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Technology alliances and firm performance: Portuguese SMEs in an EU-sponsored research setting

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I hereby declare that this thesis has not been submitted, either in the same or different form, to this or any other University for a degree.

Signature: _____

To my lovely wife Minervina and daughter Inês.

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UNIVERSITY OF SUSSEX

Adão António Nunes de Carvalho Doctor of Philosophy

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SUMMARY

This thesis is concerned with the relationship between R&D (research and development) alliances and firm performance. It investigates whether SMEs (small and medium-sized enterprises) have performance improvements through participation in government-sponsored R&D alliances and attempts to understand the extent to which they are capable of turning alliance outcomes into performance. The thesis analyses simultaneously the alliance performance and firm performance and looks at the influence of the initial conditions and implementation process on both. Complementary to this, the study addresses the issue of organisational learning from alliances.

The empirical evidence is based on the experience of a sample of Portuguese manufacturing SMEs from several traditional sectors who participated in the collaborative programme CRAFT (1994-98) sponsored by the EU (European Union). The data were collected through face-to-face interviews, using a structured questionnaire for guiding them. The study aims primarily at capturing the firm's perspective, with the CRAFT programme regarded as a source of resources the firm uses in pursuit of its objectives.

The successful cases, though quite few, illustrate the potential performance benefits SMEs can achieve with the CRAFT model of partnering, if the projects are technically successful and provided the conditions to exploit the alliance outcomes can also be met. Alliance success however does not necessarily imply better firm performance. In general, the real impact on the firms' performance indicators fell below the initial expectations and more than 60% of all firms in the study did not have a significant impact on performance. Nevertheless, that does not necessarily mean alliance failure or dissatisfaction with the alliance performance. Turning alliance outcomes into firm performance is not an automatic process and the thesis identifies several internal and external factors which may impede the successful exploitation of alliance outcomes. The thesis also distinguishes several barriers to learning which had an influence on the ability of firms to learn from alliances.

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1 INTRODUCTION

1.1 PURPOSE OF THE THESIS

This thesis is concerned with the relationship between certain types of R&D alliances, namely government-sponsored R&D alliances, and firm performance. It attempts to understand whether small and medium size enterprises (SMEs) experience performance improvements by participating in such alliances, and the extent to which they are capable of turning alliance outcomes into economic benefits. Why is this an important issue? The full answer to this question has three important components. First, there is enough evidence to claim that the number of new alliances formed each year increased significantly as from the late 1970s and early 1980s, which were characterised by a multiplicity of alliance forms, involving an increasing number of sectors and activities. This holds for alliances in general and R&D alliances in particular. Currently, alliance formation is not increasing at rates registered over the last decades, but alliances are widely used by firms as a competitive strategy. Second, governments have been actively promoting and supporting cooperation, joining together firms, universities and research institutions, aiming at fostering industrial competitiveness and, in the case of R&D alliances, correcting market failures that result in private under-investment in research and development activities.

There is, thus, a “favourable environment” for firms to engage in cooperative projects, which is supported by the numerous studies alleging the potential benefits of inter-firm cooperation, in particular technology-based cooperation, putting pressure on firms of all sizes and sectors to seek external relationships. This leads to the third component of the answer: the number of studies that have analysed empirically the relationship between alliances and firm performance is rather small. Furthermore, these studies examined alliances in different contexts and employed a number of research methodologies, often

achieving inconsistent results. As a result, the impact of alliances on firm performance is still very much unexplored, despite its importance for understanding what advantages alliances can really offer. There are some well-known cases of success, but what is of concern are the several studies reporting a high failure rate of alliances. The thesis aims to contribute to the debate over the advantages of alliances for firm performance, especially for R&D alliances involving SMEs.

Is it appropriate to analyse the impact of R&D alliances on firm performance? It may be difficult or even inappropriate to assess R&D alliances formed with the purpose of carrying out fundamental research, given the uncertainty about the outcomes and the large period of time it may take before achieving any economic benefits. This is less likely to be the case here. All the R&D alliances under the EU's CRAFT programme examined here were near-to-market R&D projects and the outcomes were to be exploited straight after the research phase, perhaps with the exception of one case. The firms involved in such alliances are SMEs from non-technology-intensive sectors, and only exceptionally could they afford to invest in basic research. Therefore, it does seem appropriate to examine the impact on performance.

This thesis differs in many respects from previous research on this matter. A substantial number of previous studies attempted to find associations between alliances and firm performance, often using statistical methods, but were unable to prove the underlying cause-effect links. Here, the causality between alliances and firm performance is addressed and is fundamental. The thesis analyses simultaneously the alliance performance and firm performance, and attempts to understand the influence of the initial conditions and implementation process on both. Furthermore, the thesis examines the ability of firms to exploit the alliance outcomes, i.e. the ability to materialise the potential benefits generated together. Empirical research bridging (technology) alliances with firm performance, by focusing on the ability of firms to exploit the alliance outcomes, is scarce indeed. The thesis also has some limitations, in particular at the methodology level. The methodology employed to collect the data is a compromise between the interview and questionnaire methods, which turned out to benefit from the advantages of both and produced interesting results. However, the process employed to assess the performance variations and the cross-sectional analysis are the main methodological limitations (see Chapter 4).

The findings of this thesis are relevant at three different levels. Regarding the theoretical perspectives on alliances, this study addresses an issue largely neglected in the literature and sheds some light on the actual performance benefits that SMEs achieve with R&D alliances and the risk of failure that the exploitation of alliance outcomes involves. The perceived importance of R&D alliances for firm performance is not unequivocally supported by empirical studies. For this reason, the findings are highly significant for firms, especially SMEs, who are considering the R&D alliance option. The findings are also relevant at the policy level, namely for the design of collaborative programmes, even though this is not a major concern of this thesis.

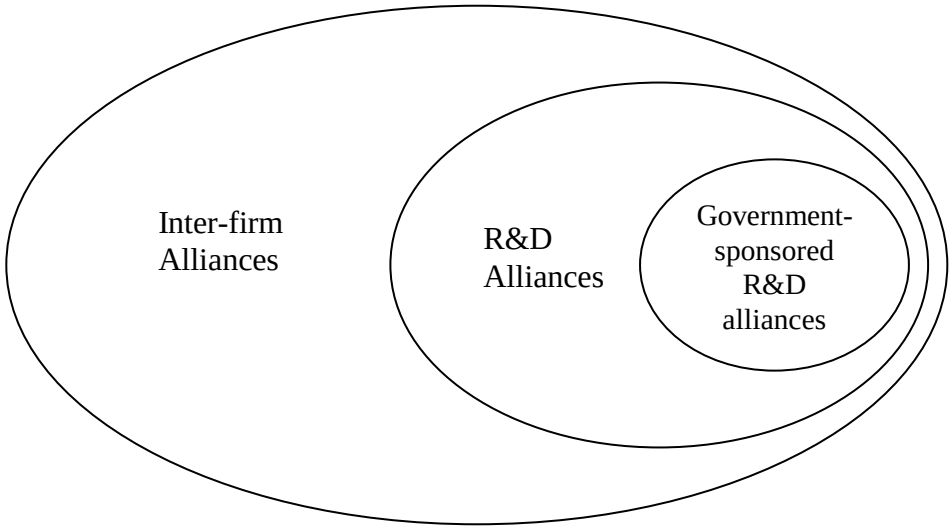
1.2 BOUNDARIES OF THIS STUDY

This thesis examines the relationship between technology alliances and firm performance in a rather specific context. It looks at the experience of a sample of Portuguese small and medium-sized manufacturing firms (with less than 500 employees) who participated in the cooperative research (CRAFT) programme sponsored by the European Union (EU). The choice of this particular sample of firms may suggest a deliberate intention to analyse the effectiveness of the EU policy in encouraging cooperation, but this is not entirely the case. The main reason for not taking this direction has to do with practical considerations. It is always difficult to get information about the involvement of firms in cooperative research projects, particularly in the case of SMEs, and information about the projects such as the alliance partners, alliance objectives, beginning and the ending dates of projects. Besides that, it is very difficult to find a set of alliances sharing a number of characteristics. The CRAFT programme was designed for SMEs, the projects were selected according to the same criteria, and the essential information on projects for this study, such as the partners' name, duration and objectives of projects, addresses, etc., is easily available.

Figure 1.1 represents straightforwardly the wider context in which the CRAFT R&D alliances fit. Government-sponsored R&D alliances, which are characterised by government intervention in their formation, represent a subclass of R&D alliances, which in turn are a subclass of inter-firm alliances. The major distinguishing features of CRAFT R&D alliances as a subclass within the R&D alliances group, besides being designed for SMEs, is that part of the research costs are covered by public funding and the alliances are

formed under the rules governing the programme. All the essential characteristics of an R&D alliance (see Chapter 2) can be found in the CRAFT alliances.

Figure 1.1 *The wider context of CRAFT R&D alliances*



Source: Author's elaboration.

Since the alliances under analysis took place in the context of an EU-sponsored programme, the results can be interpreted from the firm's viewpoint, from the European Union's viewpoint, or by analysing both perspectives simultaneously. Firms regard public funding as a source of resources they can use in pursuit of their objectives and, as profit-seekers, firms are expected to use such resources to achieve benefits that will ultimately affect their performance. Firms enter alliances because they need the resources of others to achieve their objectives or because they are not willing to take the risk of an alternative strategy. The decision to enter an alliance is based on a cost-benefit analysis, very much like any other project; public funding certainly shifts the balance of that relationship by reducing the costs even if not raising the benefits, and hence minimises the risk of projects. On the other hand, policy-makers are interested in assessing the effectiveness of their policies; for instance, by comparing the CRAFT programme's objectives (see Chapter 4) and the general objectives of such policies (see Chapter 3) with the actual outcomes. It can happen that a mismatch arises between the intended objectives and the actual outcomes, calling into question the efficacy of public policies to promote inter-firm cooperation. Such an assessment goes beyond the boundaries of the firm and involves political and social dimensions.

This study has been designed primarily to capture the firm's viewpoint, and therefore the unit of analysis is the firm and to a less extent the R&D alliance. Despite the "environmental pressure" to engage in external relationships, it is the firm which decides to enter alliances and it is also the firm that is the prime beneficiary of their outcomes. The study is not designed to provide a comprehensive assessment of the CRAFT programme or EU RTD (research and technological development) policy. However, the feedback from the firms directly involved in the programme and the research findings do have policy implications. Based on this feedback, some observations and recommendations for policy-makers are presented in the concluding chapter.

1.3 RESEARCH QUESTION AND METHODS[1]

Previous research generated different conclusions about the impact of alliances on firm performance, and the different nature of the studies further complicates the understanding of this issue. The study focuses on the following research question: *Do (successful) research alliances cause better firm performance*? This question addresses the issue of causality between technology alliances and firm performance, aiming at understanding the relevant factors linking the two and testing the accepted assumption by the programme sponsor and in the literature on alliances that (technologically) successful alliances lead to better firm performance. The literature greatly emphasises the necessary conditions for the success of alliances[2] and satisfaction of partners, and policy-makers believe that promoting technology alliances between firms (and other bodies) is sufficient to strengthen the technological capability of firms, and consequently enhance their performance. Apparently, neither of them takes into consideration or is fully aware of the risk of failure that the post-alliance period involves.

This question has a number of implications attached, leading to a set of questions which the thesis will attempt to provide some answers: *Does satisfaction with the alliance imply better firm performance*? *To what extent can firms turn technology alliances into performance*? *What are the factors behind the unsuccessful exploitation of alliance*

[1] Chapter 4 develops thoroughly the issue of research design, methodology and the limitations of the research approach which is used in this study.
[2] However, the success of alliances is itself difficult to define (cf. Chapter 2).

outcomes? and *To what extent do the initial conditions and the alliance implementation process affect the alliance outcomes*? Complementary to these questions, the study attempts to examine the issue of organisational learning from alliances.

This study is based on the experience of 41 Portuguese manufacturing SMEs (43 project-firm groupings), who participated in 30 technology alliances under the CRAFT programme. The empirical data was collected through face-to-face interviews with top management staff or technical directors at the firms' premises, using a questionnaire (consisting of a set of structured questions) for guiding the interviews. To understand the alliance effect on firm performance, eight indicators of performance were selected, five of them being traditional indicators - productivity, production costs, sales, profit and market share - and the remaining three non-financial indicators, which despite being increasingly important to firms still lack a generalised measurement system - customer satisfaction, product/service quality and environmental damage. A ninth variable - overall impact - has been used to assess the general effect on firm performance as opposed to the assessment of the specific aspects given by the former indicators. The executives were first invited to assess the impact on these performance indicators on a five-point importance scale, and subsequently asked to translate that impact into percentages.

As mentioned above, the cross-sectional analysis used in this study can be criticised in terms of its limitations for addressing an issue with implications over a period of time, but the design of the questionnaire, the interaction with the respondents and the systematic approach in collecting the data considerably minimised those limitations and greatly helped to capture changes.

1.4 STRUCTURE OF THE THESIS

The thesis falls into two distinct parts. The first part, which includes Chapters 2 and 3, is mainly concerned with the theoretical framework for the rest of the thesis. The second part of the thesis describes the research project and presents the empirical findings; it includes Chapters 4 to 8. Chapter 9 draws some conclusions and policy implications.

The theoretical background is split into two complementary chapters. Chapter 2 is more

specific in scope and more analytical in approach. It addresses three major concepts which are important for the thesis, namely the concepts of inter-firm alliance (and R&D alliance), alliance success, and organisational performance. Besides underlining the core characteristics of these concepts, the discussion intends also to capture their evolving nature and the persisting disagreement concerning their boundaries. The chapter then proceeds with a detailed discussion of four different perspectives on examining performance in the context of alliances. This section tackles the question of performance extensively, by taking on board a range of different studies and perspectives that often goes beyond the context of research and development (R&D) alliances. It includes an extensive literature review of empirical studies on the performance of alliances and on the performance of firms through alliances, uncovering several different approaches taken by researchers to deal with the two issues. The next section addresses the issue of organisational learning and competence-building through alliances, which is a different and complementary way of assessing the impact of alliances on firm performance. Finally, the chapter includes a literature review on the relative advantages of alliances over alternative strategies, particularly the go-it-alone option. This last point is extremely important to understand in what circumstances an alliance might be a better choice; however, the issue will not be analysed from an empirical viewpoint.

Unlike Chapter 2, Chapter 3 is less focused and less analytical. It is aimed at describing the context in which the CRAFT R&D alliances examined in the following chapters took place. The information provided in this chapter is important to understand the causes for the formation of those alliances and the consequences for the Portuguese firms, but a more detailed discussion of the issues addressed in the chapter is beyond the scope of the thesis. It begins by looking at the trends in the formation of R&D alliances and the participation of SMEs in this type of alliance, highlighting the fact that the existing databases on alliances have several structural problems and are thus not entirely reliable. The chapter proceeds with a characterisation of the Portuguese industry, its structural problems and dependency on technology from abroad. This helps to understand some intrinsic characteristics of Portuguese SMEs and how important a programme such as CRAFT can be for them. Since the CRAFT programme was sponsored by the European Union, it is relevant to understand the rationale for the public incentives to cooperation and the major EU instruments for the research and technological development within the Union (i.e., the Framework

Programmes and Structural Funds).

Chapter 4 describes the research approach which is used in this study, including the set of questions that the thesis attempts to answer, the method of data collection, and the advantages and limitations of the research process employed here. The chapter also provides a more detailed analysis of the characteristics of the CRAFT programme.

Chapters 5 to 8 detail the findings of the empirical research. The first three chapters have a "natural" sequence and each of them highlights fundamental aspects for understanding the alliance-performance link in three different stages of the process. Together, they cover the whole process of cooperation, from the inception of alliances to the impact on firm performance. Chapter 5 centres on the pre-project implementation stage and aims to capture the circumstances in which the R&D alliances were shaped, assess the strategic importance of projects for firms and identify potential strengths and weaknesses that may affect the alliance outcomes. Chapter 6 focuses on the actual cooperation process (i.e., the alliance implementation period). It assesses the investment issues, identifies the negative factors of cooperation and the benefits achieved by firms, and assesses the alliance performance. Chapter 7 is concerned with the post-alliance period. It assesses the impact of alliances on firm performance, analyses the ability of firms to transform alliance outcomes into performance and examines retrospectively how the initial conditions and the implementation process might have affected the achievement of better results. Complementary to this, Chapter 8 draws attention to the issue of organisational learning and attempts to understand in what ways firms have learned from the alliances and to identify the barriers to learning.

Finally, Chapter 9 draws the conclusions and some policy implications. In the appendixes there is a copy of the questionnaire, data on the interviews, technical information concerning previous studies on performance, and the statistical outputs.

2 ALLIANCES AND PERFORMANCE

2.1 INTRODUCTION

The aim of this chapter is to review the literature on alliances with a view to deriving the theoretical framework for the rest of the investigation. It has three main objectives: (i) to examine the major conceptual issues which are important to link technology alliances to firm performance, and, in particular, identify within the large spectrum of alliances the specific context where the alliances analysed in the subsequent chapters fit; (ii) to provide a detailed analysis of different ways of addressing performance in the context of alliances; (iii) to examine the rationale in terms of performance indicators. The chapter tackles the question of performance extensively by offering the reader a range of different studies and perspectives which often goes beyond the specific context of the R&D alliances and government-sponsored R&D alliances in particular. The many different perspectives and concepts in the literature suggest that an approach too focused on the R&D alliances literature would likely be rather insufficient.

The interest in studying the performance of alliances is not new, in particular joint ventures performance; certainly it is bound to be an important line of research given the amount and diversity of alliances formed recently and the urgent need to understand what advantages alliances can really offer and in what circumstances they might be a better alternative. There are, however, various onerous research obstacles on the road. Measuring alliance performance is complex because it involves a great logistical challenge to collect the rich data necessary to assess the issue in greater detail (Gulati, 1998), sometimes relating to a long period of time. It is difficult to empirically link alliance activity with firm performance due to the enormous problems in filtering variations in performance attributable to alliances, since many other activities contribute to firm performance. The

lack of a conceptual framework and appropriate research instruments to collect the data explain why the assessment of alliance performance and the impact of alliances on firm performance has received much less empirical attention than the rest of the theory on alliances.

Despite these problems, several researchers have gone beyond the initial efforts of setting out the problem, and a few valuable contributions have uncovered some relevant factors that affect performance. In earlier studies, however, different methodologies have been utilised to assess performance in different research contexts, therefore reducing substantially the chances for comparison and generalisation of the results.

This chapter is structured as follows. Firstly, it discusses the concepts of interfirm alliance and R&D alliance, aiming at emphasising their fundamental characteristics, the abundance of terminology in the literature and the lack of consensus regarding the boundaries of the concepts. This is intended also to contextualise the type of alliances analysed in the next chapters. Secondly, the chapter analyses the performance of alliances, first by discussing the concept and then by examining how prior studies have operationalised it. The following section examines the performance of firms through alliances, the notion of organisational performance, differentiating determinants from indicators of performance, and the multiplicity of perspectives and indicators authors have used to assess the impact on performance. The chapter proceeds with a section concerning learning and competence-building through alliances, which is a different and complementary way to assess the impact on firm performance. It attempts to show that alliances are a mechanism for learning from partners and that the knowledge acquired may not be immediately reflected in performance. Finally, the chapter addresses briefly the issue of performance of alliances versus alternative strategies, focusing specifically on the relative advantages of alliances over an independent strategy. Some conclusions end the chapter.

2.2 ON THE CONCEPT OF ALLIANCE

2.2.1 Definitions and boundaries

Over recent years, authors have used a profusion of terms to describe inter-firm alliances.

On the one hand, this certainly is the consequence of the increasing diversity and multi-dimensional characteristics of alliances. Concepts should evolve to capture more adequately the phenomenon they are supposed to describe. On the other hand, it is also a consequence of a sudden interest of a large number of researchers in this matter, easily observable in the stack of literature on this field of study, who have been stimulated by the uncharacteristic importance alliances have gained recently. To Chesnais (1988: 55) such profusion of terms is a sign of a "high degree of flexibility in the definitions proposed", but it can also be interpreted as representing, in part at least, "a degree of analytical imprecision." "The numerous definitions of cooperation scholars have offered without making much attempt to reference other usages of the term" (Smith et al., 1995: 10) undoubtedly complicate the integration of all contributions in a coherent and robust framework.

Table 2.1 contains the transcription of several definitions of inter-firm alliances subjectively selected from the relevant literature since the early 1980s. For each definition, it also includes information on the alliance duration, type of contract, characteristics of alliance partners and level of interdependence between them. The purpose of gathering all of these definitions is threefold. First, to illustrate (without being exhaustive) the profusion of terms one can find in the literature. Second, to underline similarities between different terms and stress differences between seemingly identical expressions. Third, to understand the evolution of the concept and ultimately identify its boundaries, by discussing some noticeable divergences between definitions. This is important because the use of a given term does not necessarily identify a specific and different alliance context. Selecting relevant literature for this thesis based uniquely on a terminology criterion would not be very effective.

In filling in the characteristics that each definition encompasses, we have taken into account not only the definition itself, but also any complementary explanation given by the author and the overall information included in the reference. When clear information on a specific aspect could not be found, the respective cell was left blank, meaning it is unclear what is the author's position on that point. With the exception of the variable "duration", which if not explicitly mentioned only "long-term" was assumed here, this procedure was used even when the definition is so general that anything could be included in it.

