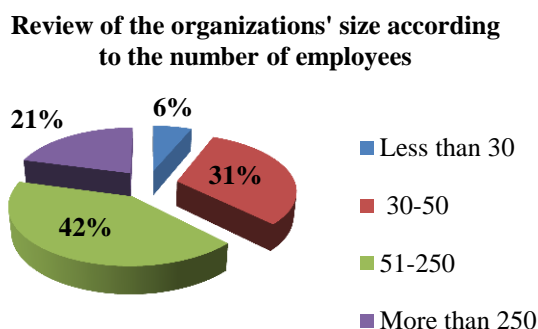


Figure 3. Review of the organizations' size according to the number of employees

By improving the management of logistics is expected to meet the needs of the providers who want to minimize the

total cost consisting of: transport costs, costs related to inventories, assets, processes and services, and thereby to meet all customer needs for delivery.

On the other hand, are expected enterprise to maximize revenues from the assets invested by the optimization: cost of vehicles, fixed operating costs, transportation costs, costs to produce the quantities that are transported, and general overheads.

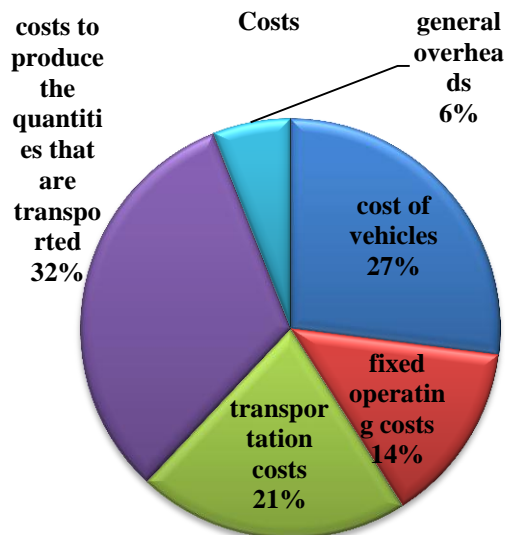


Figure 4. Costs

Companies that have efficient logistics and reduced costs for it are more competitive and more respected by consumers for fast delivery, cost, flexibility, reliability and quality of the product or service.

The average effective and timely logistics are saving over 12% of the total cost of surveyed companies. It is one of the most important indicators for organizational competitiveness. For companies that are very aware, but do not take timely steps for building efficient logistics.

Managers need to make many decisions when designing effective channels that will be in service users. For example, you have to decide whether to sell directly to the user through the stores that are company-owned stores or franchise, or indirectly, through a combination of intermediaries such times as independent retailers, wholesalers and agents. You need to decide whether to use through retail stores, retail store out of a combination of both. Also, managers need to make decisions about the location of the head office of the company and the stack, the products will be delivered to customers and marketing functions that will perform in a given channel.

## III. CONCLUSION

Through the supply chain companies provide transfers of tangible and intangible resources (goods or services) necessary to produce a product or service then evaluate the market by customers.

Along with products in the network of suppliers to customers, each will have feedback on orders and information to their suppliers.

For companies there are three important reasons to consider the supply network:

- Assist the company as effectively compete.
- Helps identify important links in the network.
- Assist the company to focus on long-term position in the network.

The current global market is sometimes easier to find than a physical product to be delivered to the final consumer. Companies must decide how to keep the products and to observe the terms of use of the same (depending on the type of product), and to distribute them to consumers at the right time, the right place and fully intact.

The trade logistics as a science and as trade logistics activity is one of the most important types of logistics not only in tertiary logistics systems but also in logistics primary, secondary logistics, logistics and quarterly logistics systems, because without such logistics would not be able to play the system works: production, distribution, exchange and consumption. Trade logistics, in fact, covers the wholesale and retail trade (sale without processing) of any type of goods and provision of services related to the sale of goods.

In the study of fundamental phenomena of trade logistics, ie phenomena of wholesale and retail should be

kept in mind an important fact, which is that it represents the last stage in view of the distribution of material goods.