Table 2.1 *Definitions of inter-firm alliances*

Reference	Definition	Duration		Contract		Partners				Interdependence					
		S	L	F	I	No.	V	H	O	JV	Min	C	M	A	L
Mariti & Smiley (1983: 437)	"[...]a **co-operative agreement** is any long term, explicit agreement amongst two or more firms."	×	✓	✓	✓	≥ 2				✓		✓	×	×	✓
Porter & Fuller (1986: 315)	"**Coalitions** are formal, long-term alliances between firms that link aspects of their businesses but fall short of merger. They include joint ventures, licensing agreements, supply agreements, marketing agreements, and a variety of other arrangements."	×	✓	✓	×	≥ 2				✓			×	×	✓
Chesnais (1988: 56)	"**Inter-company co-operation agreements**, which are formal, and informal, agreements between two or more companies providing for a certain degree of collaboration between them (and) involving equity participation or the creation of new companies (as well as) non-equity agreements."		✓	✓	✓	≥ 2			✓	✓	✓	✓	×	×	✓
Harrigan (1988: 205)	"**Strategic alliances** – JV, cooperative agreements, and so forth – are partnerships among firms that work together to attain some strategic objective."	✓	✓	✓		= 2 ?	✓	✓		✓					
Jarillo (1988: 32)	"I see **strategic networks** as long-term, purposeful arrangements among distinct but related for-profit organizations that allow those firms in them to gain or sustain competitive advantage vis-à-vis their competitors outside the network. Firms in the network are independent along some dimensions."	×	✓			≥ 2			×		✓		×	×	
Jorde & Teece (1989: 8)	"A **strategic alliance** can be defined as a bilateral relationship characterized by the commitment of two or more partner firms to reach a common goal, and which entails the pooling of specialized assets and capabilities."	×	✓	✓		≥ 2				✓	✓	✓	×	×	×
Lewis (1990: 1)	"In a **strategic alliance** firms cooperate out of mutual need and share the risks to reach a common objective."		✓	✓	✓	≥ 2	✓	✓	✓	✓	✓	✓	×	×	
Forrest (1992: 25)	"**Strategic alliances** are those collaborations between firms and other organizations, both short- and long-term, which can involve either partial or contractual ownership, and are developed for strategic reasons."	✓	✓	✓		≥ 2			✓	✓	✓				✓
Dodgson (1993b: 10)	"There is a plethora of definitions of **collaboration** – also known as 'alliances', 'cooperative agreements' and 'networks' – including a huge range of activities. They are formed by firms with other firms [...] and with higher education institutes and contract research organizations. Collaborations take place in the research, development, manufacturing and marketing functions, and take a wide variety of forms."		✓	✓	✓	≥ 2	✓	✓	✓	✓		✓			×
Håkansson et al. (1993: 66)	"**Strategic alliances** are loosely defined as two or more autonomous firms agreeing to co-ordinate some of their resources for joint purposes. Thus a wide variety of formal and informal agreements – from buyer-seller relationships to mergers and acquisitions – are perceived as strategic alliances."		✓	✓	✓	≥ 2	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hagedoorn (1993: 377)	"We define **cooperative agreements** as common interests between independent (industrial) partners which are not connected through (majority) ownership."	✓	✓	✓		≥ 2	✓	✓		✓	✓	✓	×	×	✓
Gomes-Casseres (1996: 34)	"An **alliance** is any governance structure involving an *incomplete contract* between *separate firms* and in which each partner has *limited control*. Because the partners remain separate firms, there is no automatic convergence in their interests and actions. As a result, to deal with unforseen contingencies the partners need to make decisions jointly."		✓	✓		≥ 2	✓	✓		✓	✓		×	×	✓
Rosenfeld (1996: 248)	"A **network** is loosely defined as three or more firms that cooperate in order to gain strength of numbers, solve problems, enter new markets, or develop and produce goods."		✓	✓	✓	≥ 3				✓					
Gulati (1998: 293)	"I define **strategic alliances** as voluntary arrangements between firms involving exchange, sharing, or codevelopment of products, technologies, or services."		✓	✓		≥ 2	✓	✓		✓					
Dussauge & Garrette (1999: 4)	"**Strategic alliances** are links formed between two –or more– independent companies which choose to carry out a project or specific activity joinly by coordinating the necessary skills and resources rather than: i) pursuing the project or activity on their own, taking on all the risks and confronting competition alone; ii) merging their operations or acquiring and divesting entire business units."	✓	✓	✓	✓	≥ 2	✓	✓		✓	✓	✓	×	×	
Nooteboom (1999: 1)	"'**Alliance**' is a broad term capturing many forms of inter-firm cooperation that go beyond mere market transactions. It includes 'vertical', [...] 'horizontal' [...] and 'diagonal' alliances between firms in different industries. It covers the whole range of forms from incidental cooperation between independent firms, through licensing, more systematic and lasting forms of cooperation, equity swaps and equity joint ventures all the way to mergers and acquisitions."	✓	✓	✓	✓	≥ 2	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plunket (1999: 2-3)	"La **coopération interfirmes** peut se définir comme une modalité de rapprochement de deux ou plusiers entreprises, juridiquement indépendantes, ayant pour object la mise en commun de ressources financières, humaines et de savoir-faire dans le but de réaliser conjointement des activités telles que la recherche et développement (R&D), la production ou encore la commercialisation."		✓	✓		≥ 2	✓	✓	✓	✓			×	×	

Key: Duration (**S**hort-term, **L**ong-term); Contract (**F**ormal, **I**nformal); Partners (**N**umber of firms, **V**ertical alliances, **H**orizontal alliances, **O**ther institutions such as Universities, Research Centres); Interdependence (**J**oint **V**entures, **Min**ority equity, **C**onsortium, **M**ergers, **A**cquisitions, Simple **L**icensing agreements). **Note**: Emphases added, except the italic in Gomes-Casseres definition. **Source**: Author's compilation.

Table 2.1 shows a very diversified set of terms used by authors to refer to interfirm cooperation but the definitions, arguably, are not essentially different. The concept appears to have evolved in order to capture the increasing complex and diversified nature of relationships, but the effort to integrate the different perspectives has not been sustained enough. It is beyond the scope of this thesis to find the best wording for inter-firm alliances, but below there is a brief discussion on some observable disagreements which helps to understand the boundaries of the concept.

A first divergence concerns the duration of alliances and specifically whether "short-term" relationships should be considered alliances. Barlow et al. (1997) and Horton (1998), for instance, put the question in terms of a one-off project or long-term relationships (several projects), but their opinions diverge. Mariti and Smiley (1983: 437) understand that the agreement must be long-term because "a one-time purchase of goods and services is not a co-operative agreement, but an agreement to purchase all inputs from one supplier over the next ten years is." Jarillo's (1988: 32) argument is that "entrepreneurs use purposefully [the networks] to obtain a competitive advantage for their firms, instead of as a 'metaphor' to describe business transactions." Leaving aside the always challenging difficulty concerning the delimitation of short-term from long-term, and keeping in mind that certain alliances "require" longer relationships in order to reach their objectives, both the strategic importance of alliances and their consequences for the partner firms are not necessarily positively correlated with the length of time.[3]

A second divergence is about the simple licensing agreements. Many authors, conveniently or not, consider licensing agreements as alliances (cf. Table 2.1). However, Dodgson (1993b: 13) argues that licensing is excluded from his restricted definition of collaboration because it is essentially a one-way transfer of know-how. Jorde and Teece (1989: 8) say that agreements where one partner gets a "cash-based" retribution is not considered an alliance. The main argument against including them points out that unidirectional licensing agreements fall within the realm of market transactions. However, as Chesnais (1988) observes, the case is somewhat different if the contract implies some kind of further

[3] To Niosi (1996: 99), long-term is six months or more. In many alliances the negotiation phase alone takes more than six months, though. According to Harrigan's (1988: 207) findings, "of the ventures that were mutually assessed to be successful by their sponsors, 4.7 percent lasted one year or less." See also the section "Duration, termination and mortality rates of alliances" below.

interaction (e.g. communication of improvements). That is one of the reasons why licensing agreements are considered alliances in many studies and in many databases as well.

A third divergence has to do with the interdependence of partners. In the context of alliances, some authors (e.g. Brockhoff et al., 1991; Lorange and Loos, 1992; Chiesa and Manzini, 1998) consider that mergers and acquisitions represent the highest degree of organisational dependence or integration. Many other authors, however, do not agree that mergers and acquisitions can be called alliances. One fundamental argument is that in a genuine alliance the partners must be independent from each other, i.e. be able to make decisions autonomously. If that is not the case, it undermines the basic nature of any inter-firm alliance, which means both partners are under the same hierarchical structure. “The merger or acquisition per se implies that the original entities are answerable to a single chain of command [...] and that, as a result, they lose all autonomy in the choice of their objectives and definition of their strategies” (Dussauge and Garrette, 1999: 3). “Obviously, an acquisition is not an alliance” (Nueno, 1999: 319). In an alliance, the partners are free to exit the relationship (Murray and Mahon, 1993: 103). Therefore, for many researchers, mergers, acquisitions and majority equity investments (i.e. the acquisition of more than 50% of another firm) are not alliances. Gomes-Casseres (1996: 262) concludes, “the requirement of separate firms is almost universal.”

A fourth disagreement, not noticeable in Table 2.1, concerns joint ventures. Some authors, e.g. Chiesa and Manzini (1998), exclude joint ventures from their notion of alliances. To these authors, alliances are basically agreements between firms without involving any form of equity participation. Tidd et al. (1997) understand joint ventures as a type of collaboration but not a strategic alliance. Callahan and Mackenzie (1999: 366) are explicit in their conclusion: “an alliance is not a joint venture. In a joint venture, a new corporate entity is formed.” However, most authors include JVs in their notion of alliance (cf. Table 2.1). They argue that it is the nature rather than the legal status that defines an alliance (Dussauge and Garrette, 1999: 10).

The last divergence refers to the meaning of the word “strategic”. The term is fashionable, widely used and rather inaccurate, since the literature is characterised by a multiplicity of

perspectives. It is possible to identify three different approaches:

- The literature that takes the concept as a given and does not bother to define it or even quote other definitions;
- The literature that use the word "strategic" in the definition, however does not assign it any special meaning (e.g. Håkansson et al., 1993; Gulati, 1998);
- The literature that uses it and provides an explanation for its meaning. Some authors have gone beyond that and suggest alternatives to "strategic".

Devlin and Bleackley (1988: 18) state that "strategic alliances are specifically concerned with securing, maintaining or enhancing a company's competitive advantage", and "take place in the context of a company's long-term strategic plan and seek to improve or dramatically change a company's competitive position". In Mytelka (1991), "alliances are regarded as strategic where they seek to improve the future competitive position of the firm. [Strategic alliances tend to] assume greater importance in the long-term planning objectives of a firm than it does as an ad hoc to the opportunities for short-term gain" (Mytelka, 1991: 1). For the European Commission (1995: 32), an alliance is strategic if it demonstrates some or all of the following main features:

(1) Its "intent" is strategic. That is, the partners mean the alliance to further some highly important objectives for the firm concerned.
(2) In so doing, the alliance is likely to exist for a longer rather than shorter period of time – in practice several years.
(3) There is a specific goal or goals to do with generating competitive advantage in either products, key activities or major markets.
(4) Partners often "give up" something important in their own competence in return for the success of the alliance.

To Dussauge and Garrette (1999: 22), an alliance can be described as strategic "when it contributes significantly to the strategies pursued by the partner companies, and when it involves pooling and combining the partners' capabilities". They note that "true strategic alliances are aimed at creating and enhancing the competitive positions of the firms involved, in a highly competitive environment" (p. 21).

Dodgson (1992b: 229) makes the distinction between the strategic and the tactical nature of R&D collaboration if it focuses on issues important for the long-term development of the

company or not. Eventually, he concludes that there is some contradictory evidence concerning the strategic nature of collaboration in R&D. Hagedoorn (1993: 372) states that "the strategic character of the agreement relates to the expected long-term effects of the agreement on the product-market positioning of at least one of the partners". He suggests that the alternative to strategic intent is cost-economising, which is "associated with either transaction costs or operating costs of companies" (p. 377), but acknowledges that there is no strict correlation between organisational modes of cooperation and their strategic or cost-economising content. Tidd et al. (1997: 199) in their model of collaboration understand that the motives to collaborate can be strategic (leadership and learning) or tactical (cost, time and risk).

The notion of "strategic" has some drawbacks. As seen above, there is no consensus about its meaning. The term is itself rather vague and subjective given the difficulty in sorting out ex ante whether or not a certain collaborative project is strategic. Frequently, the assessment of the "strategic" intent of an alliance is made by researchers, sometimes based on scarce information about the projects (e.g. announcements in specialised literature). Putting the question the other way round, in what situations can one say that a specific alliance has no strategic intent if it is established in a purposeful and deliberative way? Are "strategic" alliances strategic to all alliance partners? It is a flexible term as well, in the sense that the "strategic" nature of an alliance may change over time depending on its outcomes and other environmental circumstances. Is an alliance strategic that has negative implications for (some of) the partners involved when its initial intent was strategic? The discussion above suggests that the boundary between alliance and strategic alliance is somewhat loose and difficult to establish clearly, which helps to explain why both terms are frequently used interchangeably.

The lack of consensus about the terminology and boundaries of alliances complicates the researcher's work in selecting and analysing the relevant literature. For instance, the fact that the CRAFT R&D alliances have a maximum duration of two years - not a strategic alliance according to many definitions - appears not to be sufficient to dismiss straight away the literature on strategic alliances as irrelevant, because, as explained above, the importance of an alliance is not necessarily related to its duration.

2.2.2 The notion of R&D alliance

Whereas the concept of interfirm alliance is still a matter of intense discussion, it is widely accepted in the literature that an R&D alliance is one of the many types of alliances within the inter-firm alliance spectrum. R&D alliances fit within the general definitions discussed above, having, however, proper characteristics that distinguish them from other types of alliances. Again, there is no consensus about the exact definition of an R&D alliance, its boundaries are rather unclear and the terminology is diversified as well. The following definitions contain the fundamental characteristics of an R&D alliance and illustrate this point.

> "Co-operation and/or technology exchange between firms (or between firms and other categories of research organisations) can either take place at a single given point of the R&D-to-commercialisation process or cover the whole process. It can concern either the creation of new technology or the acquisition and use of an already existing one or [...] both." (Chesnais, 1988: 57-9)

> "Technological collaboration includes any activity where two or more partners contribute differential resources and know-how to agreed complementary aims. In this definition may be included the following, both privately created or promoted by public policy: (a) Collaborative research programmes or consortia; (b) Joint ventures and strategic alliances; (c) Shared R&D and production contracts. Both vertical and horizontal linkages are included [...] direct investment, licensing, marketing agreements and computerized networks and data-banks [...] are not included as they are essentially one-way transfers of know-how." (Dodgson, 1993b: 13)

> [...] "strategic technology partnering, i.e., interfirm cooperation for which a combined innovative activity or an exchange of technology is at least part of their agreement." (Hagedoorn, 1993: 371-2)

> "Technical cooperation among firms takes place when independent enterprises put together commonly defined R&D projects, often with help of universities and government laboratories. The spectrum of technical cooperation goes from informal collaboration (usually through the short-term exchange of research personnel, ideas, and/or laboratory material without any written contract between the parties) to strategic technical alliances (i.e. long-term – six months or more – written R&D agreements between firms aiming at the creation of new or

improved products or processes). Technological collaboration thus differs both from technology transfer, and from other types of strategic alliances (i.e. commercial, manufacturing, advertising, etc.)." (Niosi, 1996: 99)

"Partnerships are defined [...] as cooperative arrangements engaging companies, universities, and government agencies and laboratories in various combinations to pool resources in pursuit of a shared R&D objective." (Council on Competitiveness, 1996: 3)[4]

"We define a research partnership broadly as an innovative-based relationship that involves, at least partly, a significant effort in research and development (R&D)." (Hagedoorn, Link and Vonortas, 2000: 567-8)

Taking the standpoint of innovation, Freeman (1991: 502) classifies R&D cooperation in ten categories of "innovation networks": (1) Joint ventures and research corporations; (2) Joint R&D agreements; (3) Technology exchange agreements; (4) Direct investment (minority holdings) motivated by technology factors; (5) Licensing and second-sourcing agreements; (6) Sub-contracting, production-sharing and supplier networks; (7) Research associations; (8) Government-sponsored joint research programmes; (9) Computerised data banks and value-added networks for technical and scientific interchange; (10) Other networks, including informal networks.

The multiplicity of R&D alliance types may be also classified under four main headings (Gugler and Dunning, 1993: 145), as follows:

- University-located R&D alliances that involve more than one industrial firm;
- Private alliances negotiated and organised without the intervention of government;
- Alliances organised through governmental agreements (e.g. Airbus);
- National and international collaborative programmes (e.g. Esprit).

These classifications of R&D alliances and some of the definitions above clearly regard government-sponsored R&D alliances as a subset within the R&D alliance category. The promotion of international collaborative programmes such as CRAFT, which is sponsored by the European Union through funding, is a way of government intervention in the

[4] Quoted in Link (1999) and Hagedoorn et al. (2000).

formation of alliances. The empirical research in this thesis is thus primarily relevant in the context of R&D alliances.

2.3 ALLIANCE PERFORMANCE

2.3.1 On the notion of alliance success[5]

There is no straightforward notion of alliance success. The large spectrum of alliance types, their multiplicity of purposes and diversity of results, make it very difficult to find a single, all-embracing definition. The task gets harder when the individual perspectives of partner firms are taken into consideration; it is hardly surprising to obtain divergent opinions about the success or failure of the alliance, due to the different set of objectives they are likely to have. Arnold et al. (1992: 42) claim that, in the context of technological collaboration, projects are successful if achievements match or surpass expectations and useful unanticipated results and benefits can render a project successful, even if the original expectations are not met. However, the problems in measuring the alliance success appear to be rather more complex, as the following quotations show.

> "Each strategic alliance obviously has unique characteristics. Therefore, it is virtually impossible to give a prescription for performance appraisal that is valid for more than a limited number of cases." (Lorange and Roos, 1992: 42)

> "It is notoriously difficult to define success in collaboration. The range of firms' circumstances and their experiences of collaboration are so variable as to make uniform definitions of success and failure unwise." (Dodgson, 1993b: 151)

> "Success is a concept with a multitude of facets, which makes it difficult to develop a measurement approach." (Brockhoff and Teichert, 1995: 111)

> "It is difficult to assess the success of a collaborative venture, and in particular termination of a partnership does not necessarily indicate failure if the objectives have been met." (Tidd Bessant and Pavitt, 1997: 228)

[5] Some authors use the term success, others performance, apparently with no distinction between them. Both terms are used here interchangeably.

> "In the case of alliances, the very notion of success is indeed quite ambiguous; alliance success is usually assessed on the basis of the performance of the joint project or venture, but very rarely takes into account the impact that collaboration may have on the situation of the various partner firms. This issue is compounded by the fact that these partner firms may have very different reasons to collaborate and may pursue radically different strategic goals through the alliance." (Dussauge and Garrette, 1999: 206)

The assessment of alliances has been of concern to many researchers over the last few decades, particularly the assessment of joint ventures; however the progress has been rather modest so far because of the many difficulties referred to above. Basically, the question of alliance success has been considered in two different ways. On the one hand, part of the literature is of a prescriptive-type nature, since its main concern is to identify critical aspects of the relationship where partners should focus their attention if success is to be attained, however normally no underlying definition of success is provided (e.g., Perlmutter and Heenan, 1986; Devlin and Bleackley, 1988). The result of this approach is a "collection of good practices" aimed at guiding the partners through the whole complex process of cooperation in order to achieve the "best possible results" (see, for instance, Duysters et al. (1999) for a recent example).

On the other hand, some studies take alliance success in a totally different perspective by concentrating their efforts on the identification of relevant variables aiming at operationalising the concept of alliance success. Here, the focus is the alliance outcomes and the way they can be assessed. At least three different perspectives can be observed in the literature concerning the assessment of alliances. However, despite the interesting suggestions for alliance assessment described in the boxes below, many of them are hardly operational and, consequently, ineffective. Some suggestions for alliance assessment have no specific restrictions attached and, thus, are general in purpose (see Box 2.1). A second group of suggestions to assess alliances are restricted to specific types of alliances (see Box 2.2). Yet another group is even more specific, and suggests ways of measuring success of alliances aimed at reaching particular alliance objectives (see Box 2.3).

Box 2.1 *General assessment of alliances*

"Partnerships are going to be viable only insofar as the value of the joint results to both partners is superior to the opportunity cost they incur - in particular, the cost of the loss of control and autonomy that follows the partnership." (Doz, 1988: 325)

"Venture performance is determined in this analysis by considering all three indicators - venture survival, duration, and sponsor-indicated assessments of success." (Harrigan, 1988: 207)

"To be considered successful, an alliance had to pass two tests: both partners achieved their ingoing strategic objectives and both recovered their financial costs of capital." (Bleeke and Ernst, 1993b: 23)

"Business dissolution is an appropriate measure [of failure] for situations in which interfirm collaboration plays a central role in business strategy." (Singh and Mitchell, 1996: 101)

Box 2.2 *Assessment of specific alliance types*

[...] "successful **joint ventures** are those that survive over a reasonable period of time, generally over eight years, and the major parties involved - the TNC, the national partner(s), and the host government - perceive sufficient benefits in relation to costs." (Dymsza, 1988: 403)

[**Technological collaboration**] "Projects are successful if achievements match or surpass expectations; Even if original expectations are not met, useful unanticipated results and benefits can render a project successful." (Arnold et al., 1992: 42)

"We consider an alliance [**Joint venture**] successful if both parties achieve their strategic objectives and earn a return equal to or greater than their cost of capital over the life of the partnership." (Bleeke and Ernst, 1995: 98)

"In very broad terms we consider success to be the degree to which objectives are met (or surpassed) by a specific organizational arrangement (the **R&D cooperation**) within a set of situational variables." [It takes the viewpoint of any of the partners and includes only cooperation among business firms] (Brockhoff and Teichert, 1995: 112)

"**Joint ventures** are designed to meet the goals both of individual firms and of the collective undertaking, and will be successful when the value of collective outcomes exceeds opportunity costs incurred by participants, and when the distribution of both is fair." (Park and Russo, 1996: 878)

"Although the specific measurement varies in each case, the benchmark for the performance of **co-option alliances** can be summarized in terms of the improvement of the structural attractiveness of the industry for the alliance participants and the strengthening of their competitive capabilities."; "**Cospecialization alliances** that rely on skills or other ownership-specific contributions [...] ought to be measured by the value of the new opportunities they create compared with what partners could have achieved on their own."; "The success of **learning alliances** can be measured in terms of the intensity of skill improvement and the scope of learning application. Learning alliances need to be assessed on the basis of the individual partner's appropriation of that learning. [...] Relative dependence within a competence-building alliance is another criterion against which to measure success."; "Some alliances should be measured as options. **R&D alliances**, for instance, may be assessed in terms of the range of available options they present to their partners." (Doz and Hamel, 1998: 81-3)

[...] "the success of the **joint venture** itself - i.e., its survival, duration, growth and profits [...]"; "The outcomes of **alliances** [**between rival firms**] can be analyzed on the basis of three dimensions: (i) the evolution of the alliance over time [natural end; extension; premature termination; continuation by one partner; takeover]; (ii) the strategic consequences of the alliance for each partner firm [new capability acquisition; mutual specialization; one-way skill appropriation; no consequence]; and (iii) the impact of

the alliance on the intensity of competition [increased, reduced and no impact on the intensity of competition]." (Dussauge and Garrette, 1999: 81, 210)

Note: Emphases added.

Box 2.3 *Assessment of specific alliance objectives*

[**Internalization**] "The success metrics of a competitive collaboration is no longer the traditional perspective - satisfaction and longevity -, but an alternative perspective - bargaining power and competitiveness." (Hamel, 1991: 101)

[...] "an alliance to **establish standards** can be measured by: 1. the reduction in the number of competing standards and/or system architecture approaches; 2. the acceleration in market development attributed to the standards being set; 3. the growth and profitability of coalition members compared with that of counterparts outside the coalition; 4. the coalition's market share and members' margins." (Doz and Hamel, 1998: 80-1)

Note: Emphases added.

Three main observations can be drawn from the above ways of assessing alliances. First, for better capturing the complexity and evolving nature of alliance, any assessment must take into consideration a multidimensional and dynamic perspective (Tidd et al., 1997). However, the more complex the assessment is, the higher the opportunity costs involved and the more difficult it is to access the information. Second, it is complicated in many alliances, although very important, to separate the alliance performance from the performance of the underlying business. Third, it seems that there is a bias in favour of assessing the benefits and potential benefits. The assessments of costs of participating in alliances are less visible in the suggestions above.

In the context of technological collaboration, Arnold et al. (1992: 42) say that project failure is often easier to identify than success. Project failure happens when: project achievements fall substantially below expectations; a collaboration halts prior to completion; a collaboration labours along unproductively because all or most participants have lost interest, but no one has the courage to call the whole thing off; the opportunity costs outweigh the benefits, that is, when the project could have been better performed alone, or where the resources involved could have been put to more productive use. However, in certain situations the assessment of project failure or success may not be straightforward. Tidd et al. (1997: 228) point out that "an apparent failure may result in knowledge or experience which may be of future benefit", and Doz and Hamel (1998: 23) emphasise that "some [planned alliances] may not even be meant to succeed. Their purpose

is simply to forestall rival alliance negotiations or, in some cases, to catalyze the formation of other alliances or competitive developments."

In summary, the multi-purpose nature of most alliances suggests that success should be measured taking a multidimensional perspective, that of the project and of the partners. The measurement of performance has to be set against objectives, both the alliance and partners' objectives. Flexibility in assessment is important to capture the evolving nature of alliance objectives and unexpected results that can occur in the course of the relationship. The results of any alliance are likely to include both planned and unplanned outcomes (benefits and costs), and other benefits that may accrue outside the alliance which are strategic rather than financial according to Doz and Hamel (1998). In evaluating the alliance success one may find, for instance, that there was a technical success but an economic failure, or, even when the alliance objectives are attained, some partners may not be satisfied. "Collaboration is not necessarily a zero sum game, but it sometimes appears this way" (Arnold et al., 1992). The achievement of objectives may be asymmetric.

The empirical research was designed to assess both the degree to which the alliance objectives were attained and the partners' level of satisfaction. It analyses both the technical and economic success of alliances. The level of analysis and type of indicators used were conditioned by the research conditions, namely time, financial resources and timing to collect data from a relatively large sample of firms. The study attempts also to understand the type of benefits achieved by firms, related or not to the alliance objectives, the relative financial effort of firms to participate in the research project, and the opportunity costs involved.

2.3.2 Prior empirical research on alliance performance

Prior research on alliance performance dates back to the early 1970s. Over this three-decade period, at least two different streams of research can be observed. The first stream refers to the study of joint venture performance, which has been undertaken over the whole period, however with less visibility during the 1990s. The JV structure has been one of the most preferred inter-organisational forms of cooperation used by firms, in particular before the 1980s (Jones and Shill, 1993), but also in the 1990s. The creation of a separate

organisation[6] favours the research because it is substantially easier to track down than other types of alliance. It also offers the advantage of enhanced comparability and thus more homogeneity in the sample (Park and Russo, 1996).

Since the mid-1980s, a second stream of research has developed and is characterised by the study of a larger number of inter-firm relationship types. Alliances, strategic alliances or cooperative agreements are some of the designations authors have used to refer to a number of different inter-organisational forms of cooperation, including JVs. This is a consequence of the cooperation phenomenon that started in the late 1970s[7]. Diversity of forms and higher flexibility compared to alternative strategies made it possible to use cooperation by large and small firms, extending cooperation to a large number of sectors and activities. However, such diversity of alliance structures and purposes has significantly complicated the assessment task.

Box 2.4 contains the overall findings of previous empirical studies on alliance performance. Table A2.1 in Appendix 2 contains technical information on these studies, including the type of alliances analysed, sample size, period under analysis, sectors, firm size, country of origin, performance indicators used and data collection method.

Box 2.4 *Previous studies on alliance performance - findings*

"There is some evidence that profitability of joint ventures varies inversely with the size of the foreign partner."; [...] "the evidence indicates that higher levels of return were obtained from joint venture investments by U.K. firms with a more relaxed attitude toward control."; "Once past the stage of commitment of funds and resources, the actual rate of return on the joint venture type of overseas investment has limited validity for evaluating performance." (Tomlinson, 1970: 90, 147, 174)

"American multinational firms' willingness to tolerate joint-venture partners' influence varies with explicit elements of their strategies and organizational implementation of those strategies." (Franko, 1971: 195)

"The overwhelming fact present in this chapter is that shared management joint ventures have a dramatically higher failure rate than dominant parent ventures." (Killing, 1983: 28)

[...] "ventures last longer between partners of similar cultures, asset sizes, and venturing experience levels. [Ventures] last longer when their activities are related (in products, markets and/or technologies) [and] it appears that partner's traits and sponsor-venture relationship traits do not offer much explanatory power in

[6] It is widely accepted that a joint venture occurs when two or more firms pool a portion of their resources to create a new, separate organisation.

[7] See, for instance, Harrigan (1986), Porter and Fuller (1986) and Hagedoorn (1990), for some figures on the number of alliances formed per year.

models of venture survival, duration, and success." (Harrigan, 1988: 225)

[...] "joint ventures between partners who have other long-term relationships are more stable."; "Clearly, termination is not synonymous with failure or poor financial performance."; "Ventures including research and development in R&D intensive industries tend less to be dissolved than other ventures. [...] Reciprocity in the potential to reward and penalize behavior among transacting parties is fundamental to the achievement of long-term cooperation." (Kogut, 1989: 184-197)

"Correlations were generally positive and significant between subjective and objective measures of IJV performance." (Geringer and Hebert, 1991: 256)

"It is appropriate to conclude that mode of ownership is associated with the behavior and performance of overseas subsidiaries in a fairly measurable and predictable way." (Chowdhury, 1992: 129-0)

[...] "the expected durability of a cooperative relationship tends to be positively associated with favorable net spillover effects, greater relative profitability, and higher overall alliance performance assessment."; "[...] the perception of opportunistic behavior has a significant, negative effect on alliance performance." (Parkhe, 1993: 814-6)

[...] "semistructured projects achieve better economic performance than unstructured co-production projects. [...] The technical quality variable was not found to have a significant influence on performance." (Dussauge and Garrette, 1995: 523)

"This study concluded that the objective conditions such as company's size and its competitive environment do not have direct influence on the effectiveness of the alliance. On the other hand, the support, attitude and recognization of the alliance are the key factors towards building an effective, strong and successful alliance." (Yuan and Wang, 1995: 785)

[...] "cooperating with competitors is risky business. [...] Our results support the notion that while the joint venture, a hybrid form of governance, does indeed fail for reasons that are a hybrid of both arms-length and internal governance, those hazards corresponding to arms-length contracting appear to be the dominant predictors of failure." (Park and Russo, 1996: 887-8)

[...] "IJV termination is predominantly effected by ownership reallocations between existing parent firms [...] venture termination is often asymmetric, or parent-specific, phenomenon in the sense that one firm typically expands its resource commitment to the business while a partner simultaneously reduces its stake in the business." (Reuer, 1997: 7)

"Findings suggest that although initial satisfaction may be explained by relationship characteristics, including prior relationship with a partner and similarities between partners, a combination of partner and relationship characteristics offers the stronger explanation of sustained alliance success." (Saxton, 1997: 457)

"Of the objective performance measures identified, survival was found to have the strongest and most significant set of correlations with overall subjective performance measures and perceptions of the extent to which the alliance had performed, relative to expectations across a range of individual dimensions. In comparison, the objective performance measures of duration and stability (in EJVs) were, in general, weak and non-significant." (Glaister and Buckley, 1998: 111)

Prior empirical research on alliance performance can be featured according to two different approaches. A first group of studies, which "have set the pace and been influential in the literature" (George and Farris, 1999), considered partner characteristics (e.g., partner influence, asymmetry, size.) as the causal variables of performance and examined alliance performance based on ex post facto measures (e.g., survival, longevity, managerial

perceptions, profitability). Unlike those studies, some recent works take a different approach by concentrating not on the overall success itself but on factors that can explain differences in alliance performance or differences in performance of different alliance structures.

2.3.2.1 Perceptual measures

The issue of alliance success (and failure) is likely to be one of those of most concern to researchers, but the various problems associated with its assessment have been rather discouraging. An approach that overcomes some of the problems consists in analysing the performance of alliances based on the partners' own assessment (i.e., perceptual measures). Several studies have followed this line of research, however with some differences among them.

Killing (1983) utilised the JV manager's own perception to assess the performance of joint ventures and concluded that dominant parent ventures have better performance assessments. In a similar fashion, Harrigan's (1988) concept of success is based on the sponsor's opinion, with an alliance being successful when all sponsors regard it as a success (see Table 2.2 for some figures). Harrigan demonstrated that partner asymmetries were detrimental to the success of the cooperative venture. On the contrary, if partners had similar culture, size and venturing experience and related activities, their venture had better chances to last longer.

Geringer and Hebert (1991) compared a range of objective performance measures (IJV[8] survival, stability and duration) with a subjective performance measure (parents' satisfaction) and found out that the two types of measures are positively and significantly correlated with each other. Saxton (1997) also used partner's opinion to measure alliance performance, not to determine the alliance success rate, but as a means of better understanding the contribution of certain factors in explaining it. Yuan and Wang (1995) assessed the alliance effectiveness using partners' subjective judgements, and Glaister and Buckley (1998) attempted to replicate Geringer and Hebert's (1991) work and extend their

[8] International Joint Ventures.

analysis to other alliance structures than IJVs. In their study on the impacts in Finland of the EU's Fourth Framework Programme for Research and Development, Luukkonen and Hälikkä (2000) asked firms "to estimate the success of the project", concluding that project success was only very weakly related to the type of network (i.e vertical, horizontal...). Larédo (1998) says that SME networks (EU collaborative projects) were those with far the highest degree of perceived failures, as judged by the respondents themselves.

Table 2.2 *Partners' own assessment of alliance performance*

Type of alliance	Sample size		Successful		Partly successful		Unsuccessful		Satisfaction (%)		
	n	%	n	%	n	%	n	%	Poor	Satis-factory	Good
Joint ventures [(a)]	37	100							36	22	42
Dominant parent	13	35.1							23	23	54
Shared mgmt	20	54.1							55	20	25
Independent	4	10.8							25	0	75
Strat. alliances [(b)]											
Total	895	100		45.3							
Ongoing		45.2		59.3							
Not ongoing		54.8						66.7 *			
Networks [(c)] (**)											
All firms	275	100	150	55	111	40	8	3			
Large firms	164	60	92	56	67	41	2	1			
Small firms	111	40	58	52	44	40	6	5			

Notes: (*) Considered unsuccessful at least by one of the sponsors. (**) Percentages do not total 100% because there were some missing observations not included here.
Sources: (a) Killing (1983); (b) Harrigan (1988); (c) Luukkonen and Hälikkä (2000).

The advantage of this process (i.e. perceptual measures) is its ability to provide information regarding the extent to which the alliance has achieved its overall objectives (Geringer and Hebert, 1991), the partners' objectives or their level of satisfaction, even when the alliance objectives are not fully attained. However, Dussauge and Garrette (1995: 521) have a somewhat different understanding. They say that this method is not adequate in the context of their study because "managers' opinions may be good indicators of the quality of inter-partner relationships but are probably not reliable when assessing the objective quality and success of products they have contributed to develop, produce and market." To overcome this problem, they assessed the success of the production projects by relying on the judgement of industry analysts and aerospace and defence company executives from different countries. Company executives were asked to evaluate all the projects and not only the alliances in which their company had been involved.

Perceptual measures, although subjective, are widely used and accepted as a relatively efficient means to assess alliance success because they are based on the partners' own assessment, who are regarded as better positioned to compare the achievements against initial expectations. The empirical part of this thesis relies heavily on perceptual measures of performance. Executives were asked to assess both the degree to which the project objectives were attained and the firm's level of satisfaction with the alliance performance.

2.3.2.2 Alliance instability

The study of alliance instability has been another line of research pursued by researchers to assess the performance of alliances. Several definitions of instability have been used, in particular in the joint ventures literature, and the issue is still under discussion (Kogut, 1988b; Beamish and Inkpen, 1995; Inkpen and Beamish, 1997)[9]. Basically, instability of alliances refers to major changes occurred in its ownership (e.g., changes in partners' equity stakes) and its termination modes. Table 2.3 summarises the findings of a number of studies and illustrates different ways of examining alliance termination modes.

Some authors define alliance failure by analysing the termination modes. Killing (1983) considered as failure all the JVs that disappeared through liquidation or suffered a major reorganization (new product line, new executives) because of poor performance. According to his definition, 31% of all JVs analysed failed, and shared management JV registered the highest failure rate. Park and Russo (1996) looked at the rate of failure of JVs with no fixed duration and considered as failure only dissolutions and the venture's sale to a third party. Acquisition of the venture from one of the partners was not considered a failure. They observed a 27.5% failure rate.

Changes in ownership (in the case of JVs) and alliance termination modes alone do not provide sufficient information to allow a robust answer about alliance performance, about the partners' levels of satisfaction, and whether or not the alliance objectives have been fulfilled. However, that information in conjunction with other indicators helps to

[9] Kogut (1988b: 328-9) clarifies: "several authors have defined instability in terms of attitudinal data; others have looked at the dissolution of the venture; and still others have looked at dissolution, acquisition, or any change in ownership." See these references for further discussion on IJV instability.

understand alliance performance. In the case of JVs, the alliance structure where this kind of analysis is easier to conduct, common assets need a destiny at the end of the relationship. Bleeke and Ernst (1995: 97) affirm that 80% of joint ventures ultimately end in a sale by one of the partners. The assessment of alliance performance based on alliance instability must be done with caution in order to avoid confusing performance with a means of ending a relationship.

Table 2.3 *Alliance termination modes*

Alliances [a]			Foreign-affiliated company (FAC) [b]		
Alliance outcomes:	n	%	FAC failures (*) - termination mode:	n	%
Acquired by a partner	14	78	*Sold out to Japanese partner*	114	67
Acquired by a third party	1	5	*Acquired by FAC*	12	7
Dissolved	3	17	*Liquidated*	44	26
Sample size	18	100	Sample size	170	100
Strategic alliances [c]			International joint ventures [d]		
Alliance outcomes:	n	%	IJV termination mode:	n	%
Ongoing alliances	61	31	*Focal firm (**) acquires IJV*	93	34.2
Natural end	18	9	*Focal firm sells out to partners*	135	49.4
Extension	45	23	*Focal firm sells its equity stake to third party*	11	4.0
Premature termination	32	16	*Focal firm and partners sell IJV to third party*	8	2.9
Continuation by one partner	27	14	*Focal firm and partners liquidates IJV's assets*	25	9.2
Takeover	14	7	Sample size	272	100
Sample size	197	100			

Notes: (*) No definition provided for alliance failure; presumably it includes the three termination modes. (**) Focal firm refers to a US-based firm.
Sources: (a) Bleeke and Ernst (1993b); (b) Jones and Still (1993); (c) Dussauge and Garrette (1997, 1999); (d) Reuer (1997).

In the context of EU-sponsored collaborative programmes like those discussed in this thesis, changes in ownership and most of the termination modes are not appropriate to assessing alliance performance. Only three modes appear to be of relevance: alliance cancellation by the EU, premature termination (partners' decision), and natural end. The fact that the CRAFT R&D projects have pre-defined goals and can last no longer than two years, natural end is a fact that does not say much about their success or failure. However, in cases where the projects cannot be fully accomplished within the time available (see the section below), the "natural end" of alliances becomes important and allows one to question the project structure and its goals, the set limit of time imposed on the projects by the sponsor, or both.

2.3.2.3 Duration, termination and mortality rates of alliances

How long should an alliance last to be successful? The study of alliance duration, chiefly JV duration, has been another way of assessing alliance performance, with Harrigan's (1988) study being probably the most exhaustive ever done (see Table 2.4 for some figures). This question is still under discussion given the lack of consensus about the minimum duration that an alliance should last for. Some authors think of alliances only as long-term relationships, while others deem it inadequate to restrict the definition according to its duration.[10]

Table 2.4 *Alliance duration and termination rates*

Venture duration (a)	Number of years				
Strategic alliances (n = 895)	3.5	< = 1	> 4	< = 10	> = 20
Percentage of ventures	Average	6.6	42	36.1	1.1

Exit rate; Longevity (b)	Entry periods								
International joint ventures	1951-1960	1956-1965	1961-1970	1966-1975	1961-1975	1956-1975	1951-1975	1971-1975	Exit cases
Exit Rate (*) by entry periods (%)	24.15	27.05	20.18	23.52	25.28	24.44	26.73	14.66	
Longevity by entry periods (in years)	10.56	7.61	5.51	3.82	5.22	6.24	6.68		9.33

Mortality rates (c)	Years						
Joint ventures (n = 148)	1	2	3	4	5	6	> 6
All JVs terminated (%) (**)	4.7	9.3	8.1	8.7	14.7	14.8	20.9
Dissolved (%)	3.4	5.0	2.4	2.9	12.0	8.2	11.6
Acquired (%)	1.3	4.3	5.7	5.8	2.4	6.6	9.3

Note: (*) Include sale, liquidation, confiscation/expropriation and legal reorganisation. (**) As percentage of those at risk.
Sources: (a) Harrigan (1988); (b) Chowdhury (1992); (c) Kogut (1988a).

Some studies have understood alliance success as a long-lasting partnership and thought of failure as an untimely end (e.g., Dymsza, 1988). In other studies, alliance duration[11] and survival have been treated as objective performance measures. For instance, Geringer and Hebert (1991) found that "IJVs perceived by their parents as performing more successfully were more likely to remain in operation than those IJVs that were evaluated as being less successful. Successful IJVs also tended to remain in operation for a longer period of time, a correlation which received support from data on the IJV duration measure."

[10] See Table 2.1 and the discussion on this point above.
[11] Duration is normally measured based on the number of years between the alliance formation and either its termination or the time of data collection. This method may generate a bias in the results since different alliance statuses are analysed simultaneously.

Assessing the success or failure of a partnership according to its longevity is a common mistake when evaluating strategic alliances (Hamel et al., 1989), because alliance termination gives us very limited information about the performance per se (Gulati, 1998). Gulati provides two reasons: first, studying failure by looking at termination fails to distinguish between natural and untimely deaths; second, studies of alliance termination and alliance failure implicitly consider performance as an either/or condition. Harrigan (1988: 207) emphasises that "if exit barriers are high, successful strategic alliances are not necessarily indicated by long-lived ventures, and short-lived ventures can be judged as success from both sponsors' perspectives if they have achieved their strategic purpose." Furthermore, if alliances are designed with a finite goal or set of tasks in mind, for example to develop a specific product, success might imply termination (Lorange and Roos, 1992; Park and Russo, 1996). That is the case of the alliances under CRAFT, as mentioned above.

2.3.2.4 Financial performance of alliances

Another approach to study alliance performance has been the analysis of its profitability. Tomlinson (1970) examined the return on investment of 39 joint ventures (U.K. partners) according to the reasons for selecting a specific partner and the size of the parent companies (see Table 2.5). He concluded that higher profitability was associated with the advantages that had made a past association favourable and with positive contributions of the partners to the alliance. His findings also indicate that the profitability figures were inversely related to the size of the parent company.

Table 2.5 *Profitability of joint ventures*

Size of parent company (Value of parent assets or sales - $ millions)			Reasons for selecting a specific associate		
	n	% ROI *		n	% ROI *
Small (<51)	8	21.25	*Favourable past association*	13	18.5
Medium (51-100)	8	19.75	*Convenience of facilities or resources*	15	15.7
Large (101-500)	15	11.1	*Status / identity*	9	11.8
Very large (>500)	8	12.5	*Forced choices*	2	6.6
Sample size / Average ROI	39	15.3	Sample size / Average ROI	39	15.3

Note: (*) Return on investment (weighted average) before U.K. taxes.
Source: Tomlinson (1970).

Bleeke and Ernst (1993b) considered an alliance successful if both partners achieved their

in-going strategic objectives and both recovered their financial costs of capital. The assessment of the success, summarised in Table 2.6, was based on market share, sales volume, new product development, and other criteria specific to the alliance.

Table 2.6 *Alliance success rates*

Type of alliance	Sample		Successful		Unsuccessful		Mixed results	
	n	%	n	%	n	%	n	%
Cross-border alliances	49	100	25	51	16	33	8	16

Source: Bleeke & Ernst (1993b).

Is financial performance a good measure of alliance performance? The sole use of financial indicators to assess alliance performance seems not to be enough to support a complete answer. It appears that the relevance of achieving poor or good financial results is chiefly connected with the objectives of the alliance and does not have any particular importance when analysed out of that context. Financial performance may fail to adequately reflect the extent that an alliance achieved its objectives, especially those that are not financial in nature (Anderson, 1990). Geringer (1989: 246) affirm that "Despite poor financial results, liquidation, or instability, an IJV may nevertheless have attained the objectives of its parents - for example, of transferring a technology - and thus be considered 'successful' by one or all of the parents. Likewise, IJVs may be viewed as 'unsuccessful', despite achieving good financial results or continued stability in ownership or governance structures."

When risk and uncertainty are high, profitability by itself is a poor measure of the joint venture's value (or, for that matter, any business's value) (Anderson, 1990). And considering that many alliances are really options (they allow a parent to maintain a doorway into a market or a technology), financial measures are not adequate to measure alliance performance. As Doz and Hamel (1998) emphasise, financial indicators are able to capture neither the strategic benefits achieved nor the opportunities foreclosed due to the alliance, therefore reducing substantially their explanatory power. Costs and profitability can rarely be used as performance indicators for reasons of data availability (Dussauge and Garrette 1995: 521).

The use of financial measures to assess the alliance performance falls, with perhaps some

exceptions, in the sphere of firm/business performance. The case of R&D alliances is illustrative. Their financial returns occur when the new knowledge acquired is used in the production of goods and services (or sold to others, e.g. licensing). Assessing the financial performance of alliances requires generally the assessment of their impact on firm performance, the object of analysis below.

2.3.2.5 Factors affecting alliance performance

There is a strong theoretical body of knowledge on both the partner and relationship characteristics that identifies the relevant factors that affect the alliance behaviour and outcomes. There has been, however, a lack of empirical attention regarding the impact of those factors on alliance performance (Dussauge and Garrette, 1995; Saxton, 1997). Only a few studies have attempted to assess how the partner and alliance characteristics may affect alliance performance.

Saxton (1997) examined factors that may affect alliance performance by interacting simultaneously with both the partner and relationship characteristics, analysing them in a separate and combined manner. Reputation[12] was the partner characteristic examined, using a multidimensional construct (product quality, management and financial performance). The relationship characteristics included prior affiliation, i.e., prior market contact (e.g., customer, alliance partner), shared decision-making and similarities between partners (e.g., marketing, culture, technology). The alliance outcomes, i.e., the partner subjective performance assessment, were a function of reputation, similarity scale and prior relationship. "Findings support a positive relationship between partner firms' benefits from alliance participation and partner reputation, shared decision making, and strategic similarities between partners" (Saxton, 1997: 443). His findings also demonstrate that a model including both partner and relationship characteristics can better explain the benefits from an alliance than can one incorporating either set of variables alone. Also interesting is the finding that some similarities between partners, such as culture and human resources, were negatively related to alliance outcomes. This is surprising since it contradicts the accepted idea that different cultures have a potentially negative effect on alliance

[12] Reputation was operationally defined as the perceptions of the representative of a respondent firm of its partner's characteristics.

performance.