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# NNtex application to civil engineering

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**Abstract—** This paper describes the use of NNtex, a matlab's toolbox for Neural Networks developed in Departamento de Ingeniería Civil. Transportes (Department of Civil Engineering-Transport) of the Universidad Politécnica de Madrid (Technical University of Madrid) to solve civil engineering problems. Using NNtex can be processed and calculated data through simple operations. Through the built-in neural network toolbox NNtex, the users can optimize and calculate the input data and get the visual output and analysis results, including tables and figures.

**Keywords-** *Matlab, Neural Network, NNtex, Labbtex Containerised traffic (trade), Pplanning, Forecast*

## I. INTRODUCTION

An optimal toolbox: NNtex [1], which is based on Matlab software is developed in this paper. And its application to civil engineering. With the NNtex [1], the users can process and calculate the data through the simple operations. Through the built-in neural network toolbox in the NNtex [1], the users can optimize and calculate the input data and get the visual output and analysis results, including tables and figures. At the same time, by adopting the optimization algorithm, the models use less memory space and has a fast operation, and for large-scale data it can also get the operation result in short time. The NNtex [1] toolbox is applicable to be used in every field of science, and is convenient used for scientific and technological personnel, and it will have a good social value.

Artificial Neural Networks (ANNs) is also referred to as Neural Networks (NNs) or called Connection Model. Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. [2] It is a mathematical model that imitates the neural network behavior characteristic of animals, and process the distributed parallel information. This network relies on the complexity of the system, through the adjustment of the internal connected relations of the nodes, in order to achieve the purpose of processing information[3].

Matlab is a well-known mathematical optimization software, the software is widely accepted and used by the science researchers in many different research fields. The

friendly interface and simple operation of Matlab can make it easy to be used by the non-professionals. Matlab software has already contained some basic programs about the neural network, and we can use them to assist the writing of the programs which are required.

In recent years, the research about the neural network is very popular, till now, a variety of neural network models have been developed and applied in different areas, such as the Back Propagation Neural Network (BP Neural Network), the Radical Basis Function Neural Network (RBF Neural Network), the Linear Neural Networks, etc.[4][5][6]. The neural network is used to forecast, classification and identification, optimization and other typical fields, and plays an important role in all the fields. Especially for classification problem, the neural network is widely used because of its short operation time characteristic and the high operation efficiency.

However, the neural network theory is esoteric and the parameters setting process is relatively complex, and the quality of the parameters setting has great influence for the operation time and the accuracy of the operation result. So towards the normal users, such as engineers and beginners, how to use the neural network and how to set the related parameters will be a big difficult question. At the same time, through many years of experience and research, we often meet optimization and forecast problems in the transport and logistics research process. Therefore, in order to facilitate the repeated use, simplify the use process, and improve efficiency, we have developed NNtex [1] toolbox. Through the use of NNtex [1] toolbox, the users only by entering the data can get the optimization results and analysis results through the automatic operation of the program. In this way, it will reduce the difficulty and the workload for the users.

In order to ensure the accuracy of the NNtex [1] toolbox operation results, we embedded three different kinds of neural network models in the development process, including the BP neural network, the RBF neural network and the linear neural network. After the user input the data, the three kinds of neural network will be operated in order, and then get three different operation results. After this, we choose the best result by

comparing the results with the receiver operating characteristic curve (ROC Curve)[7]. By using the NNtex [1] toolbox, not only can let the users use the neural network toolbox through more simple ways, but also can choose the best answer from the different networks, and output tables and figures for users to adopt.

## II. DESCRIPTION OF NNTEX

We develop the NNtex [1] toolbox by using the Matlab R2009a software. The NNtex [1] toolbox consists of seven parts, as following:

1. data input module: provide the data input window for users
2. data normalization module: normalize the input data, and get the data which is suitable for the model operation.
3. BP neural network module: construct the BP neural network, this network could select the corresponding parameter and compare the results of different parameters according to the characteristics of the input data, and get the better the BP neural network and results.
4. RBF neural network module: set up the RBF neural network, this network could choose the corresponding parameter and could obtain the good optimization operation result.
5. linear neural network module: establish the linear neural network, this network could select the corresponding parameter, and get the good result.
6. ROC analysis: compare the operation results of the BP neural network, RBF neural network and linear network, obtain the ROC curves and the area under concentration-time curve(AUC) values, and then select the maximum AUC value of the results for best result.
7. data output: export the running results and acquire the analysis report by using Labbtex [8].