Dussauge and Garrette (1995) developed a taxonomy of collaboration - semistructured and unstructured co-production projects[13] - to overcome the difficulty of comparing the performance of projects with different structure types. They note, "as both semistructured and unstructured projects lead to the production of a particular product, their performance can be measured on the basis of the product's success, and thus compared" (p. 519). Respondents were asked to evaluate each project according to three different criteria, which in turn have been used as the success measure: technical quality and economic success (commercial success + financial results). They found that semistructured projects achieved better economic performance than unstructured ones and that the technical quality variable appears not to have a significant influence on performance, which they believe is due to the fact that alliance type and technical quality are not independent variables.

The study attempts to understand how the partners and alliance characteristics affected the performance of alliances by analysing the initial conditions leading to their formation and assessing the extent to which a set of factors had negatively influenced the achievement of better results.

As we have seen, there are several ways of analysing alliance performance and past empirical studies have produced much valuable information. The construction of a general framework for the assessment of alliances, however, has proven to be very complex, given the number of alliance structures, their multiplicity of objectives, and the relative usefulness of each assessment indicator, making virtually each alliance different from all the others. Lorange and Roos (1992: 42) argue that it is practically impossible to give a prescription for performance assessment that is valid for all cases. Prior research has demonstrated that the use of single assessment measures cannot capture the whole phenomenon. Optimally, the alliance assessment should be based on a multiplicity of subjective and objective indicators for better capturing the multidimensional nature of alliances.

[13] Semistructured projects are cooperative programmes in which development and manufacturing tasks are distributed among the allied firms, but marketing, sales and after-sales are carried out by a separate joint venture. Unstructured projects are characterised by the fact that all tasks (R&D, manufacturing and marketing) are distributed to the various partner firms and carried out separately by them.

Several studies reported relatively high alliance failure rates and in many alliances the results were mixed, with some partners satisfied and others not so satisfied.[14] Although these results are very important as an indication of the alliance success rate, previous research does not cover the whole spectrum of alliance structures, thus considering such results a basis for generalisation might be misleading. Besides that, any comparability of the results has to be carefully made since the period of time of each study is different. Furthermore, and perhaps more important, a great deal of alliances set up in the 1990s are not covered by those studies, consequently they cannot assess how much firms have learned from past experience and the knowledge about alliances produced so far.

2.4 PERFORMANCE OF FIRMS THROUGH ALLIANCES

2.4.1 On the notion of organisational performance

Defining "organisational performance" can be very difficult indeed and its measurement a rather complex task. The type and number of performance indicators varies from study to study according to authors' preferences, their backgrounds and availability of information, thus influencing the underlying definitions. As Cameron (1986: 541) says, there is a generally accepted point that "consensus regarding the best, or sufficient, set of indicators of effectiveness is impossible to obtain. Criteria are based on the values and preference of individuals, and no specifiable construct boundaries exist." To Cameron, the basic problems surrounding organisational effectiveness are not theoretical problems but criteria problems. However, in choosing an arbitrary set of indicators, researchers may only describe partially the many aspects that are likely to influence organisational performance. Not every indicator is appropriate to assess organisational performance of every firm. For instance, Woiceshyn and Hartel (1996) examined the performance of Canadian biotechnology firms and stressed that "traditional performance measures such as profits could not have been used to capture value-added progress as only a few of these firms were profitable yet" (p. 234). They argue the same way to reject the use of sales as the comparison indicator.

[14] Based on an extensive literature review, Duysters et al. (1999: 345) conclude that the percentage of strategic alliances that fail should be about 50-60%, which is a rate between the "optimistic and pessimistic conclusions of different authors."

Gathering the relevant data to assess firm performance represents a serious research obstacle even in the case of using traditional quantitative financial indicators, because some refinement is needed to overcome possible interpretation bias given the indicators' insufficiencies. The use of qualitative indicators adds subjectivity and complexity to the analysis and reduces the possibility of performance comparisons of firms belonging to different sectors. Besides the problems in accessing the information, two methodological aspects are of relevance. The first involves the distinction between determinants and indicators of performance and the second has to do with the selection of the performance indicators.

2.4.1.1 Determinants and indicators of performance

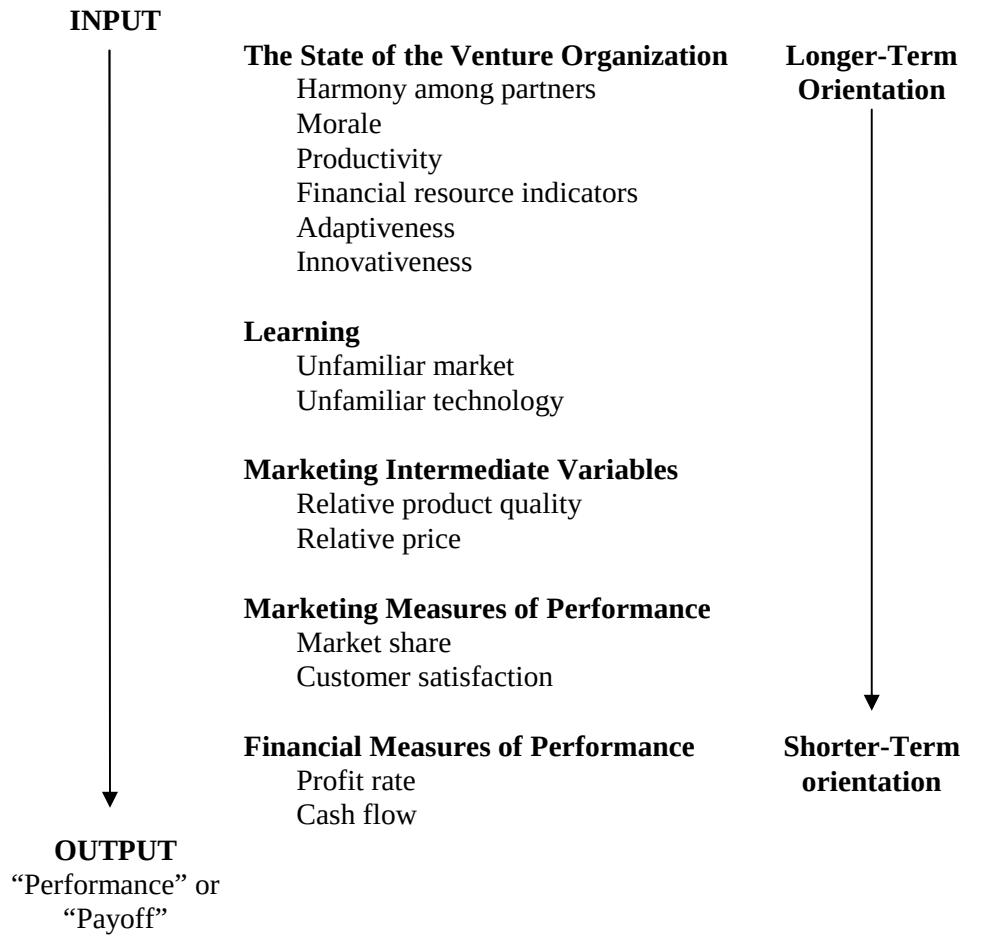
One problem associated with performance measurement relates to the lack of clarity about the difference between an "indicator" of performance and a "determinant" of performance. It is not possible to make general statements about whether a variable is of one type or the other because what is a determinant variable in one context may be an indicator variable in another context (Lewin and Minton, 1986). Two examples reflect this: "One study [...] may use group cohesion as an indicator of effectiveness while another may treat it as a predictor" (Cameron, 1986: 543); "Employee satisfaction is often used as an indicator of high performance organization (an output), but others classify satisfaction as a cause of performance (an input), and still others ignore satisfaction altogether on the grounds that it is neither indicator nor determinant" (Anderson, 1990: 21).

Anderson (1990: 22) believes that theory and practice seem to converge on a 'package' approach, in which inputs [determinants of performance] and outputs [indicators of performance] are weighed to arrive at a composite index of effectiveness, which is then used to allocate resources. Anderson suggests a method to assess the performance of a joint venture[15] called "The Input-Output Continuum" (see Figure 2.1). "At the output extreme are the 'results' measures that most people use to assess current performance: these are financial measures, of which profitability is the most commonly used. At the input extreme are indicators of states (e.g., high morale, coordinated action). The input extreme represents

[15] Anderson argues that joint ventures should be evaluated primarily as stand-alone entities seeking to maximise their own performance, not the parents'.

variables that should determine (create) measurable results. Inputs represent what the organisation is doing (e.g., using resources) and how it is struggling to achieve eventual results (outputs) (pp. 22-3)." Inputs are not themselves measures of firm's goals, however they are indicators of the firm's health and viability and they are likely to influence the output measures. Therefore, input measures should be considered as assessing longer-term effectiveness.

Figure 2.1 *The Input-Output Continuum for a Joint Venture*



Source: Anderson (1990: 22, Figure 1)

The present thesis borrows some ideas from Anderson (1990). The direct and indirect benefits firms achieve with the alliance are here interpreted as determinants of performance; that is, inputs such as new technology, a prototype, new knowledge about competitors or experience in cooperation which are expected to affect the firm's outputs (assessed in terms of performance indicators). Linking inputs to outputs may prove to be a

rather difficult exercise in many situations. The inputs enhance the knowledge base of firms and are likely to have a lasting effect on performance.

2.4.1.2 Performance indicators

Financial measures[16] are the performance indicators widely used to assess firm performance, typically including indicators such as Profit, Cash Flow and their derivatives. These are the traditional indicators utilised in evaluating and comparing firm's performance, and the support for many strategic decisions. This is not surprising since the accounting systems have been evolving for a long period of time and are the most sophisticated measurement systems in providing information to firm managers. However, it is becoming apparent that financial measures of performance alone are being increasingly recognised by businesses as inadequate for the control of organisations (Stainer, 1999). Such measurements can provide useful information to managers in identifying the sources of their problems or the reasons for their success, but they do not provide the kind of information needed by companies that seek to create a competitive advantage (Hayes et al., 1995). Eccles (1991) argues convincingly about the insufficiencies of these performance indicators, stressing that there must be a shift from treating them as the foundation for performance management to treating them as one among a broader set of measures.[17]

Such limitations suggest that other performance indicators should be considered in assessing organisational performance. However, the reality takes time to change. Anderson (1990: 22) points out that "corporate managers, while they profess to weigh many factors in assessing performance, often simplify the job by giving a very high weight to one factor; from habit, sheer profitability is likely to be that factor." Even when managers include other non-financial measures (e.g. quality, market share) in their set of performance indicators, they hardly give them an equal status in determining firm's strategy and in case of conflict, financial considerations prevail over any others (Eccles, 1991).

[16] See also the section above concerning the use of financial measures to assess the alliance performance.

[17] The limitations of the financial measures found in the literature include: failure to provide information to support essential investments in new technologies and markets for future successful performance; scope for accounting manipulations; differences in methods of consolidating accounts and lack of international standardisation of accounting conventions; they are better at measuring the consequences of yesterday's decisions than they are at indicating tomorrow's performance; they do not explain by themselves the underlying causes of their variability; they are not enough to distinguish excellent from ordinary firms.

The new competitive reality demands a different measurement system that should take into account firm's objectives and characteristics and be able to provide accurate information about the capabilities that are key to a company's future success. Eccles (1991) identifies a number of non-financial performance indicators firms may use along with the financial ones, including product and service quality, customer satisfaction, innovation, market share and human resources, complemented with a competitive benchmarking strategy. This new approach to measure firm performance requires the development of new information systems within organisations and a new attitude of managers (and investors) to be effective.

The thesis aims to establish a link between a specific investment decision – the R&D alliance – and firm performance; it aims to assess the variation on a range of performance indicators, including both financial and non-financial indicators, as the result of alliance participation. Most of the insufficiencies of financial measures do not apply in this context because there are no intentions of assessing the whole performance of firms or making sectoral or intersectoral performance comparisons. The fact that the assessment is based on the interviewees' perceptions avoids the difficulties of collecting the information, but adds subjectivity to the analysis.

2.4.2 Previous empirical research on firm performance through alliances

Research on the impact of alliance outcomes on firm performance is a rather recent issue despite its unquestionable importance for firms, policy-makers, academics and theorising about alliances. Earlier empirical studies can be divided into four different categories (see Table 2.7): event studies of stock-market reaction to the alliance formation announcements; longitudinal studies that examine the importance of alliances for firm survival; statistical studies that explore the relationship between alliance intensity and firm performance; and studies that focus on the alliance outcomes. Overall, previous works appear to privilege the analysis of positive consequences for firms from alliance participation. The analysis of the costs of participating in alliances (i.e., transaction costs and foreclosed opportunities) or the negative impacts on firm performance have not been paid much attention so far.

Table 2.7 *Previous empirical studies of firm performance through alliances*

Category of studies	Examples of studies
Stock-market reaction to alliance formation announcements	McConnell and Nantell (1985); Woolridge and Snow (1990); Koh and Venkatraman (1991)
Likelihood of firm (business) survival	Singh and Mitchell (1996); Singh (1997); Tripsas (1997); De Meyer (1999)
Alliance intensity and firm performance	Berg, Duncan and Friedman (1982); Hagedoorn and Schakenraad (1994); Mowery, Oxley and Silverman (1996); Schmitz (1998); Benfratello and Sembenelli (2000); Stuart (2000)
Alliance outcome analysis	Beta (1993); BIE (1995); Rosenfeld (1996); Human and Provan (1997)

Source: Author's elaboration.

Box 2.5 below contains the general findings of previous empirical studies on firm performance through alliances. Table A2.2 in Appendix 2 contains technical information on these studies. Each study has unique characteristics in terms of type of alliances analysed, sectors, size of firms, country of origin and the research methods employed. Perhaps more important, the type and number of performance indicators vary considerably across studies, illustrating the complexity of studying the impact of alliances on firm performance and denoting a non-existent effective means to assess it. This complicates any comparison of results, especially when they are contradictory as sometimes happens.

Box 2.5 *Previous studies of firm performance through alliances - findings*

"The results indicate that the stockholders of companies involved in joint ventures earn statistically significant excess returns around the time at which intercorporate joint ventures are announced." (McConnell and Nantell, 1985: 527)

[...] "the stock market responded positively to the announcement of joint venture formation." (Woolridge and Snow, 1990: 358)

"Does the stock market react positively to joint venture formations? [...] such formations have a positive and significant impact on the market value of the participating firms, [...] smaller partners benefited more from joint venture formation than larger partners." (Koh and Venkatraman, 1991: 887-8)

"The 176 contractants of the sample received 39.4 MECU (1991). 611 economic effects have been measured while in addition about 300 have been identified without being quantified (mainly due to lack of information). 413.3 MECU will have been directly generated in the firms at the end of 1993 and 522.5 MECU at the end of 1995. The corresponding ratios direct effects/EEC funding amount to 10.5 and 13.3 respectively." (Beta, 1993: 20)

[...] "generally speaking, the key cooperative arrangement provides improvements to the bulk of firms, regardless of industry, size, age, product type and so on." (BIE, 1995: 169)

"Our research generates no straightforward relations between strategic technology partnering and

company performance" [...] "The results indicate that companies attracting technology through their alliances and companies concentrating on R&D cooperation have significantly higher rates of profit." (Hagedoorn and Schakenraad, 1994: 300-1)

[...] "international alliances produce less interfirm exchange of technological capabilities" [...] "We find that equity joint ventures appear to be more effective conduits for the transfer of complex capabilities than are contract-based alliances such as licensing agreements" (Mowery, Oxley and Silverman, 1996: 87-9)

[...] "our findings on outcomes indicate that member firms appear to achieve substantial benefits from network involvement." "Our comparison of network and market firms in the same industry demonstrates that interorganizational relationships within purposefully constructed SME networks are unique and that network involvement can yield positive results that are not likely for non-network firms." (Human and Provan, 1997: 386, 398)

"As a general empirical outcome, businesses with collaborative agreements will tend to outperform businesses that take independent approaches in complex business situations, if managers are at least intendedly rational in their approach to interfirm relationships." (Singh and Mitchell, 1996: 101)

"Without controlling for other factors, the simple cross-tabulation suggests that businesses with alliances had higher survival likelihoods than businesses without alliances at each level of technological complexity." "These results provide only partial support for the widely accepted proposition that collaboration improves the performance of the allied firms. [...] Alliances are not necessarily valuable for all firms or in all circumstances. On the contrary, they may only be beneficial under relatively narrow circumstances." (Singh, 1997: 353, 360)

"One of the main results of the survey is the positive and significant relationship between co-operation and performance. Enterprises which increased co-operation improved their performance more than those which did not." (Schmitz, 1998: 47)

"There was evidence of improved construction performance - in some cases greatly improved performance - in all the case studies. However, it appears that the benefits of partnering were not uniformly spread among all the parties. An improvement in one are sometimes had detrimental spin-off effects." (Barlow et al., 1997: 44)

2.4.2.1 Stock-market reaction to alliance formation announcements

Several researchers have studied the stock-market reaction to the alliance formation announcements, namely joint ventures, aiming at estimating its influence on market value of the parent firms. McConnell and Nantell (1985) analysed stock returns of US companies that entered into 136 joint ventures between 1972 and 1979, and found a significant and positive impact on the stock market values of the parent firms around the time of the JV announcement. Considering that JV formations were motivated by synergies,[18] and noting the similarity in their findings with those of merger activities, they suggest that both joint ventures and mergers are carried out mainly for efficiency reasons. However, their findings

[18] Synergies may take the form of economies of scale, the combining of complementary resources, increased market power, improved production techniques, improved marketing and product distribution opportunities, and so on.

did not provide sufficient information to determine which economic factors explain the substantial wealth increases associated with mergers and joint ventures.

Woolridge and Snow (1990) examined the stock-market reaction to announcements of corporate strategic investment decisions. They found that the stock-market reacted positively to the announcement of JV formations, one of the strategic investments analysed. Furthermore, their findings suggest that the stock-market appears to favour investments in R&D and joint ventures over those in product/market diversification and capital expenditures. Koh and Venkatraman (1991) did a similar analysis for the information technology sector, obtaining a positive relationship between the two as well. They also noted better results when partners' activities were in similar sectors.

Despite the likely interest of such an association, one can hardly draw any strong conclusion about the relationship between alliances and firm performance, because all the studies examined the stock-market reaction to JV formation announcements instead of the outcomes of those corporate strategies, which would be more appropriate for that purpose. That these intended strategies may never become true or they may be modified during implementation (Woolridge and Snow, 1990) weakens any possible inference.

2.4.2.2 Alliances and firm (business) survival

The studies included in this category took firm (business) survival as a proxy for firm performance and looked at the importance of firms' participation in alliances for the likelihood of their survival.

Based on data for the U.S. hospital software systems industry, Singh (1997) investigated the impact of technological complexity on business survival[19] and how alliances mediate this relationship. He has demonstrated that technological complexity is a significant influence on the likelihood of business survival and the risk of failure correlates positively with the complexity of the technology that a business develops. The simple cross-

[19] "A complex technology is defined [...] as an applied system whose components have multiple interactions and constitute a nondecomposable whole" (Singh, 1997: 340). Survival was measured as a firm's participation in the industry. Failure was recorded when a business discontinued operations and ceased to operate as an entity.

tabulation between these two dimensions suggests that businesses with alliances had higher survival probabilities than businesses without alliances at each level of technological complexity (see Table 2.8), but medium-complexity-technology firms with technology alliances had lower risks of failure than other businesses. Non-technology-related alliances have no survival benefits for complex-technology-related challenges.

Table 2.8 *Cross-tabulation of technological complexity and business failure*

Technological Complexity	Businesses									
	All		With alliances				Without alliances			
			Survived		Failed		Survived		Failed	
	n	%	n	%	n	%	n	%	n	%
High	290	29.8	106	89.8	12	10.2	111	64.5	61	35.5
Medium	427	43.9	67	83.8	13	16.2	201	57.9	146	42.1
Low	256	26.3	40	80.0	10	20.0	132	64.1	74	35.9
Total			213	85.9	35	14.1	444	67.1	281	32.9
All businesses	973 (100 %)		248 (25.5 %)				725 (74.5 %)			

Note: All percentages sum horizontally, except in the first column, which sum vertically.
Source: Singh (1997: 356).

Singh's (1997: 360) findings "provide only partial support for the widely accepted proposition that collaboration improves the performance of allied firms." Singh says emphatically that alliances may only be beneficial under relatively narrow circumstances. His findings, however, are insufficient for such a wide generalisation. On the other hand, they seem to be inconsistent with Singh and Mitchell's (1996: 112) findings when they note "The positive main effects of collaboration are consistent with the argument that collaboration provides substantial advantages."

Singh and Mitchell (1996) have used the same data on U.S. hospital software systems industry to investigate the risk of a firm becoming dependent when their partners shut down or form new partnerships. They found out that businesses become more likely to shut down following the dissolution of a partner if they do not add a new partner themselves or when their partners form collaborative relationships with new partners. But, businesses with development or marketing relationships were less likely to shut down than other businesses (development or marketing collaboration). They did not detect any impact of the size of the largest partner on business dissolution. "Simply allying with a large business does not help a business avoid dissolution and, conversely, allying with a small business does not increase the chance of failure" (Singh and Mitchell, 1996: 111).

Tripsas (1997) examined the technological trajectories of three firms of the typesetter industry from 1886 to 1990, aiming at understanding what factors make certain incumbents systematically better than others at adapting to radical technological change, i.e., what differentiates those firms with dynamic capability[20]. The development of "external integrative capability", i.e., the ability to identify and integrate knowledge from outside the boundaries of the firm, was regarded as crucial for attaining dynamic capability. This comprises two elements: (i) internal R&D investment that develops absorptive capacity (Cohen and Levinthal, 1990); (ii) an external communication infrastructure to facilitate the transmission of external knowledge, including both informal mechanisms such as know-how trading and more formal mechanisms such as strategic alliances or long-term supplier relationships. According to Tripsas, this external communication infrastructure must be developed over time during periods of incremental technological change in order to be effective during radical periods of transition. In the typesetter industry, alliances were a means to extend firms' survival.

De Meyer (1999) analysed five case studies of small hi-tech companies and observed that "in most cases these companies chose or were forced to engage in a technology partnership in order to develop or survive." Having the technology, these companies needed capacity and entered alliances to get access to complementary assets (Teece, 1986) and to develop dominant designs. Many of the alliances in which these five companies were engaged with included large organisations, whose main contribution was managerial resources, distribution systems, or capital.

2.4.2.3 Alliance intensity and firm performance

This group of studies looked at the relationship between the alliance activity of firms and their economic performance (one or several performance indicators) often using statistical methods, but without establishing a clear cause-effect link between the two. Berg, Duncan and Friedman (1982)[21] found a negative relationship between joint venture incidence and firms' profitability in the chemical and mechanical engineering industries. They could not,

[20] "Dynamic capability [is] the capacity of a firm to renew, augment and adapt its core competencies over time" (Tripsas, 1997: 342).
[21] Quoted in Hagedoorn and Schakenraad (1994) and Gulati (1998).

however, establish the causal relationship between the two (Gulati, 1998: 309).

Based on the CATI[22] database data, Hagedoorn and Schakenraad (1994) investigated to what extent the intensity of firms' strategic technology partnering[23] affected the economic performance of the companies engaged in such joint efforts. The economic performance was measured by the net income to sales ratio or profit rate. They found no straightforward relationship between strategic technology partnering and company performance, and no generally significant effects of firms' size on profitability. They say, however, that "for European and American process industries there is a positive association between R&D-driven cooperation and profitability. [...] companies attracting technology through their alliances and companies concentrating on R&D cooperation have significant[ly] higher rates of profit" (pp. 300-1). It appears that the content and direction of strategic alliances, namely R&D alliances, have a greater impact on profitability than the extent and intensity of cooperation. Hagedoorn and Schakenraad (1994: 303) conclude by stating, "Apparently the crucial relation between strategic technology partnering and profitability of firms is of indirect character which can to a large extent be explained by the differentiation of firms and sectors with regard to these technological opportunities." These results leave the question of causality unanswered and are not very convincing, in the view of Brockhoff and Teichert (1995).

Schmitz (1998) looked at the relationship between firm performance and the intensity of cooperation in a footwear cluster industry. Using cooperation and performance indexes, Schmitz found a positive relation between the two and concluded that those firms that had improved cooperation had improved their performance more than those firms that did not. He stresses, however, that this is not evidence of a cause-effect relationship. Benfratello and Sembenelli (2000) tested whether participation in EU-sponsored research joint ventures (RJVs) had a positive impact on participating firms' performance. They found that firms participating in EUREKA had a significant improvement in productivity and price-

[22] The CATI (Cooperative Agreements and Technology Indicators) database is one of the most comprehensive existing databases on alliances, which is located at MERIT, University of Limburg. See, for instance, Hagedoorn (1990, 1993) for further details.

[23] The study did not considered the number of firm's alliances but the number of strategic linkages (dyads). For example, a project with three partners, called A, B and C, results in three different dyads - A-B, A-C and B-C.

cost margin, while firms participating in RJVs under the Framework Programmes did not show any significant change in performance. Given the different nature and co-ordination structure of EUREKA (near-to-market research projects, proposed and defined by the participants) and the Framework Programmes (pre-competitive research projects, co-ordinated by the European Commission), they suggest that bottom-up, market-oriented cooperative research programmes have a more direct impact on firms' performance than the centralised R&D programmes.

Mowery, Oxley and Silverman's (1996) study focused on the transfer of technological capabilities among alliance partners. They examined how collaboration changed the relationship between a firm's technological portfolio and those of its alliance partner(s). Their approach to measuring the changes in alliance partners' technological capabilities is based on citation patterns of their patent portfolios. A number of conclusions are drawn from their work. First, "there is no consistently positive pattern of interfirm learning in our overall alliance sample" (p. 87), the explanation being the presence of both "convergent" and "divergent"[24] alliances. Second, international alliances (i.e., US firm / non-US firm(s) alliances) result in less interfirm knowledge exchange, reflecting their greater logistical and cultural complexities. Third, the alliance structure is important. Equity joint ventures appear to be more effective for the transfer of technological capabilities than contract-based alliances. Unilateral alliances (e.g., licensing) appear to support lower levels of interfirm knowledge transfer. Fourth, larger firms absorb fewer capabilities from their alliance partners, while relatively R&D intensive firms do not exhibit superior capability absorption in alliances.

Stuart's (2000) study, which examined 1600 dyadic alliances in the semiconductor industry, offers evidence to confirm the assumption that strategic alliances can improve firm performance. Based on either the firm's rate of innovation[25] or the rates of sales growth, Stuart concluded that more important than the number of alliances a firm is involved in for the alliance-performance link are the partners' attributes. "Technology alliances with large and innovative partners improved baseline innovators and growth rates,

[24] Divergent alliances - if they enable their members to specialise in different but complementary areas of technology. Convergent alliances - partners get increasingly similar capabilities.
[25] The study used patent citation data to construct innovativeness scores for the sampled firms.

but collaborations with small and technologically unsophisticated partners had an immaterial effect on performance" (Stuart, 2000: 808). The findings also suggest that alliances can be highly advantageous even when they fail to achieve the strategic objectives that led to their formation.

2.4.2.4 Alliance outcome analysis

This group of studies takes a totally different approach in analysing the alliance-performance link. They differ from the preceding because they attempt to identify and assess the benefits of alliances for the participating firms, normally based on opinions rendered by participants (by means of questionnaire or direct interview), rather than making associations between the two using statistical methods.

Beta (1993) is the only study, as far as we know, that attempted to quantify all the benefits achieved by firms in currency units. The study, based on a sample of 50 consortia and 176 firms, who participated in the EURAM, BRITE and BRITE-EURAM I R&D EC-sponsored programmes, aimed to measure the quantitative economic effects generated by the participating firms for their own benefit. The data were gathered through direct interviews with all but three of the 176 firms. Two major groups of economic effects were evaluated. One group, called direct effects, relates to the attainment of the research project objectives. For instance, if the objective was to develop a new product, the sales of this product were considered direct effects. The rule was maintained even in the case of more fundamental research-oriented projects. Here the direct effects were related to the application of new scientific knowledge or the new technologies in the field foreseen at the beginning of the project. The other group, called indirect effects, concerns the achievement of economic benefits that were not part of the alliance objectives. The indirect effects have been broken down into technological, commercial, organisational and method, and work factor effects (see Table 2.9). Direct effects and most of the indirect effects have been expressed in terms of added value[26] generated by sales and cost reductions.

[26] "The added value can be defined as the difference between total sales and the sum of the costs of goods and services. Added value is made up the sum of labour costs, operating results, and amortization and depreciation." (Beta, 1993: 7)

Table 2.9 *Assessment of the economic effects - variables and their quantification method*

Type of effects	Quantification methods
Direct effects (The effects which are directly related to the objectives of the research projects, as they were defined at the beginning of each of the projects)	Sales/Cost reduction
Indirect effects (Those which go beyond the scope of the objectives of the projects):	
• **Technological effects** (Concern the transfer of technology from the project to other activities of the participant):	
- *Transfer of product*	Sales/New research contracts
- *Transfer of process*	Cost reduction/New research contracts
- *Transfer of service*	Sales/New research contracts
- *Patents*	Cost of establishing and holding the patent (proxy value)
• **Commercial effects** (Increased economic activities - sales of products and services or new research projects - that do not incorporate significant technological innovation coming from the project itself):	
- *Network effect*	Sales/Cost reduction/New research contracts
- *Reputation effect*	Sales/Cost reduction/New research contracts
• **Organization and Method effects** (Occur when experience gained through the project allows the participant to modify its internal organization and/or apply new methods):	
- *Project management*	Cost reduction
- *Organisation effects*	Sales/Cost reduction/New research contracts budget (proxy value)
- *Methods effects*	Cost reduction
• **Work factor effects** (Describe the impact of the project on the "human capital" of the participant):	
- *Competence*	Monetary equivalent of man-hours (proxy value)
- *Training*	Monetary equivalent of man-hours (proxy value)

Source: Beta (1993: 4-9).

The Beta study expressed all the effects identified by firms, many of them of a qualitative nature, in monetary terms (ECUs). Although this procedure may have advantages in terms of interpretation and comparison[27] of results, it has important drawbacks as well, since some of the measurement techniques used and assumptions made are highly questionable. Furthermore, because the purpose of the Beta (1993: 12) study was "to assess only the economic effects for the participant", everything has been quantified in currency units and, as a result, other important information has been lost or hidden in the course of the quantification process. Even so, about one-third of all identified economic effects could not be measured, mainly due to lack of information.

Considering all the direct and indirect benefits (i.e., "realised", "anticipated" and "future"

[27] Especially the comparison between the amount of money given by the EC to the projects and the economic benefits they generated for the participating firms.

effects), the study concludes, “The 176 contractants of the sample received 39.4 MECU (1991). 611 economic effects have been measured while in addition about 300 have been identified without being quantified (mainly due to lack of information). 413.3 MECU will have been directly generated in the firms at the end of 1993 and 522.5 MECU at the end of 1995. The corresponding ratios direct effects/EEC funding amount to 10.5 and 13.3 respectively” (Beta, 1993: 20). Firms which were most efficient at generating direct effects were those which were able to attract the best research laboratories, and the long projects generated more direct and indirect benefits economic effects than the short projects.

The BIE’s (1995) study assessed the impact on performance (employment levels, turnover, profits, productivity, exports) and on competitiveness (technology, quality, price, customer service) of respondent firms to a mail questionnaire. Firms were invited to indicate how the “key” arrangement (i.e. “the most important cooperative relationship a firm has established” (BIE, 1995: 145)) has affected (in percentage terms) those indicators over the three years prior to the study. It found that “cooperative arrangements can and do play an important role in improving the performance and competitiveness of Australian manufactures” (p. 169). In general, the key cooperative arrangement provided improvements for the bulk of firms, regardless of industry, size, age, product type and so on. Impacts on performance and competitiveness are likely to vary more frequently with the characteristics of the key arrangements than with the characteristics of cooperating firms. Interestingly, some firms reported negative impacts on the performance indicators. For instance, 5% of respondents indicated that their key arrangement has resulted in lower profits for the business over the three-year period prior to the study.

In Rosenfeld’s (1996) assessment of two network initiatives, the participant firms were asked to report changes in their business performance and the extent to which those changes could be attributed to cooperation. Most firms reported having had performance improvements, namely improvements in the domestic sales, but they did not credit all the changes to inter-firm collaboration. Barlow et al. (1997) examined the managerial processes in five client-led partnering[28] arrangements of the construction industry and

[28] “Partnering is [...] a range of practices designed to promote greater cooperation between organisations. It is best understood as an interaction between initiatives in business and procurement strategy, information systems, collaborative working and human resource practices” (Barlow et al. 1997: 58).

assessed the consequences of alliances for partner firms. They identified a number of partnering outcomes (mainly for clients), such as cost reduction, shortened delivery time and quality improvements, and a number of partnering problems (mainly for contractors), including increase in the amount of time communicating, uneven balance of power and ambiguous organisation roles. They were able to collect some quantitative data to demonstrate the benefits relating to the reduction of the construction costs and delivery time. These quantitative performance benefits were measured against the costs and delivery time of similar projects firms have been involved in before. The "share of experience" and the "contact with other ways of doing things" appear to be two general benefits (in terms of organisational learning) for all alliance partners.

Human and Provan's (1997) approach is different because their main aim was to categorise the network[29] outcomes based on what the small firms have achieved from network participation. They have identified four main categories of outcomes, namely: inter-organisational exchanges (i.e., direct transactions or exchanges among network firms, such as buying and selling, jointly producing and marketing a product, and exchanging friendship and information with each other); organisational credibility (i.e., respondents' perceptions that firm external legitimacy was enhanced through association with the network); access to resources (i.e., how network participation played an instrumental role in respondents' accessing new markets, new product ideas and other valued resources for their companies); and financial performance (i.e., economic benefits that occurred within a short time after joining the network and long-term perspectives on economic benefits). Based on the SMEs' answers to a list of potential firm outcomes, they then assessed the percentage of SMEs that achieved each type of the listed benefits, concluding that the "involvement in an SME manufacturing network can be advantageous for firms" (p. 397). Networks are worthwhile despite their costs, and both transactional and transformational outcomes of network involvement occur.

2.4.2.5 Alliance performance and firm performance

The discussion above somewhat polarised the debate between alliance performance and the

[29] They adopted Jarillo's (1988) definition of strategic networks, with some restrictions (see Table 2.1).

impact of alliances on firm performance, yet drawing a line between the two is not always easy. The two perspectives, although different in nature, are not necessarily independent of each other. Often the performance of alliances takes into consideration the achievement of technical as well as economic objectives, thus involving firm performance. As one executive put it, perhaps excessively, the success of alliances is "measured in the market" (Carvalho, 1996)[30]. R&D alliances often involve the production and transfer of knowledge to be, ultimately, used as input and transformed into results. It may happen, however, that the individual objectives of firms do not include the achievement of economic benefits, at least directly or immediately. On the other hand, when assessing the impact on firm performance, one is also addressing the alliance performance issue, even if unintentionally. Measuring the impact on firm performance does not elucidate, however, the extent to which the objectives were met or the level of satisfaction of partners.

In general, the literature overlooked the relationship between alliance performance and the impact of alliances on firm performance. The Dussauge and Garrette's (1995) study addresses both issues, although their main objective was to link the success of alliances to the way in which collaboration was organised and managed. They assessed alliances using three major indicators - technical quality of the project, commercial success and financial performance - which link firm performance with alliance performance. Previous research normally addressed just one aspect and did not attempt to establish a link between the impact on performance with the achievement of objectives, satisfaction of partners or the conditions in which the alliances were formed. As a result, the link between alliance performance and firm performance is still very much unknown.

2.5 LEARNING THROUGH ALLIANCES

The resource-based perspective of the firm[31] views the firm as "a unique bundle of assets, skills and capabilities that influences the firm's evolution, competitive strategies and growth paths" (Lei, 1997: 209). "Core competencies" (Hamel et al., 1989), "invisible assets" (Itami, 1987) and "dynamic capabilities" (Teece and Pisano, 1994; Teece et al.,

[30] When questioned on the notion of alliance success, four out of seven executives emphasised the importance of good commercial results as a measure of alliance success.
[31] For a revision of the resource-based perspective literature see, for instance, Teece et al. (1997).

1997) refer in somewhat differing ways to intangible, knowledge-based resources, a subset of the resource-based theory literature (Soo et al., 1999: 2), that constitute important sources of the firm's competitive advantage.

Self-sufficiency is becoming increasingly difficult in a rapidly changing environment and not many firms can go it alone (Hamel et al., 1989; Inkpen, 1996). To compete in a dynamic environment where time-to-market is critical and the rate of technological change is rapid, firms need a fast and effective way of acquiring knowledge and skills to renew their competencies. Even in less dynamic environments, normally firms do not possess all the information and knowledge needed to innovate. In their study on the dimensions of complexity, von Tunzelmann and Wang (1997) note that "Complexity now appears to be occurring with increasing frequency as an environmental contingency, and affecting supposedly 'low-tech' industries as much as 'high-tech'"; therefore, the technologies may have to be partly acquired elsewhere. SMEs tend to have additional difficulties to cope with technological development because they often lack suitably qualified technical specialists and are often unable to support a formal R&D effort on an appreciable scale (Rothwell, 1991: 97). Whether in a fast-changing business environment or not, cooperation can be an effective mechanism for the acquisition of knowledge and skills, with advantages over alternative strategies.

According to Ciborra (1991: 51), alliances "allow firms to implement strategies for organisational learning and innovation more effectively." They provide firms with a unique opportunity to leverage their strengths with the help of partners (Inkpen, 1996: 123). Alliances are considered a mechanism to facilitate the transfer of knowledge, enhance the firm's learning capabilities and to deal more effectively with technological and market uncertainty (Hagedoorn et al., 2000: 572-3). Alliances may be an avenue for learning and internalising new skills, in particular those which are tacit, collective and embedded (Doz and Hamel, 1998: 5).

The difficulties associated with the transfer of knowledge, especially tacit knowledge, drive firms to seek alliances. Because tacit knowledge is embedded in the organisation's practices and routines, it is difficult for firms to learn and absorb such skills from their partners without close contact, in a master-apprentice relationship (Badaracco, 1991; Doz

and Hamel, 1998). Close inter-partner collaboration can thus help firms absorb and internalise the tacit knowledge and skills possessed by their partners, but "close interaction with another firm on a day-to-day basis is not a requirement to learn explicit knowledge" (Lei, 1997: 215). This has implications in terms of the design and implementation of alliances; the alliance design and type of interaction between the partners are indications of the type of knowledge most likely to be transferred. For instance, Mowery et al. (1996: 87-9) found that joint ventures are more effective conduits for the transfer of complex capabilities than contract-based alliances such as licensing agreements.[32]

The fact that new knowledge is the product and the goal of alliances (Ciborra, 1991: 59), namely in the context of R&D alliances, and that collaborations exist to transfer knowledge (Dodgson, 1992b: 238) turns organisational learning[33] into a critical factor of success. Learning is not an automatic process and involves a substantial effort. It requires a proactive attitude of firms to learn and the ability to understand and internalise the knowledge and skills acquired from partners. However, to suggest that incremental learning should always lead to incremental performance improvements is misleading, argue Inkpen and Crossan (1995: 603). Hamel (1991) examined the process of inter-partner learning within alliances and found three broad determinants of learning outcomes: intent, transparency and receptivity. "*Intent* refers to a firm's initial propensity to view collaboration as an opportunity to learn; *transparency* to the 'knowability' or openness of each partner, and thus the potential for learning; and *receptivity* to a partner's capacity for learning, or 'absorptiveness'" (Hamel, 1991: 89-90). While intent establishes the desire to learn and transparency the opportunity, receptivity determines the capacity to learn.

The firm's absorptive capacity (Cohen and Levinthal, 1990) is an important determinant of learning, perhaps the most important. It refers to the ability of firms to identify, assimilate and exploit external knowledge, which in this context refers to knowledge from alliance partners. This ability is largely a function of the level of prior related knowledge (i.e. path-

[32] This conclusion is in line with the conclusions of Davis (1977), Killing (1983), Henart (1988) and Kogut (1988a).

[33] Organisational learning can be described as "the ways firms build, supplement and organize knowledge and routines around their activities and within their cultures, and adopt and develop organizational efficiency by improving the use of the broad skills of their workforces" (Dodgson, 1993a: 377). Dodgson also discusses the processes of learning and the ways in which the organisational learning may be facilitated and impeded.

dependent) and is a critical component of innovative capabilities. The organisation's absorptive capacity depends on the absorptive capacities of its individual members and the internal structure of communication to disseminate the knowledge across the firm. Two empirical studies confirmed the Cohen and Levinthal assertion that the firm's ability to absorb new knowledge from alliance partners is path-dependent. Mowery et al. (1996: 89) found that experience in related technological areas is an important determinant of absorptive capacity. Soo et al.'s (1999: 26) results suggest that individual level of absorptive capacity has significant influence on both information and know-how acquisition, and organisation-level absorptive capacity has a significant impact on information (but not know-how) acquisition.

The difficulties of small firms to learn from partners in the context of an R&D alliance can be quite substantial. Although SMEs have efficient and informal internal communication networks, essential for the dissemination of knowledge across the firm, they often lack the time and resources to identify and use external sources of scientific and technological expertise and often lack suitable R&D resources to conduct formal R&D in-house (Rothwell, 1991; Rothwell and Dodgson, 1991). In their study of the U.K motor industry, Beecham and Cordey-Hayes (1998: 193) note that small firms (fewer than 100 employees) continue to have difficulty in "assimilating and adopting new technologies through customer-supplier partnership arrangements." In line with the arguments above, the ability of SMEs to absorb knowledge and skills from alliance partners tends to decrease when the R&D projects are less related to the firm's core activities. Desire and opportunity to learn from partners can be impeded by the capacity to do so.

To understand better the impact of alliances on firm performance, it is important to include the organisational learning dimension in the analysis. The acquisition of knowledge and skills through alliances may not be totally or immediately captured by the performance indicators, but they are an important component of innovative activities. Examining the extent to which firms learn from alliances can be regarded as a different way of interpreting performance, and surely complements the information obtained through the performance indicators.

2.6 PERFORMANCE OF ALLIANCES VERSUS OTHER STRATEGIES

The question of comparing performance of alliances with the performance of its possible alternatives is of relevance given the unusual use of alliances for competitive purposes, suggesting that firms might get more net benefits through cooperation. Alliances are not just a high technology industries phenomenon any more (if they ever were) and their use is spreading across low technological and service sectors as well (Gugler, 1992; Doz and Hamel, 1998). Furthermore, governments have had an active role in promoting interfirm relationships, which is an important indication of a perceived competitive advantage of cooperation, at both the macro and the micro levels. In the context of this thesis, it is worth understanding whether the SMEs had an alternative available to carry out the research project and, if so, what were the advantages of alliances.

In principle, the choice for an alliance instead of an alternative strategy, such as go-it-alone, merger, acquisition or licensing,[34] should be based on a net-benefit comparative analysis of each alternative. In practice, the choice of a given strategy is more complex than that because the range of choices is not always available to firms and the assessment of alternative strategies is complex and costly. Each of these strategies encompasses a different set of advantages and disadvantages that make it difficult to consider them as perfect alternatives to cooperation. “Going it alone can be time consuming. Licensing is only a short-term fix. Merger and acquisition is often prohibited by antitrust laws or barriers to foreign ownership” (Bleeke and Ernst, 1993a: 11). Actually, although all the above strategies might be used to reach a specific benefit or objective, they may only be considered partial substitutes to cooperation because each of them has necessarily dissimilar implications in terms of human resources, investment, management skills, flexibility, control, time and so forth. Of course, small- and medium-sized firms face more difficulties and, generally, do not have all the above alternatives available.

A few studies have touched on the question but no strong empirical evidence has been produced so far. Previous studies normally took a general approach and rarely was a

[34] Licensing agreements, especially one-way ones, might be considered an alternative strategy to an alliance, however, in some cases they are considered alliances, which is basically due to the problems of identifying those licensing agreements that are merely market transactions.

particular alliance structure and/or sector analysed in greater detail. It is beyond the scope of this thesis to carry out any detailed analysis of the matter, which is by the way an excellent suggestion for another DPhil thesis. Only the main arguments put forward by researchers concerning the option to cooperate instead of an independent strategy, likely the most meaningful issue for this research, are presented here[35]. Porter and Fuller (1986: 329) argue that "coalitions are a more rapid means of repositioning than internal development." Harrigan (1986) observed that joint ventures allow partners to make smaller investments in risky projects than they would otherwise do to tackle them on their own. Thus, partners share the risk and the return on investment but the net effect of the risk-return trade-off make JV partners better off than if they have to go it alone.

One of the questions that guided Human and Provan's (1997) study was whether outcomes for firms in SME networks differ from outcomes for firms that are not network members (i.e., market-based firms). They were not able to accurately determine whether financial performance was stronger for network or non-network firms, but they were told that market firms achieved financial performance through independent and competitive activities. They concluded, "Overall [...] network membership provided an external structure beyond market mechanisms through which network firms generated new interorganizational exchanges, expanded organizational legitimacy, and accessed organizational resources" (p. 387).

Schmitz (1998) investigated a footwear industry cluster in the period 1992-97 and reported a positive relationship between changes in performance and changes in cooperation. He stresses that "firms which have stepped up co-operation have improved their performance more than those which have not" (p. 21). Singh and Mitchell (1996) and Singh (1997) examined the U.S. hospital software systems industry between 1961-91 and found that business survival is positively correlated with collaboration, and collaborative firms outperform those that take an independent approach. "As a general empirical outcome, businesses with collaborative agreements will tend to outperform businesses that take independent approaches in complex business situations, if managers are at least intendedly

[35] For information on alliances versus mergers and acquisitions see, for instance, Porter and Fuller (1986), Doz (1988), Abravanel and Ernst (1993), Bleeke and Ernst (1993b), Hagedoorn and Schakenraad (1994), Gomes-Casseres (1996), Doz and Hamel (1998). For alliances versus licensing see, for instance, Mowery (1989).

rational in their approach to interfirm relationships" (Singh and Mitchell, 1996: 101).