The calculate flow chart of NNtex [1] is shown in Figure 1:

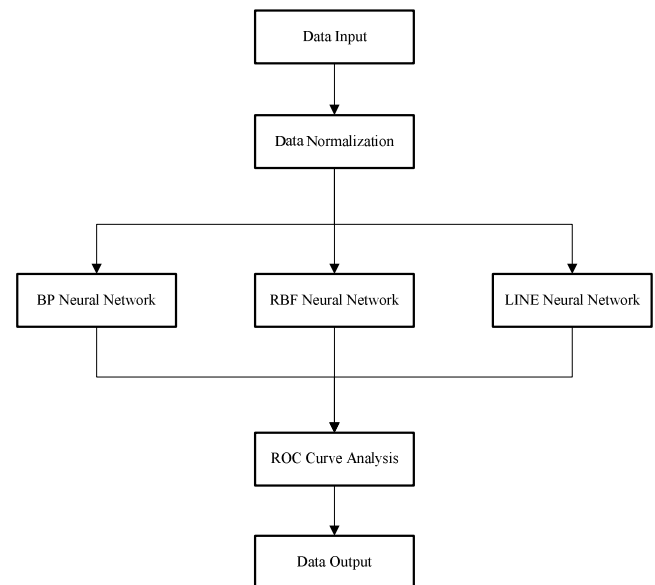


Figure 1. Calculate flow chart of NNtex [1]

## III. A REAL-WORLD EXAMPLE

By using the NNtex [1] toolbox, we can get the research result in the following form:

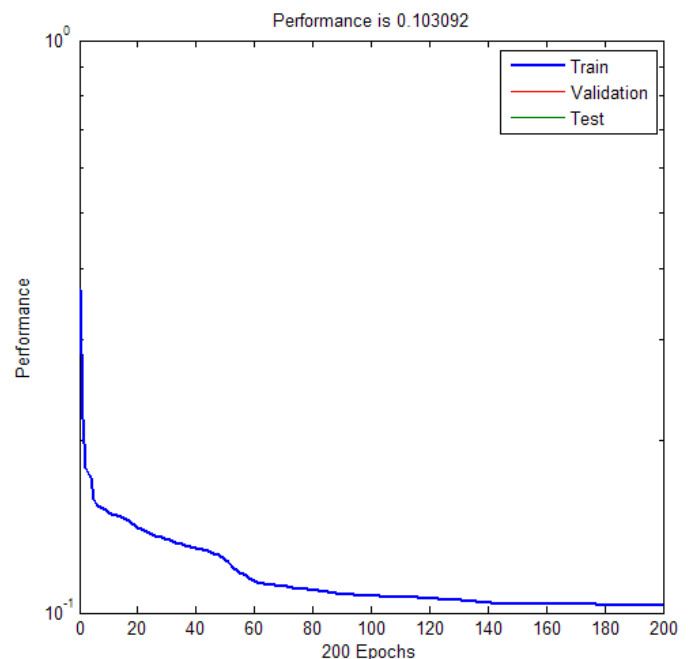


Figure 2. Calculate result of Neural Network

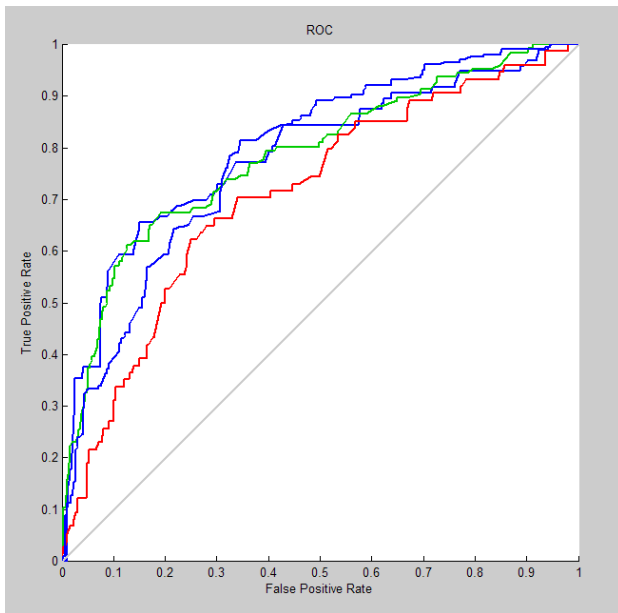


Figure 3. ROC analysis result

We can see from Figure 2 and Figure 3 that there is an intuitive calculate result which could show the computing process clearly and has a strong persuasion. After we get the research results and figures, we can generate the research report by using Labtext [8] in the right forms.