In line with the advantages of alliances in acquiring knowledge and skills from partners explained above, when the cooperative project involves technological- or knowledge-related objectives, the option to cooperate seems to be a good strategy. According to Brockhoff and Teichert (1995), "firms which take part in R&D cooperation seem to be more successful than firms that do not take part in such cooperations." Link and Bauer (1989)[36] demonstrated that the return on R&D investment of U.S. manufacturing firms was higher in cooperating firms than in those firms that did not cooperate; firms cooperating in research enjoy greater R&D efficiencies than those that do not. The findings in Hagedoorn and Schakenraad (1994: 300-1), who analysed the correlation between corporate performance and strategic technology partnering (i.e., external linkages of firms), indicate that "companies attracting technology through their alliances and companies concentrating on R&D cooperation have significant[ly] higher rates of profit." Doz and Hamel (1998: 52) point out that an alliance is a better and faster alternative to win the race to learn, because internal development is often slow and uncertain. And Mowery (1989: 23) affirms that collaborations "allow established firms a more rapid and less costly means than internal development to gain access to new technologies that are not easily licensed."

Unlike these optimistic views of alliances, Kotabe and Swan (1995) studied product innovativeness within the context of cooperative strategies and, according to their findings, "there appears to be a disadvantage to cooperating with other firms in developing and introducing more innovative new products. [...] We cannot rule out the possibility that poor performance can cause firms to seek additional cooperation with competitors." They could not find support to validate the hypothesis that products of cooperating firms tend to be more innovative than products of a single firm. They acknowledged some possible bias of their results due to limitations of the study, though.

Comparative empirical research fully demonstrating (or not) the relative advantages of alliances over alternative strategies does not yet exist. Despite some studies recognising weaknesses on the evidence provided, the message appears to be that alliances have

[36] Quoted in Watkins (1991: 89) and Brockhoff and Teichert (1995: 112).

advantages in many situations, but cannot be considered a universally better option. Comparisons in absolute terms are virtually impossible. According to Chowdhury (1992), a given strategy is not better than another in an absolute sense, but it is only relatively superior (or inferior) to others in specific circumstances. In the context of government-sponsored alliances, it is important to understand the extent to which an alliance is a better option because of government intervention.

2.7 CONCLUSION

This chapter is concerned with the theoretical background for the rest of the investigation. It analyses the major conceptual issues relevant for this thesis and contextualises the government-sponsored R&D alliances. A common feature to all the concepts is the lack of consensus among scholars regarding their definition and boundaries. The concept of interfirm alliance has been evolving to describe the increasing diversity and complexity of alliance forms, but the problems concerning its boundaries and wording still remain. There appears to be no doubt, though, that an R&D alliance is one of many alliance types, one which involves R&D activities or the transference of technology between alliance partners.

It is difficult to find a single definition for alliance success because of the large spectrum of alliance types, the multiplicity of purposes and diversity of results. Ultimately, the notion of alliance success must reflect the individual perspective of alliance partners, irrespective of the common achievements. Concerning the notion of organisational performance, there is no unique set of indicators or "best way" to measure it. The notion of organisational performance is, thus, based on individual preferences of those involved in measuring it. In any case, traditional financial indicators seem no longer to suffice because they are essentially good at measuring past performance, but rather poor at assessing the firm's future competitive stance.

The chapter discusses several different ways of analysing performance in the context of alliances. One approach has to do with the assessment of alliance performance. This has been of concern of researchers for a long time, namely the performance of joint ventures. Earlier empirical studies used an array of measures, ranging from perceptual measures (i.e., partners' own assessment) to financial indicators. Each measure captures partially the

phenomenon, and not all measures are adequate to measure the performance of all alliance types. A multidimensional approach is likely to be a more effective way of assessing the performance of alliances. A second perspective to analyse performance consists in assessing the impact of alliances on firm performance and, again, a range of perspectives and performance indicators have been used to do so. Some studies analysed the stock-market reaction to the alliance formation announcements, other studies examined the importance of alliances to firm survival. Another group of studies looked at the relationship between alliance intensity and firm performance, normally using statistical methods to find associations between the two, but with relative success given the difficulty in proving the cause-effect link. Yet another group of studies examined the alliance outcomes and impact on firm performance using direct interviews or questionnaires. This approach overcomes the causality issue but cannot avoid the problem of subjectivity because it is based essentially on perceptual measures.

Performance can also be interpreted from the viewpoint of organisational learning and competence-building. An alliance is an appropriate mechanism for the acquisition of knowledge and skills from partners, especially tacit knowledge, but the learning process is far from automatic, requiring effort and ability of firms to recognise, assimilate and exploit the new knowledge. Because the performance indicators may not capture in full what firms have learned from alliances, analysing organisational learning is likely to complement the understanding of the impact of alliances on firm performance. Yet another way of analysing performance is to assess the performance of alliances against alternative strategies (i.e., go-it-alone, merger, acquisition and licensing). These alternative strategies are not perfect substitutes for each other and not all of them are always available to target particular objectives. Further, there is no absolute advantage of one strategy over the others; each strategy is only relatively advantageous over the others.

The next chapter addresses specific theoretical issues related to the type of alliances under analysis and the context in which they took place.

3 R&D ALLIANCES - EMPIRICAL BACKGROUND

3.1 INTRODUCTION

Unlike the previous chapter, which focused extensively on the question of performance assessment, this chapter overviews some relevant matters aiming at locating the CRAFT alliances examined below and characterising the context in which they took place. This will help towards a better understanding of the formation of CRAFT alliances and the interpretation of later results. The upward trend in the formation of R&D alliances is an environmental pressure for SMEs to seek external relationships, for instance, in the context of government-sponsored schemes. Governments promote collaborative research for a number of reasons, such as correcting market failures, speeding-up technological innovations and transferring technology. The Portuguese industrial structure surely needs and welcomes initiatives aimed at increasing its innovative potential, but this also raises the question of the extent to which the ability of SMEs to participate in R&D alliances and absorb knowledge from partners is affected by the relatively low performance of Portuguese industry.

The chapter structure is as follows. First, it looks at the trends in the formation of R&D alliances, the existing databases on alliances and the participation of SMEs in R&D alliances. Then, a general picture of the Portuguese industrial structure and its performance is provided. In sections 3.3 and 3.4, the chapter addresses the rationale behind the government's policy towards cooperation and gives an overview of EU RTD (research and technological development) policy, emphasising the role of the Framework Programmes and the Structural Funds. Some concluding remarks close the chapter.

3.2 TRENDS IN R&D ALLIANCES

There is a general perception and acceptance in the literature that the formation of alliances since the early 1980s has registered an upward trend. This holds for alliances in general and for R&D alliances in particular, both government-sponsored and market-driven alliances. So far, no study has convincingly refuted it as untrue. However, von Tunzelmann (1995: 268-9) believes that the networks might be a structuring device to cope with the current period of "fast history" in technology that in due course will abate. The alliance phenomenon gained enormous visibility over the last two decades in part due to its extent and pervasiveness across different sectors; however there is no comprehensive database on alliances, capturing the phenomenon in its multiplicity of alliance types, range of sectors and the different types of partners involved. The lack of a general consensus regarding the conceptual issues, as we have seen in the previous chapter, the complexity involved in systematically collecting the data, and the reliability of the information sources are some very important obstacles in the way of researchers to build reliable databases. According to Doz and Hamel (1998: 285), "statistics on strategic alliances are notoriously unreliable, since definition and reporting vary across industries and data bases." Leveque et al. (1996: 199) stress emphatically that there is an "unsurmountable bias implicit in databases."

Despite all the problems, some databases on alliances do exist even if they are partial, unbalanced (large firm alliances tend to have higher visibility) and biased according to the definitions and processes of collecting the data used. That helped Hagedoorn (1995: 207) to recognise that "the study of strategic technology partnering is to a large extent concentrated in so-called high-tech industries or core technologies." At least three different approaches have been taken in building databases, which albeit different in purpose, do share certain characteristics.

i) One approach, that may be called "project-specific databases", consists of building a database for a specific research project with no intention to develop it once the project is finished (e.g. Ghemawat et al., 1986; Harrigan, 1986, 1988).
ii) Other databases, "generalist databases", have information about different types of alliances (e.g. R&D, production, marketing) and sectors (e.g. the INSEAD database, see for instance European Commission (1995)). In European Commission (1995: 38) one can read, "alliances continue to grow rapidly in the world economy as a major tool

of strategic management for companies in almost all industries and most major trading blocs."

iii) A third approach consists of building "thematic databases". The ITSA database, "which records publicly announced interfirm alliances in IT worldwide" (Vonortas and Safioleas, 1997: 658), is an example. The authors reported an increase in the number of alliance records throughout the examined period (1984-94), with the exception of 1990-91. They observed a "rapidly increasing pace of alliances with developing country firm participation [that] is very much defined by alliances with explicit technological content" (Vonortas and Safioleas, 1997: 661). Another example is the MERIT-CATI database, which collects information on inter-firm agreements "that contain some arrangements for transferring technology or joint research" (Hagedoorn, 1995: 228). According to Vonortas and Safioleas (1997: 657), "the only large database of publicly announced interfirm alliances that has been extensively explored for economic policy research is CATI."

Hagedoorn et al. (2000) identify three major databases related to research partnerships: MERIT-CATI, CORE and NCRA-RJV databases. Concerning the MERIT-CATI database, they note that "the number of new partnerships set up annually gradually increased from about 30-40 in the early 1970s to 100-200 in the late 1970s. The 1980s marked a period of a further rapid increase. Starting from around 200 per year, the number of new partnerships announced every year reached around 600 or more later in the 1980s and 1990s" (p. 577). Concerning the CORE and NCRA-RJV databases, they say, "the significant increases in registrations during 1985-1995 have been followed by decreases in the last 3 years, which have been particularly steep in 1997 and 1998. The reasons for this change are not clearly understood" (pp. 577-8). According to OECD (1999: 76-7), the number of national and international technological alliances did not change significantly between 1988 and 1990, but rose rapidly during the period 1994-96 in the zones (United States, European Union, Japan).

The CORDIS database[37] contains a repository of information (e.g. alliance partners, objectives, duration) on the EU-sponsored cooperative projects, per project and covering

[37] http://www.cordis.lu

the range of cooperative programmes, but it is not structured in a way to provide data for statistical analysis.

3.3 SMEs AND R&D ALLIANCES

The presence of SMEs in R&D alliances has long been referred in the literature. However, it has traditionally given higher visibility to large firm alliances, in most cases disclosing information on the SMEs' cooperation activity in the context of their involvement in asymmetrical alliances. This is especially true in the case of hi-tech SMEs. Even so, Gugler and Dunning (1993: 128) affirmed that "smaller companies are becoming more involved in strategic alliances, particularly with their larger customers. [...] Asymmetrical agreements between large and small enterprises are growing more rapidly than those between large firms." Past and current government-sponsored collaborative research programmes have created better conditions for the participation of a higher number of SMEs in R&D alliances, virtually from every sector. Over 60% of SMEs participating in the European Union's Fourth Framework Programme had never participated before in regional, national or multinational RTD co-operation programmes.[38]

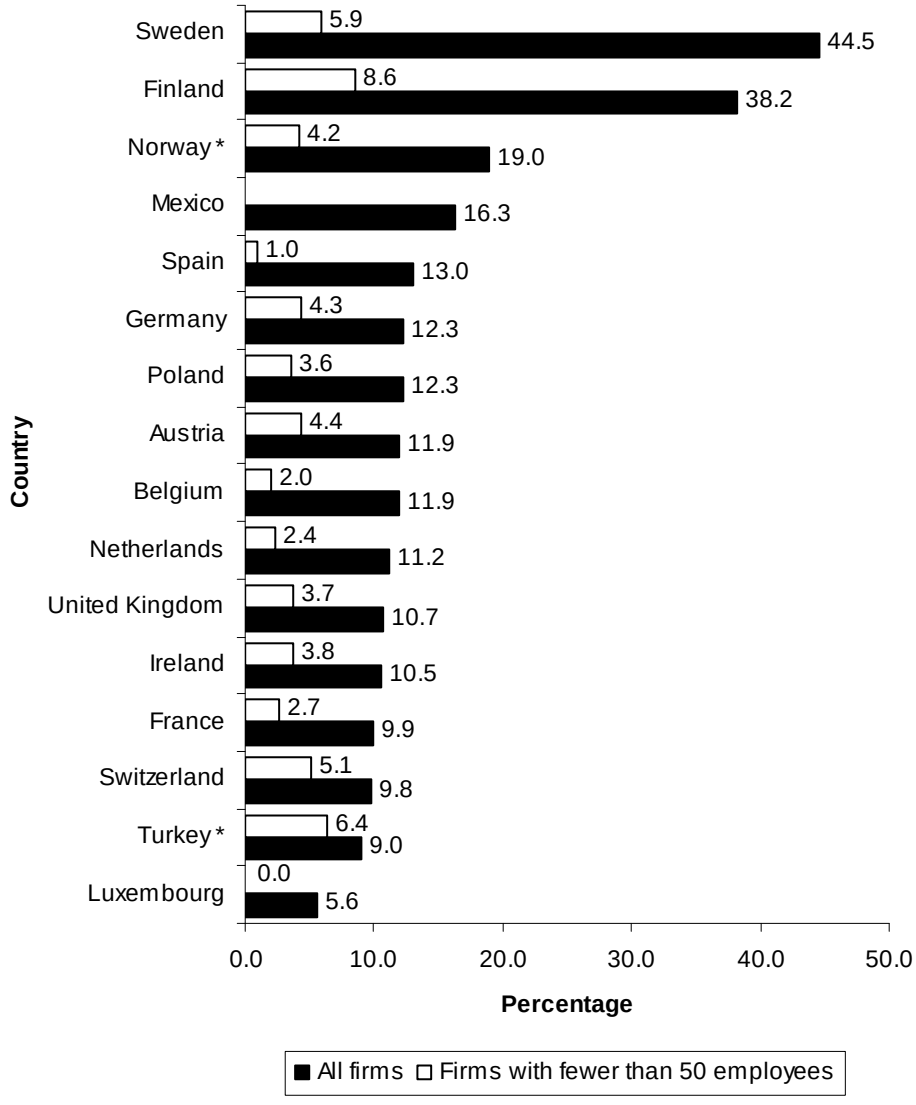
There are not many studies specifically reporting on the rate of SMEs participation in R&D alliances. Agreements between small firms tend not to be publicised and, therefore, they tend not to be included in databases on R&D alliances. It is also likely that many of them are informal and it may even happen that the R&D agreements are not considered as such by SMEs because most of them do not perform formal R&D. Of the studies on technology alliances, the majority of them tend to feature large firm collaboration rather than that undertaken by small and medium-sized enterprises (Rothwell and Dodgson, 1991: 125). One of the pioneering studies conducted on "innovative" firms from all sectors of manufacturing in the UK registered a "considerable innovation-related linkage activity amongst small and medium-sized firms. [...] A significant number of firms do engage in collaborative R&D ventures, in the same way as large firms" (Beesley and Rothwell, 1987: 10)[39]. 26% of the sampled firms were engaged in some form of collaborative R&D venture

[38] http://europa.eu.int/comm/research/faq.html#tocref3_10

[39] The study was then published as Beesley, M. and R. Rothwell (1987), Small firm linkages in the United Kingdom, *in* Rothwell, R. and J. Bessant (eds) (1987), *Innovation, adaptation and growth*. Amsterdam: Elsevier.

and about 56% of them took place with firms employing less than 200 employees. More than half of the firms who participated in the Eureka projects were SMEs with fewer than 500 employees and about 30% of the participant firms had fewer than 100 employees (Mothe and Quelin, 1999: 35). One in six French SMEs with research capabilities was involved in EC research programmes (Larédo, 1998: 35).

Figure 3.1 *Cooperation between business and the public sector (1994-96)*



Note: (*) 1995-97 instead of 1994-96.
Source: OECD Secretariat (1999a: 136, based on data from Table 4.5.1.).

In their innovation surveys, some OECD countries include a question on firms with cooperation arrangements for innovation with universities or government. Figure 3.1 shows the percentage of firms who engaged in cooperative activities with the public sector. As

expected, in all the countries, smaller firms (fewer than 50 employees) have less propensity for engaging in cooperative activities with the public sector than larger ones. Such agreements for innovation are more common for large firms than for small ones (OECD Secretariat, 1999a: 42).

It is difficult to confirm whether the general trend in the formation of R&D alliances reported in the previous section holds for small firms, in particular non-high-tech SMEs and firms with little research resources. The information sources are rather scarce and incomplete. The EU-sponsored R&D programmes appear to be creating incentives for an increasing number of SMEs to establish joint R&D projects, but the percentage of SMEs who enter new partnerships outside the EU-sponsored schemes is still unclear.

3.4 PORTUGUESE INDUSTRIAL STRUCTURE AND PERFORMANCE

This section makes a diagnosis, necessarily incomplete, of some aspects of the Portuguese industrial structure,[40] which are of relevance to understand the role of the Portuguese firms in the context of CRAFT alliances. In short, Portugal is a small open economy with a high proportion of small firms, a productive structure concentrated in traditional sectors, and heavily dependent on external sources of technology. The examiners' report in the OECD's 1993 review of Portuguese science and technology policy (OECD, 1993: 101) identifies some of the "most significant structural and cultural problems". These include: lack of R&D capacity in manufacturing industry in terms of both expenditure and skilled personnel - perhaps the single most important barrier to a technologically dynamic and competitive industry; lack of direct government support for basic pre-competitive industrial R&D; industrial structures characterised by a large number of SMEs and bias towards low-technology production in traditional sectors. Caraça et al.'s (1993) conclusions on the weaknesses of the Portuguese S&T system point to similar structural problems.

Portuguese industry is composed mainly of small and very small firms. According to OECD (2000: 169), "small firms (fewer than 50 employees) accounted for 95% of manufacturing firms in Portugal in 1995 and SMEs (fewer than 200 employees) accounted

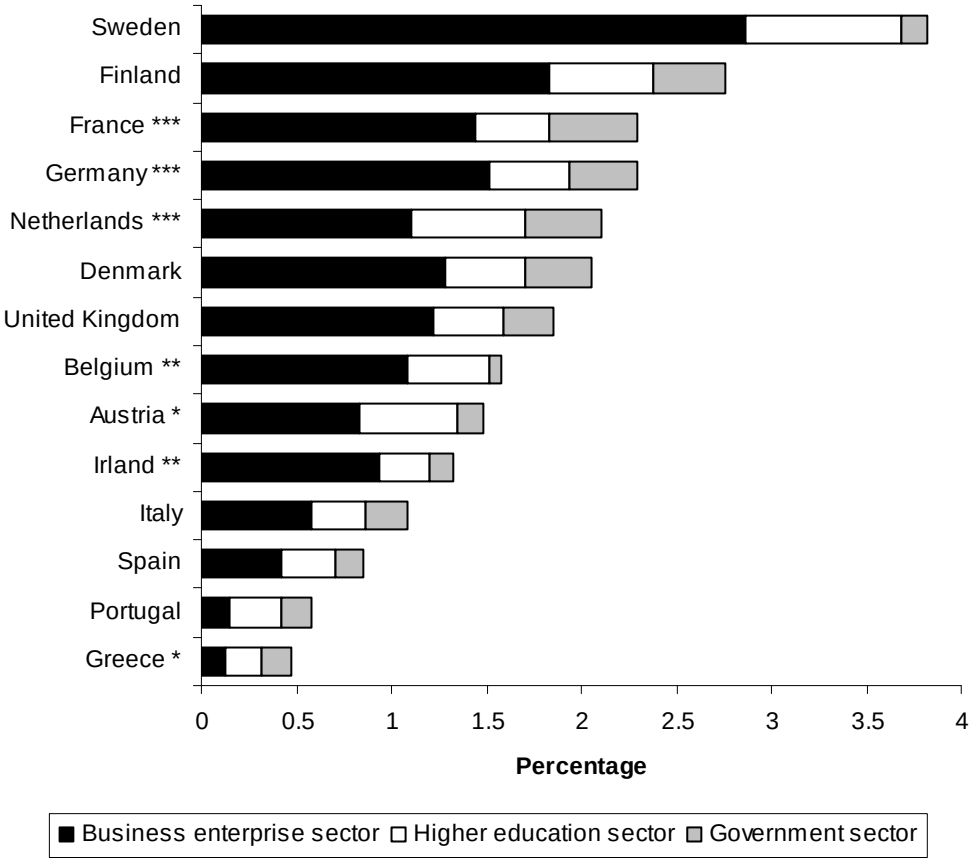
[40] See, for instance, Assis (1996: Ch. 5) and Hidalgo (1997) for a more detailed analysis of the Portuguese scientific and technological (S&T) system.

for 99%. Small firms represented 43% of employment while SMEs represented 70%. In terms of value added, the contribution of SMEs to GDP was 47% (25% by small firms). And small firms generated 29% of turnover while SMEs generated 53%." Only 0.12% of all firms have more than 250 employees, representing about 20% of employment. Besides the small size, "a low technological-intensity profile dominates the production sector" (Caraça et al., 1993: 8), because most firms are concentrated in traditional and generally low technology sectors (OECD, 1993: 125). Hidalgo (1997) provides a general description of the sectoral specialisation of the Portuguese industry.

> "Traditionally within the productive sector, it was the textile sector which showed more important rates of activity. [...] Portuguese companies are also strong in those sectors of production where they have been able to establish themselves: paper, plastic, chemical, shipbuilding etc. Proven political stability, accompanied by low labour costs compared to those of their EU partners, have led to the establishment of companies with high technological content in the country, especially in the motor sector. [...] Perhaps the most outstanding single fact is that an important productive sector does indeed exist, but lacks a sufficient technology level." (Hidalgo, 1997: 137)

"A further weakness is technological dependence" (OECD, 1991). The Portuguese production sector depends heavily on technology from abroad in comparison with the limited levels of domestic research (Hidalgo, 1997: 143). While it is entirely rational for Portugal, as a small and relatively less advanced country, to devote a limited amount of resources to R&D activities, it is the small share spent by its enterprises which is of concern (OECD, 1991). Traditionally, the Portuguese firms do not spend large amounts of resources on R&D activities, which is to a large extent the consequence of a productive structure mainly characterised by very small firms. Figure 3.2 compares the R&D expenditures as a percentage of GDP for the European Union countries. "In most countries, the BES [business enterprise sector] accounts for the largest share of R&D expenditure (as a % GDP), [...] in Greece and Portugal, the largest share of their respective total R&D expenditure is accounted by the HES [higher education sector]" (Eurostat, 1999: 26-7).

Figure 3.2 *R&D expenditure as a % of GDP by institutional sectors – 1997*



Notes: (*) 1993. (**) 1995. (***) 1996.
Source: Eurostat (1999: 86 (Table 14), 98 (Table 18), 110 (Table 22)).

Laranja and Fontes (1998: 1025-6) note that the large corporations operating in Portugal in technologically intensive sectors are essentially of two kinds: (a) "Subsidiaries of large multinationals, [...] which link directly to their home base for technology and development activities; and (b) large indigenous companies, which rely on foreign technology suppliers for their technological needs." In their study comparing Portuguese, French and English firms, Birchall et al. (1996: 296) affirm that the Portuguese firms "are less likely to report a strong input from their own R&D activity and in consequence appear more reliant on outside sources for product/service innovation. Competitors, formal linkages and informal networking, trade sources and equipment vendor are of more importance to the Portuguese." Unsurprisingly, the authors found that the Portuguese executives reported that they spend a lower proportion of their turnover on R&D than their French and British counterparts.