#### IV. SETTING THE PORT PLANNING PARAMETERS IN CONTAINER TERMINALS

The methodology focuses on the possible application of an artificial neural network to determine the fundamental parameters of a container port terminal (dock line unit, surface, number of dock cranes, etc.) analysing the data acquired from different ports worldwide. The analysis is realized applying a multiple comparison scheme, randomly generated.

The Artificial Neural Networks (ANN) are inspired by the human brain's biological neural networks. The main characteristics reproduced by the artificial neural networks can be reduced to the following three concepts: parallel processing, carried out by artificial neurons, distribution by a layers complex, and adaptation through learning from experience and minimising the error [9].

The artificial neural network model is composed by a number of inputs ( $x_j(t)$ ); synaptic weights ( $w_{ij}$ ) representing the communication degree between neurons  $j$  and  $i$ ; a propagation rule  $\sigma_i(w_{ij}, x_j(t))$  which determines the interaction potential between neuron  $i$  and the  $N$  neighbouring neurons; an activation function  $f_i[a_i(t-1), h_i(t)]$  associated to the neuron  $i$ , determining the neuron's activation state, based on the resultant potential  $h_i$  and the neuron's previous activation state  $a_i(t-1)$ ; and an exit function ( $F_i(a_i(t))$ ) representing the answer of the neuron  $i$ , given by the following formula:

$$y_i(t) = F_i ( f_i[a_i(t-1), \sigma_i(w_{ij}, x_j(t))] ) \quad (1)$$

Thus, the learning process of a neural network can be seen as the adjustment process of the network's free parameters.

Starting from a random synaptic weights set of values, the learning process searches a set of values that would allow the network to correctly develop a specific task. The learning process is therefore an iterative sequence that will refine the solution until a sufficiently good operation level is reached.

The following methodological stops have been developed:

#### A. Phase I: Data acquisition, clasification and discretisation of the values obtained from the terminals

This first phase performs a diagnosis of the containers terminals actual state within a wide variety of geographical conditions; data to be processed are also acquired, classified and arranged. Dealing with a neural network, the number of variables to be considered can be practically infinite. Databases sizes can be considerable, as well as the fields' number.

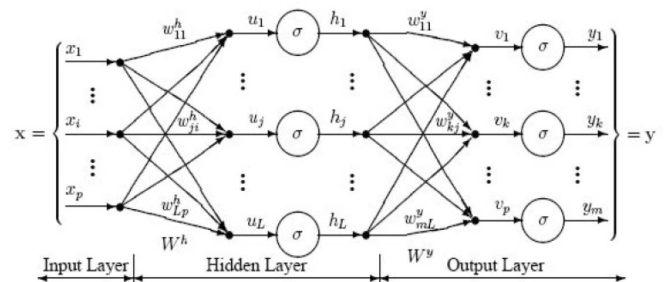


Figure 4. Network architecture scheme

Terminals values are processed during the correspondent number of years.

Databases can be generated during the process, to relation different variables like number of berthing points, stocking capacity, crane time, waiting time, berthing number and time, dock length, terminal surface, total cranes number or equipments to be used, optimum stocking areas occupation, operated containers quantity, terminal and its subsystems capacities, etc.

#### B. Phase II: Building th artificial neural network

The artificial neural network is built using the Matlab application, creating a multilayer perceptron network through a learning algorithm backpropagation with adaptable learning speed. Training method is a momentum descending gradient. Once created, and alter an initial simulation process, the network is trained using known inputs and outputs, representing real container terminal data, aiming that the network adjusts its outputs through modifying the weights and threshold values, in order to minimise the errors.

#### C. Phase III: Network functioning and obtained results analysis

Before any process, one has to define the training percentage to be considered. This comes to show what part of the data will be used for training and what part for the test, in order to verify model's effectiveness.

The number of epochs, in other words, the number of times real data have been compared to model's outputs to perform connections' weights adjustments.

The following variables, obtained from the neural network training process, will be used to analyse network's functioning:

- Correlation coefficient (C), that allows the comparison between two different observations of the same or different variables that quantifies the relation degree between real data and network's forecast. This variable can be written as:

$$C = \frac{\sum_{i=1}^N (O_i - \bar{O})(P_i - \bar{P})}{\sqrt{\sum_{i=1}^N (O_i - \bar{O})^2 \sum_{i=1}^N (P_i - \bar{P})^2}} \quad (2)$$

where;

$O_i$ , is the real value

$P_i$ , is the forecasted value

$N$ , is the number of data

- Average squared error (MSE), that measures system's error, and can be defined as:

$$MSE = \frac{1}{N} \sum_{i=1}^N (O_i - P_i)^2 \quad (3)$$

During the training phase, output variables or real values are compared to the forecasted ones. This process allows the estimation of network's approach based on training data, as shown by the graph below.

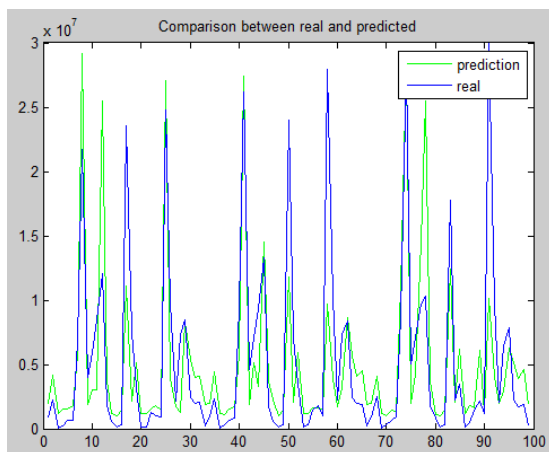


Figure 5. Approach comparison between real and forecasted values

#### D. Phase IV: Neural network validation

Once verified that network's outputs after the training process, are within the accepted range of parameters values (Correlation coefficient, Average squared error, etc), the network can be validated, estimating its suitability for a real case application.

## V. RESULTS

Data series and values from 33 terminals, observed during 6 years in Australia, Canada, Chile, Korea, Ecuador, Hong Kong, Japan, Mexico, Panama, Singapore or the United States have been processed.

Fields information include the date (year), container terminal's name, the country, dock's length, terminal's surface, the number of dock cranes and the operated containers quantity.

Network's architecture can be schematised as shown in the figure below:

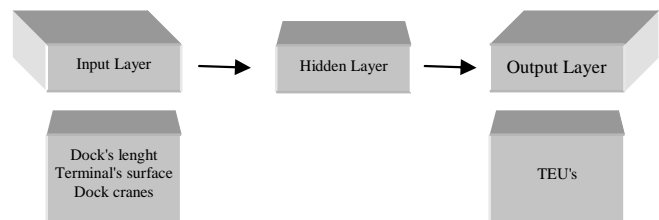


Figure 6. Network's architecture scheme

Network's parameters:

- Input layers: 3
- Hidden layers: 5
- Output layers: 1
- Epoch: 1000-3000
- Learning rate: 0,3
- Momentum: 0,6

The variables used by the neural network have been basically the initial values of parameters like dock length, terminal surface or number of dock cranes, considering as forecasted value the operated containers number or TEU's.

The number of processed data or variables is 1584 registers.

La simulation has been performed with MATLAB, using its Toolbox RNAs Tools, that can perform values' training and test based on the assigned percentage within the network.

The higher the fields' percentage assigned to training, the lower the number of fields used for results' verification, and vice versa. The same tool allowed considering the possibility risk influence on network's training.

Several attempts have been performed, varying the training-test percentage (% T-T), and the iterations number (R), to ensure the correct verification and validation.