One of the consequences of being technologically dependent is that "Portugal exports mainly low-technology goods and imports a large volume of high-technology goods" (OECD, 1993: 125). Table 3.1 gives information on the Portugal's relative export specialisation by type of industry. The data illustrate what is said above and even show a reinforcement of the export specialisation in low-technology industries in the period 1980-1992. Table 3.2 below shows a negative technology balance of payments, where the total receipts cover just 34% of the payments, further confirming the technological dependency of the Portuguese productive sector.

Table 3.1 *Relative export specialisation by type of industry (OECD average = 100)*

	High-technology industries		Medium-technology industries		Low-technology industries	
	1980	1992	1980	1992	1980	1992
Portugal	58	48	37	40	196	227

Note: See OECD (1995: 30) for information on the classification of the manufacturing industries.
Source: OECD (1995: 34).

Table 3.2 *Technology balance of payments (as a percentage of GDP)*

	Receipts	Payments	Balance	Receipts/Payments ratio (%)
Portugal (1997)	0.22	0.60	-0.39	34
European Union (1996)	0.35	0.49	-0.13	72
Total OECD (1996)	0.32	0.25	0.07	128

Source: OECD (1995: 34, extract from Table 11.5.1).

The Portuguese "characteristic" firm is, thus, an SME which invests very little in R&D, depends largely on technology from outside, and most likely belongs to a traditional sector. This implies that Portuguese firms might benefit substantially from participation in joint research projects such as CRAFT by acquiring knowledge, skills and competencies from partners. But the structural weaknesses of the Portuguese industry also act as an important obstacle for the ability of SMEs to set up and participate in R&D projects and, perhaps more important, recognise and assimilate new knowledge.

3.5 GOVERNMENT POLICY

3.5.1 The rationale for government-sponsored alliances

Governments, especially of the OECD countries, have actively promoted and supported the formation of partnerships between firms and also involving other bodies such as universities and research institutes. The CRAFT (1994-98) programme is an illustrative example of that policy at the European Union level. Pre-competitive R&D has been one important area for the collaborative policy, but collaboration is being encouraged much more widely. There appears to be no doubt about the interest and effort of governments in stimulating collaboration, it is important, however, to understand the rationale behind that public policy. An overview of the underlying factors found in the literature is presented below without any pretension of an in-depth discussion of the arguments put forward or the assessment of the results, since these would go beyond the scope of this thesis[41]. Of the following six interrelated factors, the first two are of a general nature, the others are more focused on the case of research partnerships.

Thus, governments encourage interfirm collaboration aiming at:

Stimulating competitiveness at the firm and national levels. Collaboration among SMEs is an emerging approach to industrial competitiveness and an effort to stimulate industrial modernisation (Rosenfeld, 1996). The objectives of the partnership programmes in Europe "include reinforcing the competitiveness of EU industry (especially SMEs) with benefits for the economy, and promoting employment and export potential" (Fukasaku, 1999: 110). In Australia, the cooperative programmes "have at heart the idea that firms exchange information and capabilities as well as goods and services - so that cooperation can enhance firm competitiveness" (BIE, 1995: 2). To Guy et al. (1999: 132) "public funding support for ATPs [Advanced Technology Programmes] can be justified on the grounds of [...] enhancing international competitiveness, in the face of perceived weaknesses relative to trading partners." Gugler and Dunning (1993: 156) note that, viewed from a national perspective, "R&D collaboration may [...] induce higher productivity, avoid a duplication

[41] See, for instance, Peterson and Sharp (1998) for a detailed and critical view on the EU technology policy.

of research investment, reduce structural overcapacity, and improve the competitiveness of their national champions."

Stimulating local and regional integration. This is clearly visible in the case of the European Union's collaboration policy, which encourages "firms to think in European terms, to work with firms beyond their national borders as a matter of routine, and to seek new market opportunities beyond their traditional home markets" (Peterson and Sharp, 1998: 215). And Fukasaku (1999:110) notes that "partnerships programmes in Europe have largely been aimed at enhancing European integration by involving enterprises and research bodies from different countries in joint projects." Chesnais (1988: 106) stresses that the aim and result of programmes organised on the basis of a large number of projects, co-ordinated between participants of different sizes, technological strengths and legal status, "will necessarily be mainly that of stimulating the creation of interfirm and inter-organizational linkages for R&D and technological linkages in a context where such linkages do not exist or [exist] only to a limited extent." The European framework programmes "carry out an important task of inter-territorial cohesion" (Hidalgo, 1997: 145).

Correcting market failures in R&D. Public funding support for R&D partnerships aims to correct the market failures which results in under-investment in R&D by firms (e.g. Jacquemin, 1988; Macdonald, 1992; Guy et al., 1999; Link, 1999; Scott, 1999, Hagedoorn et al., 2000). According to Scott (1999: 71), there are two broad and interrelated sources of market failures that cause under-investment in technology and innovation. One is "appropriability difficulties" - private firms typically do not appropriate all the social returns from their innovative investments. R&D cooperation between firms partially overcomes the appropriability problem by lowering the cost of the innovation to participating firms and making the results available to the entire group (Watkins, 1991: 89). The other is "risk and uncertainty" - reluctance of firms to invest in costly and risky projects that can drive them to bankruptcy if unsuccessful. R&D alliances are rarely initiated to restrict competition and, since it is usually hard to make profits from basic research, private and public collaboration in basic research may promote innovation that otherwise would not be developed (Gugler and Dunning, 1993: 156). Peterson and Sharp (1998: 46) are more emphatic on this point saying, "the market [...] will not provide basic

research. Unless the state steps in and supports it, it will not be undertaken."

Although market failures generally occur at the pre-competitive stage of technology, where the public funding can be justified, Scott (1999: 69) discusses a rather "aggressive view". Scott argues that public funding can be more important and feasible "to correct market problems that extend beyond the basic and generic end of the research spectrum and into the development and commercialisation of innovations." "There is therefore an argument for tailoring government support, such as information provision or financing, according to whether the failure lies in the pre-competitive stage or closer to market" (Cervantes, 1999: 9).

Speeding up technological innovations. Government-sponsored technological collaboration aims to speed up technological innovation and increase international competitiveness (Hagedoorn et al., 2000: 583). It is a way of improving the efficiency of the innovative base of the economy (OECD Secretariat, 1999b: 43). "The main motivation for the introduction of ESPRIT and the other schemes that became the Framework Programmes was competitiveness. European companies [...] were losing market share to their American and Japanese counterparts because they were falling behind in both the production and use of new technologies" (Peterson and Sharp, 1998: 211).

Increasing technological information exchange. "One of the assumptions concerning the promotion of collaboration is that it is primarily a mechanism for technology sharing" (Dodgson, 1992b: 466). R&D cooperation stimulates the exchange of information, scientific and technological knowledge between the public and private sector (e.g. Tijssen and Korevaar, 1997; Hagedoorn et al., 2000). Guy et al. (1999: 132) note that public funding for advanced technology programmes can be justified on the grounds of "systemic failure, where the structure of the overall R&D system may be such that bottlenecks exist in relationships between the various actors, leading to, for example, poor information flows and unnecessary constraints to the sharing of know-how and expertise." According to the OECD secretariat (1999b: 43), "today, most policy makers subscribe to the view that such collaborations [between universities and the private sector] increase the distributive power of innovation systems by allowing the smoother and faster flow of knowledge from universities to the final users of this knowledge - private sector enterprises."

Improving the efficiency of public support for R&D. According to Cervantes (1999: 9), the government's support for partnerships in the context of innovation and technology helps "improve the 'efficiency' of public R&D support by eliminating overlapping investments, reducing the time horizons for R&D and stimulating additional spillovers from public research." Public funding for R&D collaboration may avoid a duplication of research investment (Gugler and Dunning, 1993) and it is a way of co-ordinating and concentrating collaborative R&D efforts (Tijssen and Korevaar, 1997: 1278).

3.5.2 Basis for public policy towards inter-firm cooperation

As we have seen, there are a number of important reasons supporting government policy towards cooperation. The potential benefits are enormous for both the firms and the economy as a whole. But, to what extent are such policies based on actual benefits rather than perceived benefits? How effective have such policies been? Since the government support for collaboration normally takes the form of financial incentives, it raises a question about the motives for private firm participation. That is "whether firms participate to improve technological capacities or to benefit from public subsidies" (Dodgson, 1992a: 466). These are examples of pertinent questions for which there are no appropriate answers yet. Therefore, "it becomes imperative for policy makers to offer an economic rationale for their support of public/private partnerships" (Link, 1999: 191).

The Bureau of Industry Economics in Australia says that "policy makers have identified networking and similar activities as potentially useful, [however] their impacts on performance and competitiveness are largely undocumented" (BIE, 1995: 145). Cervantes (1999: 20) points out that "partnerships policies and schemes should not be designed solely on the notion that co-operation between industry and public research is intrinsically 'good'." And Rosenfeld (1996: 247-8) notes that "although there are a growing number of local, regional, and state efforts to encourage and accelerate inter-firm collaboration, there have been few systematic studies of their impacts. In the absence of hard data, policy makers rely on claims of effects and outcomes based on anecdotal evidence".

The U.S. Office of Technology Policy made an assessment of public/private partnerships,

pointing out their benefits for firms and the U.S economy[42]. Link (1999) concedes that the report's findings should be given "some credibility and perhaps even some generalizability", but also says the findings are very general and the recommendations non-operational. The efforts should first be directed at examining the question of "market failure", the main argument in favour of the participation of governments in the innovation process. Market failure must be the "cornerstone" of any evaluation, says Link (1999: 215). Concerning the EU-sponsored cooperative research programmes, "the evaluations and studies have added fairly little to the general discussion on the contribution of the programmes to furthering the competitiveness of European industries, their prime objective" (Luukkonen, 1998: 599). On the one hand, most of the evaluations and studies have been commissioned by the authorities responsible for the R&D policies, either at the European or national level. That discourages evaluators from voicing strong criticisms. On the other hand, the evaluations are based on unsystematic background information and many studies have weaknesses in their data collection process. The fact that most studies and evaluations were carried out at a micro level (projects, research teams, firms) is inadequate to understand the role of the programmes in advancing competitiveness in European industry in general (Luukkonen, 1998).

Although there are many and diverse reasons behind the government policies towards cooperation, there is insufficient empirical evidence on the impacts of such policies, in particular at the firm level. It is largely unknown what is the impact of the EU-sponsored collaborative programme on the performance of SMEs.

3.6 EUROPEAN UNION RTD POLICY

The Framework Programme (FP) is the basic, multi-annual, instrument of the European Union for the RTD (research and technological development) policy within the Union. The Single European Act, signed in 1986 and ratified in 1987, provided the formal legal basis for the EU RTD policy, legitimising it for the first time (Peterson and Sharp, 1998: 115). Subsequently, the Maastricht Treaty, signed in 1992, gave further support to the role of EU in regard to RTD policy and the competitiveness of European industry. It states in its

[42] Office of Technology Policy (1996), *Effective partnering: a report to congress on federal technology partnerships*. Washington, DC: US Department of Commerce.

Article 130f: “The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level...”

However, since the notion of competitiveness should be used in relation to firms rather than to countries[43], and the Treaty of Rome forbids the promotion of individual firms, the Framework Programmes have therefore an “in-built paradox”: while they are expected to promote competitiveness at a general level, they are not to promote particular firms (Luukkonen, 1998: 601). In order to avoid that inconsistency, the EU R&D support is described as pre-competitive R&D (i.e. concerned with generic research for which no immediate commercial application is expected).

The Maastricht Treaty also demands coordination between the Union’s and Member States’ RTD policies. According to Article 130h, “The Community and the member States shall coordinate their research and technological development activities so as to ensure that national and Community policy are mutually consistent.” It adds that the Community may take any useful initiative to promote such coordination. Therefore, the Framework Programmes (currently the Fifth - 1998-2002) include the basic areas of high-priority research grouped together in specific programmes designed to satisfy the individual and collective needs of the Member States (Hidalgo, 1987). The Framework Programmes, which are approved unanimously by all Member States, define the main technological objectives and the corresponding budget for each of them. The FPs gave coherence to the European Union’s RTD efforts (Peterson and Sharp, 1998).

There are two main sources of funds for R&D. On the one hand, there are the FPs, which are administered directly by the Commission and are materialised in RTD programmes. The CRAFT (1994-98) is an RTD programme of the Fourth Framework Programme especially designed for SMEs[44]. All institutions of the Member States can participate, but the Commission favours projects with participants from the cohesion countries (Portugal, Greece and Ireland). Although the EU spending on RTD has grown, the total amount is still relatively small. Figures for 1994 indicate that the EU RTD spending as a percentage of

[43] See, for instance, Metcalfe et al. (1992) and Sharp (1998) for a discussion on the issue of competitiveness.
[44] See Chapter 4 for detailed information on the CRAFT programme.

Member States' total RTD spending (public and private) amounted to 1.7% and 3.8% if considering only the Member States' government spending on R&D (Peterson and Sharp, 1998: 11). These authors note that such "modest EU share of all European spending on research [...] cannot hope to make a large or even tangible difference in terms of European competitiveness or employment" (p. 22). In the same way, Pavitt (1998) says that such small spending "will not have a significant rate and direction of technical change in Europe" (p. 564). Larger countries (Germany, UK, France, Italy) tend to get a larger percentage of FPs' funds. Despite the relatively small figures, the rate of firm participation in the EU research programmes makes the debate on the EU research policy necessary (Larédo, 1998: 591).

On the other hand, there are Structural Funds (SFs), which are "the principal means by which the European Union delivers regional and other assistance" (OECD, 2000: 203). These funds are mainly for the cohesion countries to build technological capabilities in order to reduce the existing technological gap between them and the other Member States. Unlike the Framework Programmes, the recipient Member State administers the Structural Funds, which amounted to about 25% of the Fourth Framework Programme. Sharp clarifies the difference between the two sources of funds:

> [...] "Structural Funds, which of course are used in conjunction with other national and regional funds, play a much more important role in funding RTD in the cohesion countries than the Framework Programme. [...] The aim of the Structural Funds [...] is implicitly to build up capabilities in terms of physical assets (in this case, laboratories and equipment) and personnel (education and training). By contrast, the Framework Programme, with its emphasis on collaboration, takes physical assets as given but seeks to add value by encouraging researchers and laboratories to work jointly on research projects. [...] While the Structural Funds upgrade the physical infrastructure, the Framework Programme collaborations provide opportunities for learning." (Sharp, 1998: 581-2)

Of the numerous initiatives taken by Portugal with Structural Funds, PEDIP[45] is probably the most ambitious scientific programme carried out since Portugal's incorporation into the

[45] PEDIP II (1994-1999) stands for "Strategic Programmes for the Promotion and Modernisation of Portuguese Industry".

EU (Hidalgo, 1997: 129). This programme "aims to promote sustained growth in the competitiveness of Portuguese industrial firms, reinforcing their capacity to respond to rapid technological and market changes and promoting their modernisation, diversification and internationalisation" (OECD, 2000: 170).

Both the Framework Programmes and Structural Funds are important for SMEs. Despite the importance of SMEs in the context of the European industry, until the Third Framework Programme their participation in RTD programmes was difficult given the programmes' pre-competitive nature and the transaction costs associated with the negotiation and implementation of cooperative projects. Since then, there has been an increasing awareness of the important role of SMEs, not only in the development of new technologies but also, and even more crucially, as users of new technologies (Peterson and Sharp, 1998: 151). Besides the "Multi-annual Programmes for SMEs", aiming at simplifying and harmonising procedures within the Union, the later Framework Programmes have included specific programmes for the participation of SMEs in RTD projects. The FP4 (1994-1998) included the programme "Technology Stimulation Measures" and the FP5 (1998-2002) includes the programme "Promotion of innovation and encouragement of SME participation".[46]

At the national level, Portugal's main economic policies and programmes have implications for SMEs. Included in these policy measures and programmes are: "support for increases in competitive capabilities; [...] support for direct investment in distribution and production; increased support for intangibles, in particular workforce skills, management capability, R&D, innovation and the quality of sales and structures; encouragement of co-operative efforts between companies; support for the modernisation of SMEs in retail trade" (OECD, 2000: 169).

3.7 CONCLUSION

This chapter gives an overview of relevant issues which characterise the context in which the CRAFT alliances took place. The existing databases on alliances have some structural

[46] See, for instance, the Internet site http://www.cordis.lu/fp5/home.html for more information.

limitations and can only capture the phenomenon partially. The available data seem, nevertheless, to indicate that the number of R&D alliances formed each year is still increasing, however at a much slower pace than that witnessed in the 1980s and early 1990s. The information about the number of SMEs involved in R&D alliances is scarce, especially alliances involving non-high-tech firms. It appears, however, that the participation of SMEs in EU-sponsored collaborative programmes is growing, which is a consequence of the government stimulation of alliances, but it may also be the result of an increasing awareness of the importance of technology for their competitiveness.

The Portuguese industrial structure has a number of characteristics such as: a large number of very small firms, mainly concentrated in traditional sectors; a small amount of investment in research by the business sector; and technological dependency from abroad which likely affects the competitiveness of Portuguese firms. While collaborative programmes like CRAFT might be important opportunities to strengthen their competencies and improve their performance, the limitations identified above might as well be important drawbacks to do so.

This chapter also identifies several factors which justify public policies towards cooperation and government intervention in the innovation process, including the stimulation of industrial competitiveness at national and international level, and correction of market failures in R&D. However, the perceived benefits of such policies are not yet supported by empirical research. Finally, we have seen that the Framework Programme is the basic EU RTD policy instrument to strengthen the competitiveness of the European industry. Additionally, the cohesion countries, such as Portugal, benefit from Structural Funds to increase their technological capability. The growing attention paid to SMEs is the consequence of an increasing awareness of their importance to the economy and the innovation process.

Chapters 2 and 3 have thus developed the theoretical and empirical backgrounds in a complementary way. Chapter 4 outlines the research approach which is used in this study.

4 RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The previous chapters reviewed the relevant literature aiming at deriving the theoretical framework for the research undertaken in this thesis and characterising the practical context in which the R&D alliances took place. This chapter outlines the research approach which is used in this thesis.

The literature reviewed in Chapter 2 made a substantial contribution to the understanding of the alliance-performance link. Authors have used a range of different approaches and indicators to assess alliance performance and the impact on firm performance in a number of contexts. This thesis examines the impact of R&D alliances on firm performance and attends to some of the limitations found in the literature. Based on a homogeneous sample of SMEs who participated in the EU-sponsored CRAFT programme, the thesis addresses the causality between R&D alliances and firm performance, examines the influence of initial conditions on the alliance performance and firm performance, looks at the ability of SMEs to exploit the alliance outcomes, and attempts to understand organisational learning from alliances.

The study is based on qualitative data, collected by means of face-to-face interviews with SME executives and using a structured questionnaire as a guide. The method of data collection is a compromise between the interview and questionnaire methods, aiming at getting deeply into the projects and simultaneously collecting data for comparative purposes and aggregate analyses. The study relies upon perceptual measures; the questionnaire was designed chiefly to capture the firm's own assessment of the alliance performance and the impact on firm performance.

The chapter is structured as follows. First, it describes the elements of the research design, namely the specific research questions and related assumptions to be tackled, the unit of analysis and the sampling. Then it proceeds with the description of the instruments for data collection used during the fieldwork and the procedures to analyse the data. The next section discusses the adequacy of the research method employed, acknowledges the methodological limitations and limitations of the collected data and addresses the question of generalisation of the findings. The chapter ends with a summary of the methodological approach used in this thesis.

4.2 ELEMENTS OF THE RESEARCH DESIGN

4.2.1 Research question and its implications

For a better understanding of the impact of R&D alliances on firm performance, the analysis should take into consideration the alliance performance, the initial conditions and the implementation process, and the capacity of firms to materialise the alliance outcomes into performance. Previous research has not considered such a combined approach and instead tended to focus on just one of the issues. Several studies attempted to correlate the use of alliances with firm performance, but failed to demonstrate the pattern of causality. The fourth group of studies that examined the impact on firm performance (see Table 2.7, Chapter 2) implicitly considered the issue of causality but did not address it purposefully. This thesis intends to address these issues and answer the following main research question and related implications.

Do (successful) technology alliances cause better firm performance?

The question addresses the issue of causality between technology alliances and firm performance, aiming at understanding the relevant factors linking the two matters. It goes beyond the identification of the number of firms who achieve performance improvements and attempts to discover whether technical success is a sufficient condition to cause any impact on performance. The attainment of technical success, here measured by the degree to which the objectives set out at the beginning (including changes in the course of the relationship) are achieved, is an important objective that the alliance partners should meet

in order to expect economic benefits. The attainment of poor technical results represents a fundamental obstacle for partner firms to derive any impact on their performance, unless unplanned benefits not related to the alliance objectives occur. On the other hand, a positive impact on the performance of the participating firms may be expected if the alliance objectives are fully met or at least substantial parts of them are attained. In other words, when the alliance's technical outcomes are sufficient for any practical use, it is expected that the partner firms will exploit such outcomes. Therefore, the following working hypothesis is to be tested:

Firms whose R&D alliance has achieved technical success are expected to exploit the alliance outcomes and have a positive impact on performance.

The above question has a number of implications attached to it which help to understand the complexity of that seemingly straightforward relationship. Those implications lead to a set of new questions for which this study will attempt to provide some answers.

- To what extent do the initial conditions and the alliance implementation process affect the alliance outcomes? This question looks at the circumstances that may affect the alliance outcomes and, consequently, the expected impact on the performance of firms. It includes factors such as the nature of the alliances and the context they were formed (i.e. R&D alliances in an EU-sponsored research setting), the circumstances in which the projects were shaped and the contribution of partners, the implementation process and the relationship between partners, especially between technology producers and technology users. The literature suggests that these factors matter although there has been an insufficiency of empirical studies attempting to link them with alliance performance and firm performance, and even fewer addressing the case of SMEs taking part in joint R&D projects.

- Does satisfaction with the alliance imply better firm performance? Despite its importance, this question has been largely neglected in the literature and, thus, remains basically unanswered. One may assume that individual satisfaction with the alliance implies better firm performance because from a firm's point of view, the notion of success generally goes beyond the achievement of technical success and includes commercial

success as well (Carvalho, 1996). However, it is important to understand the extent to which the individual satisfaction with the performance of alliances is related to the attainment of the alliance objectives and if it implies necessarily better firm performance.

- To what extent can firms turn technology alliances into performance? What are the factors behind the unsuccessful exploitation of alliance outcomes? Once an alliance reaches technical success, a great deal of the literature implicitly assumes that the process of exploiting the alliance outcomes and getting performance improvements is rather "automatic" or "unproblematic". The achievement of technical success represents a landmark for the successful exploitation of the alliance outcomes but it does not eliminate the risk of failure in doing so. The ability of firms to turn alliance outcomes into performance is crucial but it is equally important to understand the extent to which they depend on third parties or other factors to accomplish that.