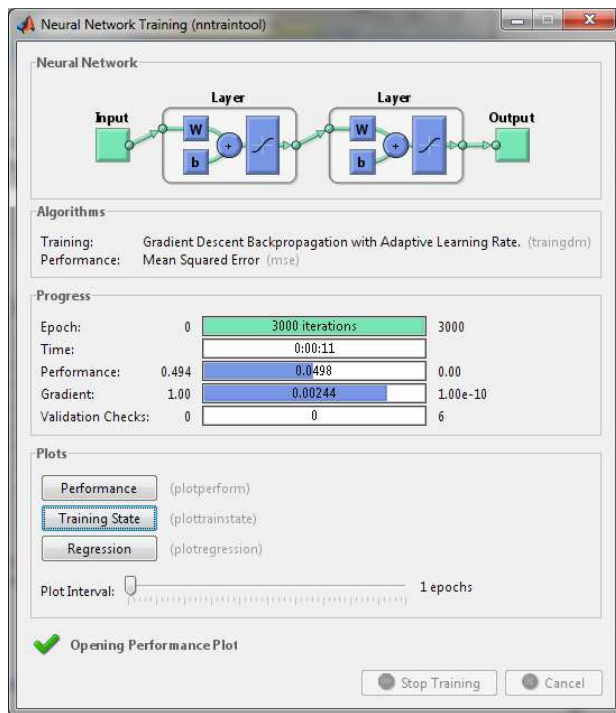


Figure 7. Network's training module

The following table shows the values of each studied variable, as well as the average values of the obtained quality indexes, in the following cases:

- % train.-test:  
50%-50%; 70%-30% ; 90%-10%.
- Iterations:  
1000; 2000; 3000

TABLE I. MODEL'S RESULTS

Model	% (T-T)	R	C	MSE
1	50-50	1000	0,7907	1,9368e+013
2	70-30	1000	0,8439	1,7151e+013
3	90-10	1000	0,8867	1,4570e+013
4	50-50	2000	0,7135	2,6750e+013
5	70-30	2000	0,8639	1,8301e+013
6	90-10	2000	0,7745	3,8271e+013
7	50-50	3000	0,7768	2,0868e+013
8	70-30	3000	0,8536	1,5879e+013
9	90-10	3000	0,8575	2,3244e+013

The research work that inspired this paper contains a more developed study. Only a few results are included here, given the paper's limits.

Real data and forecasted values relationships, related to the results shown in the table above, can be represented as shown in the following graphs.

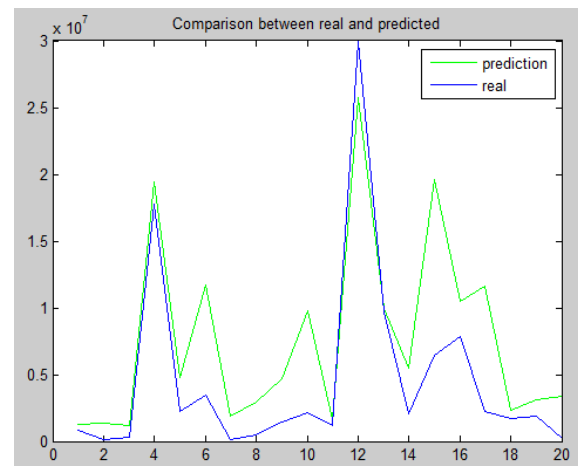


Figure 8. Graph for % (T-T) 90-10 and 3000 iterations

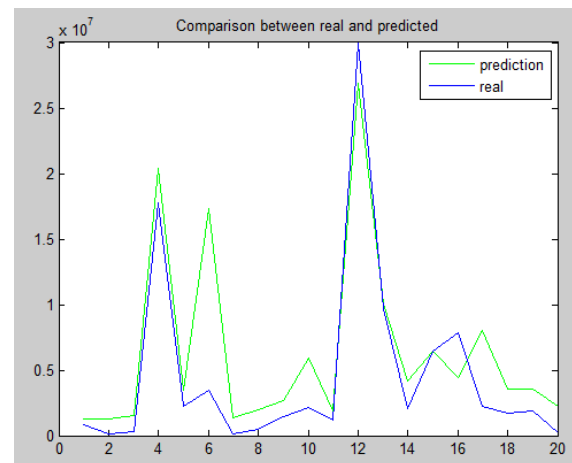


Figure 9. Graph for % (T-T) 90-10 and 1000 iterations

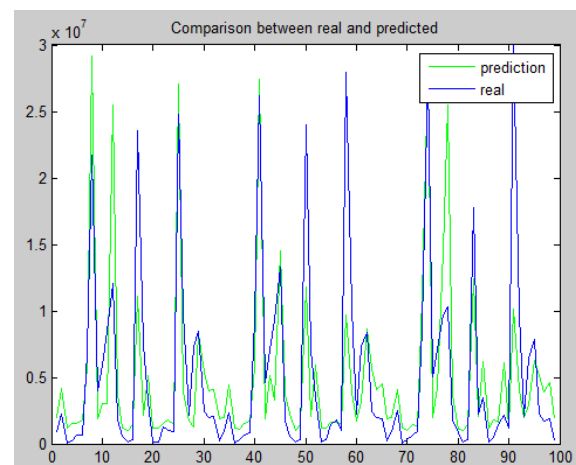


Figure 10. Graph for % (T-T) 50-50 and 3000 iterations

Among all combinations and models analysed, the best adjusted results have been obtained by increasing both the

training percentage and number of iterations; therefore, these configurations can be considered as the best fitted.

A high correlation percentage between real and predicted values has been observed in all results.

The adjustments performed through the average squared error MSE and the different correlation comparisons, show approach results at an average higher than 80% and never less than 70%.

These results show clearly that the designed neural network, can be used to predict the future needs in terms of dock cranes number, berthing length, stocking surface, according to the TEU's estimations, or vice versa.

This research can be extended to other variables involved in the planning process, considering the relationships between them (stocking capacity, waiting times, berthing points number and berthing time, dock length, terminal surface, total crane or other equipments number, optimum stocking areas occupation, operated containers quantity, terminal capacity and its different subsystems, etc.).

## VI. STUDY ON FORECASTING THE BERTHING TIME OF THE SHIPS IN THE PORT

Forecasting the berthing time of the ships has a great significance to the operation management and task arrangement in the port. The factors which influence the berthing time are proposed, the research ideas are designed and the BP neural network, RBF neural network and linear neural network are constructed. A case study which uses the data of Valencia port is analyzed. The outputs of the three neural networks are evaluated and the best neural network is obtained. The simulation results show that the outputs of the neural networks have the high accuracy and conform to the actual work needs.

In this paper, we take the Valencia port in Spain as the study object, analyze and calculate the data of the berthing time of the ships in Valencia port from the year of 2008 to 2011. We randomly select 500 sets of data as the training samples of the neural network, and randomly select 50 sets of data as the testing samples.

We study following the research ideas shown use the Matlab software to program. We put the data of the completely training samples and testing samples input to the proposed neural network models and get the computed results which are shown in Figure 11, Figure 12 and Figure 13.

By comparing the outputs of the three neural networks, we can see that the BP neural network reaches the mean squared error of  $10^{-5}$  in 61 epochs, the RBF neural network reaches the mean squared error of  $10^{-5}$  in 45 epochs, while the linear neural network reaches the mean squared error of  $10^{-2}$  in 20000 epochs which is the maximum number of calculation. Therefore, the RBF neural network achieves the accuracy requirement in a minimum number of calculated times and we choose the proposed RBF neural network as the optimal neural network. We adopt the proposed RBF neural network to simulate 50 testing samples and we obtain the results which are shown in Figure 14. We can see from Figure 14 that the RBF

neural network has high computing accuracy and has the good fitting results with the 50 testing samples, so the RBF neural network can be used as the neural network that forecasting the future berthing time of the ships in the port.

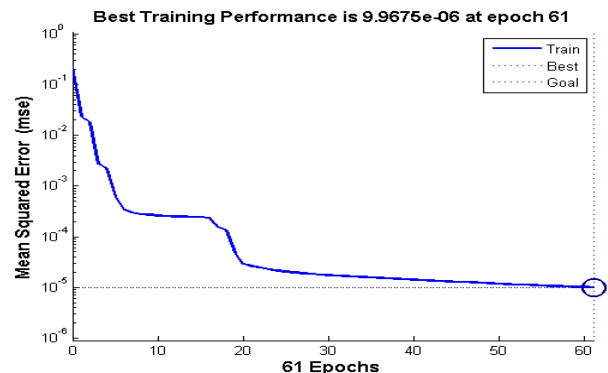


Figure 11. Training process of the BP neural net-work



Figure 12. Training process of the RBF neural network

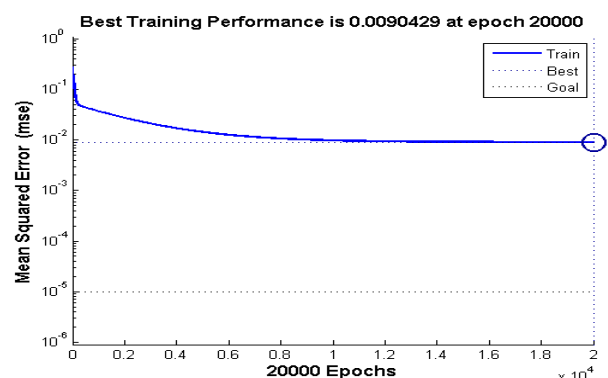


Figure 13. Training process of the linear neural network

## VII. CONCLUSIONS

NNtex [1] is an important and precious toolbox which can solve the practice problems based on the Matlab software. The calculation process of this toolbox is stable, fast and comprehensive. At the same time, NNtex [1] requires less memory and could solve the large-scale problems in the limited conditions.

In the future, our research group will develop the toolbox which has more powerful functions, such as adding more different kinds of neural networks as contrast and improve the algorithm to improve the operation efficiency.

The analysis of the obtained results shows that artificial neural networks can be used to model the port planning process related to container terminals, using consistent series of historical data.

The results show a high correlation percentage between real and predicted values, with an average higher than 80% and a minimum value above 70%.

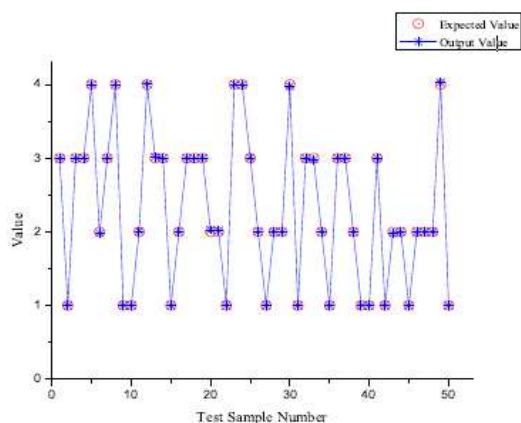


Figure 14. Fitting result of the RBF neural network

A more reliable model is obtained using a higher data quantity for network's training. This has to be carefully observed, as a training excess can lead to a forecast error.

Therefore, the estimation of equipments and surface needs based on predictions of operated TEU's, or vice versa, obtained as results of an artificial neural network modelling, can be used in a container terminal planning process, and can be highly successful.

The forecasts open the way in the future to a wide range of possibilities in terms of used parameters, either physical or equipment related.

The developed study used the following fixed or variable parameters: dock length, terminal surface, number of dock cranes and operated container quantity. This research can be

extended in the future using the same network, to involve other parameters related to the terminal planning and operation, and validating its suitability for a future possible use.

This paper analyzes the importance of forecasting the berthing time of the ships in the port and proposes four factors which affect the berthing time of the ships and are used as the input parameters of the neural networks. We build three neural network models which include the BP neural network, RBF neural network and linear neural network and analyze a case study which uses the berthing time of the ships data in Valencia port from the year of 2008 to 2011. We get the outputs of the three neural networks and through the comparative analysis, we find that the RBF neural network achieves the accuracy of the demand in a minimum number of calculations, and thus we choose the RBF neural network as the best neural network in our research. We can use the proposed RBF neural network to forecast the future berthing time of the ships in the port. The constructed neural network model has a good portability and could also be applied to the other ports in the forecasting work of the berthing time of the ships in the port and provide the support for the orderly conduct of the port operation.

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# SECTION 23.

*Wireless Technology*

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*Hardware Technology*

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