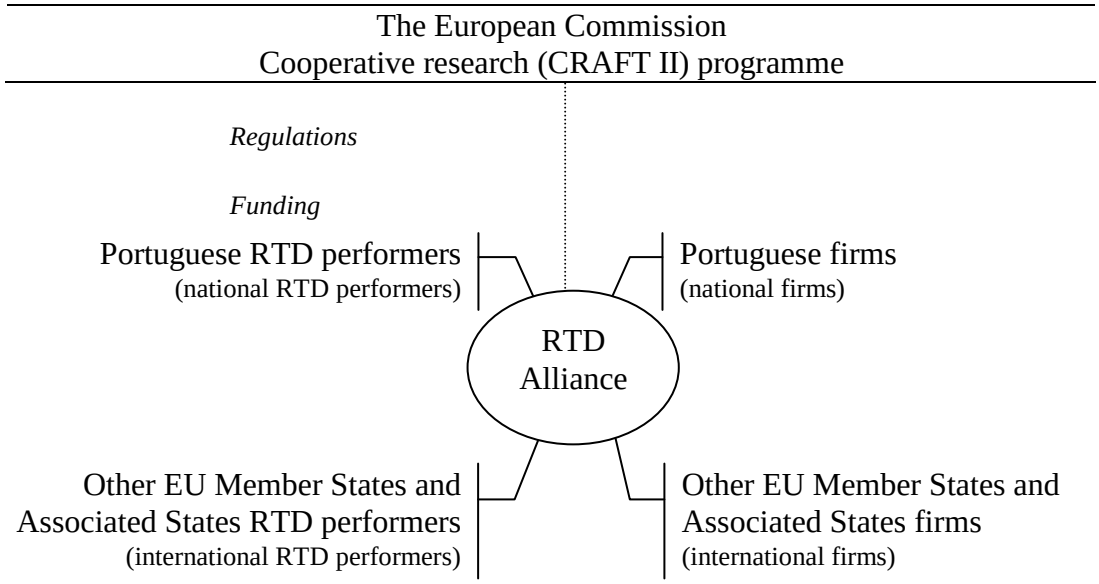
Complementary to these questions, the thesis further examines the link between R&D alliances and firm performance by addressing the issue of organisational learning. Under methodological constraints, it attempts to understand how much firms have learned from alliances and then identify some important barriers to learning.

4.2.2 Unit of analysis

There are many aspects related to the topic under analysis that could have been chosen as the unit of analysis and all of them deserve the attention of researchers. Among them the most relevant are the cooperative programme and the European Union RTD policy, the role of RTD performers, the research alliances and the firms (see Figure 4.1 below). Any alliance involves the pooling of individual resources and/or assets for a common purpose that ultimately aims to generate additional benefits for the participating firms. From the firms' point of view, it can be regarded as an investment that they expect to be rewarding. There are alliance outcomes that can be exploited together (e.g. patenting rights) but most of them, as in this study, are to be exploited by each partner firm individually. The thesis aims to examine the individual attainment of benefits. Therefore, the unit of analysis in this study is primarily the firm and secondly the research alliance. Specifically, the study aims to shed light on the research alliances versus firm performance relationship.

The main purpose of this thesis is assessing neither the role of RTD performers nor the cooperative programme (and the EU policy) under which the alliances took place. Instead, the emphasis is on the firm and its ability to get performance improvements from alliance participation. Both the RTD performers and the cooperative programme are here considered a means to be used by firms in achieving their objectives. However, they cannot be simply ignored, given the central role of the former in performing the research activities on behalf of the firms and the importance of the latter in framing the general settings of the research projects. Though these two factors are not explicitly included in the main aims of the study, their important roles will be assessed because they are expected to be linked to the performance of alliances; hence it is expected that the research will provide some important recommendations for policy-makers.

Figure 4.1 *Major participants in the CRAFT II*[47] *programme*



Source: Author's elaboration.

4.2.3 Sampling

This research project aims at studying the impact of the research alliances under the EU

[47] This is the second version of the former CRAFT (Specific programme of research and technological development in the field of industrial and materials technologies) programme (1990-94).

cooperative programme CRAFT II (1994-98) on the participating firms performance. “Cooperative Research (CRAFT) is a project type designed to enable groups of SMEs with no or inadequate R&D means of their own to engage third parties to carry out research on their behalf, to solve common or similar technical problems” (European Commission, 1994). Thus, this programme was designed to provide financial support to cooperative R&D projects involving firms, primarily small and medium-sized enterprises (SMEs), with limited research resources and facing a common industrial or technological research need. CRAFT II enables these SMEs to join together and to engage a third party – the RTD performer - to carry out the research on their behalf. RTD performers “are organisations who must have adequate R&D means to carry out the required research on behalf of the SME proposers, and can be universities, research organisations, industrial companies, etc. They must normally be from Member States or associated States and must not be affiliated to any of the proposers” (European Commission, 1994).

The objectives of the CRAFT II programme are (European Commission, 1994):

- to promote the development of technologies adapted to the needs of SMEs;
- to promote transnational networking and cooperation amongst SMEs, and between SMEs, research organisations and large companies;
- to support SMEs in their efforts to strengthen their capability to absorb and to contribute to the development of the technologies they require.

The research projects under this programme are limited in time (between 1 and 2 years) and those analysed here typically lasted two years; two of the projects under analysis lasted 18 months only.

The CRAFT II programme was chosen for a number of reasons. First, the programme itself is closed since 1998 and many of the projects were then terminated (at the time of the interviews). Therefore it seemed to be the appropriate moment to study their outcomes and evaluate the consequences for those firms involved. Second, the sample to be analysed belongs to a well-defined population and the projects have been selected by the EU supposedly according to the same criteria, assuring greater homogeneity in the sample. Third, all alliances were formed for R&D purposes. Fourth, SMEs are the unit of analysis and, despite representing a much bigger group of firms as compared to large ones, they are

under-represented in the literature on inter-firm cooperation.

After selecting the CRAFT programme, an interview was conducted with its Portuguese co-ordinator, Dra. Margarida Garrido, at the Institute for International Scientific and Technological Co-operation (ICCTI) in Lisbon. She kindly provided important information about the programme itself, about the projects with Portuguese participants and the elements of contact of the Portuguese firms, which were then confirmed by using two other sources of information (CORDIS database and an on-line phone book).

In defining the population of firms suitable for this study, three additional conditions were taken into consideration. First, cooperative research (CRAFT II) is one of the technology stimulation measures for SMEs that is implemented by several research programmes under the Fourth Framework Programme, but only the projects under the sub-programme "Industrial and materials technologies" (BRITE-EURAM III) are important for this thesis.[48] Second, this study is intended to comprise only the research alliances with Portuguese participants and, third, only the Portuguese partner firms are to be analysed. These criteria assured greater homogeneity of the sample since it comprises only one kind of alliance formed under the same EU programme, these alliances are contemporary with one another, and the firms all have the same nationality.

This means that the total population consists of 105 research projects and a total of 755 partner firms, 153 of them being Portuguese. Of those, 67 firms[49] were contacted for a face-to-face interview and 41 accepted, corresponding to 43 different project-firm groupings and 30 research alliances (see Figure 4.2). Four other interviews were carried out (two of them by phone) but the collected information is insufficient to include them in the sample and it will be used only in support of specific points.

[48] The other sub-programmes are: Standards, measurements and testing (SMT); Biomedicine and health (Biomed II); Biotechnology; Agriculture and fisheries (FAIR); Environment and climate; Marine science and technology (MAST); Non-nuclear energy (JOULE and Thermie); Transport; Information technologies (Esprit) (European Commission, 1998: preface).

[49] These were the firms in condition to be contacted (i.e. their projects were terminated or about to terminate) at the time the fieldwork was carried out (between February and May 2000). Many projects had been approved in April 1998 and started some months later, others were delayed and got extra time to close the research activities. This diminished the number of projects suitable to be studied and the number of Portuguese firms suitable to be contacted.

Figure 4.2 *Firms contacted and number of interviews carried out*

INTERVIEWS 41 firms (61.2 %)	OTHER INTERVIEWS 4 firms (6.0 %)	OTHER SITUATIONS 22 firms (32.8 %)
Remarks: • This corresponds to 43 project-firm groupings. Two firms took part in two projects simultaneously; • And 30 research alliances. In some alliances more than one partner firm has been interviewed; • In one situation the project was cancelled but the firm had had an active involvement in the alliance; • Two firms took part in two projects simultaneously but one refused to talk about the second project it was in and the other did not remember it at first but then said it was abandoned at an early stage.	*Remarks*: • Two firms have been contacted by phone only. These firms quit their alliance and were available for an interview but assured me having nothing more to say; • In one case the interviewee (the current general manager) did not know anything about the project the firm has been involved with because the "right" person to contact had left the firm. Thus, the interview was useless; • In the other case the interviewee could not tell much about the project for two reasons: first, the project has been cancelled and could not be concluded; second, the firm had no real involvement since its participation was planned to a later stage of the project.	*Remarks*: • In three cases the "right" person to contact had left the firm and there was nobody else available for an interview (i.e. someone who knew enough about the project); • One firm went out of business meanwhile; • Eighteen firms were unavailable for an interview due to several reasons.

Note: 67 firms were contacted for an interview, corresponding to 73 project-firm groupings and 44 research alliances.
Source: Author's elaboration.

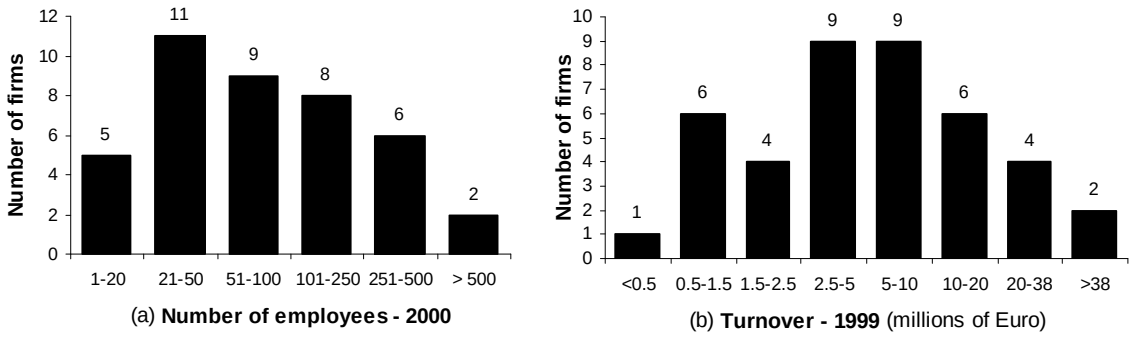
4.2.3.1 Some characteristics of the sampled firms

Figure 4.3 categorises the 41 Portuguese firms according to (a) the number of employees in the year 2000 and (b) the turnover in 1999. Five firms have less than 20 employees, about 60% (25) have less than 100 and two of them have a number of employees higher than 500. About 49% (25) of the firms had less than 5 million Euro turnover in 1999, 15% (6) had more than 20 million turnover and 2 firms surpassed 38 million. In total, three firms did not meet all the criteria to be classified as an SME[50]. The sampled firms are from thirteen industrial sectors as depicted in Figure 4.4.[51] The sectors "Machinery & Equipment" and

[50] "An SME is an enterprise which generally satisfies the following criteria: - has no more than 500 employees; - is no more than 1/3 owned by an organisation larger than an SME (based on turnover and number of employees), unless it is a financial investor such as a bank or venture capitalist;. - has an annual turnover of no more than 38 million ECU (MECU)" (European Commission, 1994). The definition has since changed, and the European Commission now defines SMEs as non-subsidiary firms with fewer than 250 employees, annual turnover not exceeding EUR 40 million and/or a balance-sheet valuation not exceeding EUR 27 million.
[51] Two firms are counted twice because each of them participated in two research alliances.

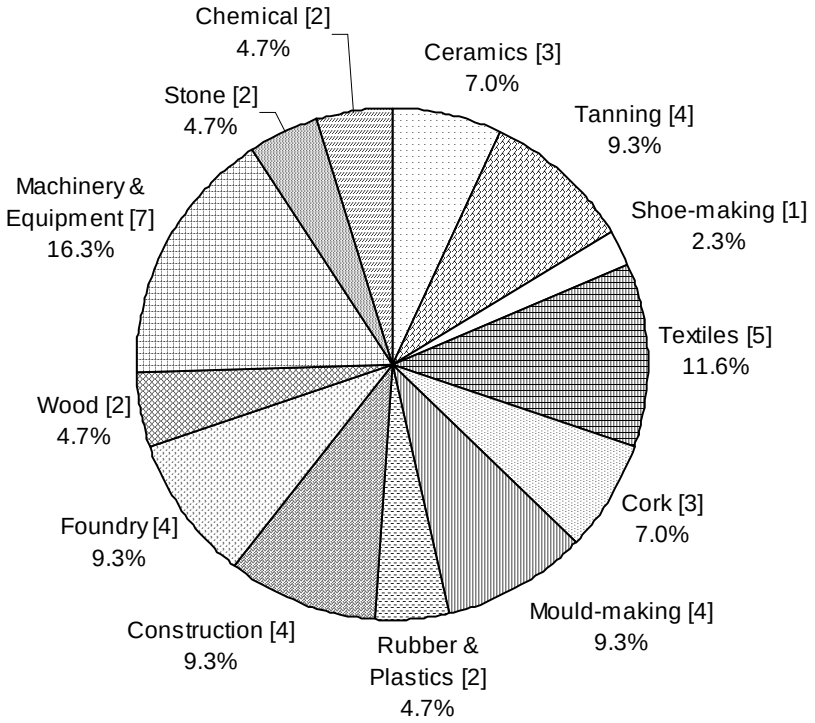
"Textiles" are those with the highest number of participants, 7 and 5 respectively. Because each sector is represented by a small number of firms, establishing sectoral differences is hardly possible. The analysis in the subsequent chapters is based on the whole sample and no reference to a particular sector will be made.

Figure 4.3 *Size of firms according to the number of employees and turnover*



Source: Interviews

Figure 4.4 *Breakdown of the sampled firms by industrial sector*



Notes: The numbers in brackets refer to the number of firms of each industrial sector. The "Machinery & Equipment" sector includes a commercial firm.
Source: Interviews.

4.3 DATA COLLECTION METHOD

The empirical data have been collected through face-to-face interviews, using a structured questionnaire as a guide during the interviewing process.

4.3.1 The questionnaire[52]

The questionnaire consists of a set of structured questions, both open-ended and scored (Likert-type) questions, whose main purpose was to be used for guiding the interviews. It also guaranteed that all the interviewees were asked this fundamental set of questions, which were regarded as being important for this research project. However, the respondents were not bounded by this pre-defined set of questions because other related issues were raised by them in the course of the interviews and additional questions were then asked. In fact, they were stimulated to take an active participation and enrich their contribution.

The questionnaire is structured in order to capture information on alliances in a longitudinal fashion, from inception to impact on firm performance. It comprises four main sections, namely the "initial importance of the projects", "structural factors", "determinants of performance" and "indicators of performance", and has been designed to meet the following objectives. First, to understand the importance of research alliances as a means to improve the performance of partner firms, analyse how the initial circumstances and the implementation process have influenced the alliance outcomes, and look at the ability of firms to exploit them. Second, to take advantage of the interview for an in-depth analysis of the research projects and simultaneously collect structured information for comparative purposes and aggregate analysis. Third, to help establish a stronger interaction with the interviewee by giving him/her an active role in filling in the Likert-type questions and at the same time being asked to explain the underlying reasons for their answers. A few of them tacitly refused to perform such a role by verbally answering the questions.

[52] A copy of the questionnaire (English version) can be found in Appendix 1. Naturally, a Portuguese version of the questionnaire has been prepared for the interviews.

4.3.2 The interviews

Table 4.1 below describes the steps taken to carry out the face-to-face interviews. All the interviews took place at the firms' premises with top management staff or technical directors (in most cases the interviewee was the entrepreneur). There were two interviewees in seven interviews and just one interviewee in all the others. The longest interview took more than three hours while the shortest one took just 45 minutes, with the average duration of the interviews being around one hour and fifty minutes. It was decided from the outset not to tape-record the interviews in order to create an informal atmosphere and avoid possible verbal inhibition of the respondents; instead, notes were taken and the answers written up immediately after the interview had taken place, using as far as possible the interviewee's own expressions. Subsequently, the answers were sent back to the contact person for validation and further comments.

At the beginning of each interview, the interviewee was given a full copy of the questionnaire. This proved to be a very important strategy because (s)he had the opportunity to follow each question being asked and re-read it when necessary. It was especially important if the terms used were not familiar to the interviewee or the question was too long and could not be fully assimilated at once. Having a copy of the questionnaire was essential to the planned interaction and active participation of the interviewee in filling in the scored questions. Furthermore, it greatly facilitated the researcher's control of the interview, namely in keeping it focused on its intended course after any respondent's diversion into particular issues, and especially after asking additional questions to clarify a particular point or justify a given answer.

The data collection process successfully combined the interview and questionnaire methods and greatly benefited from the advantages of both. The use of a mixture of open-ended and closed questions has been an appropriate approach for the purpose of getting deeply into the projects without losing the possibility of gathering data for comparative purposes. The interaction with the respondents, who after each scoring were requested to justify their answer, has been extremely successful to understand the reasons behind the answers given by them, namely those concerning the Likert-type questions. This procedure has broadened the understanding about the alliances and the firms' perspective on them,

and now permits a more accurate and extended interpretation of the results which otherwise would not be possible. The qualitative information collected by this process is extremely important to substantiate the interpretation of the scored questions and statistical findings. Indeed, this systematic data gathering process proved to be very useful to understand many results and some possible paradoxes that otherwise could hardly be explained. This compromise between both the interview and questionnaire methods ended up as an important methodological contribution of this thesis.

Table 4.1 *The fieldwork process*

Step	Action	Purpose
1	Checking the CORDIS database[53] and other Internet sites	• validating (or not) the information obtained from other sources; • getting additional information on the projects and firms; • identifying the firms who were suitable to be contacted (namely if the alliance had ended or was about to end);
2	Phone call(s)	• getting the contact person's name; • confirming the firm's address and other details;
3	Letter	• personal letter to the contact person explaining the purpose of the project, asking for an interview at the firm's premises and assuring confidentiality on the source of information;
4	Phone call(s)	• getting an answer to my letter and if affirmative setting up the interview;
5	Interview	• direct interview at the firm's premises, typically with one person but sometimes with two; • a full copy of the questionnaire was given to the interviewee(s) at the beginning of the interview; • the interviewee was invited to collaborate in filling in the Likert-type questions; • notes were taken in the course of the interview;
6	Writing-up	• the answers were written up immediately after each interview while the information was still fresh in memory;
7	Letter	• sending the questionnaire with answers to the contact person for validation. The interviewee was also invited to add other relevant information that (s)he had not recalled before;
8	Conclusion	• correcting the answers according to the feed-back received (only a small number of firms answered back and most without any suggestions for correction);

Source: Author's elaboration.

[53] http://dbs.cordis.lu/EN_PROJl_search.html

4.3.3 Procedures for data analysis

The interviews were carried out on the basis that both the firms' and the respondents' name would not be disclosed. Therefore, each project has been attributed a number between 1 and 43, in a random manner, that will be used for its clear identification whenever necessary throughout the thesis. The empirical data collected will be analysed by using matrices, categorisation and statistical tools when appropriate[54]. The interpretation of data will be supported by constant references to the qualitative information gathered from the individual cases.

4.4 STRENGTHS AND LIMITATIONS OF THE RESEARCH APPROACH

4.4.1 Adequacy of the research method

The selection of the research method(s) to collect the empirical data is extremely important for the reliability of the study. Every method of data gathering has strengths and weaknesses and the investigator's decision for one method or a mixture of methods normally takes into consideration four basic criteria: accessibility of data, economy of resources, accuracy, and relevance (Richardson, Dohrenwend and Klein, 1965: 21). While it is desirable to choose the method most likely to provide the best information, there is a trade-off in applying each criterion that weighs considerably in the investigator's decision. As Richardson et al. (idem.) point out, "in applying the criterion of accuracy, the investigator will try to choose the method that yields the greater accuracy within limits of economy and accessibility. [...] The degree of precision of a piece of information, although not inevitably related to accuracy, does affect economy and accessibility. In general, the greater the precision required, the more costly is the acquisition of the information." The present study is not an exception and it is bounded by a number of restrictions.

A longitudinal analysis would probably be a more effective approach than the cross-sectional analysis used here for the sake of accuracy, since the information would be

[54] As Guy et al. (1999: 23) say, "Although, strictly speaking, it is technically incorrect to think in terms of averages when using ordinal scales, their use does offer a simple way of visualising differences across the 'Nature' dimensions. For similar reasons histograms are used to depict these differences."

collected through several means (e.g. interviews, alliance progress reports, internal company data, press coverage) through the several stages of the cooperation process, from the negotiation phase until the impact on firm performance. This method would likely provide richer information, both qualitative and quantitative, and would avoid many of the data limitations described below. However, on the drawback side, at least three aspects are very important. First, it takes a few years' time from the inception phase of alliances to the impact on firm performance; in the present case, the research period alone generally lasted two years and only a small number of firms were able to get economic benefits immediately after that period or in the course of the relationship. Besides that, it is difficult to identify the exact moment that the stream of benefits really stops, being different from firm to firm. Therefore, a longitudinal study would be a time-consuming process, incompatible with the available time for the completion of a PhD thesis. Second, monitoring a sample of more than 40 firms for a long period of time would demand a relatively high amount of financial resources and the cost-effectiveness of that investment is not yet demonstrated. Third, there is the accessibility question. Some of the benefits achieved by firms (e.g. better image) are not easily quantifiable in terms of firm performance given the eminent difficulties in establishing a cause-effect relationship. On the other hand, most firms probably would not be available for an intense scrutiny of private and sensitive information, since "SMEs are often reluctant to share confidential information" (Rosenfeld, 1996: 262). Consequently, the accessibility to the information in great detail would likely be a critical constraint.

The methodology employed to address the matter under analysis has some limitations that need to be recognised from the outset. The cross-sectional analysis can be criticised in terms of its limitations for addressing an issue with implications over a period of time; although the design of the questionnaire, the interaction with the respondents and the systematic approach in collecting the data minimised considerably those limitations and greatly helped to capture what had changed. The study was not designed to address satisfactorily the question of organisational learning from alliances, which would improve the understanding about the effect of R&D alliances on firm performance. It is possible that firms have acquired knowledge and skills that are not immediately reflected in the performance indicators.

Another limitation has to do with the measurement process. This study uses only perceptual measures (i.e. the firm's own assessment) and a Likert-type scale to assess the impact on firm performance, meaning that the measures are qualitative and rather subjective. Unlike the Beta (1993) study, which attempted to quantify (in currency units) all the identified effects of alliances with impact on the performance of participating firms, the quantification in currency units has never been perceived as essential here and the chosen methodology would not be appropriate for that purpose. The perceptual assessment is sufficient for the purpose of understanding the impact on performance and it also permits the assessment of non-financial indicators of performance.

Concerning the instrument chosen for data collection, there was the possibility of conducting a postal questionnaire instead of interviews. The former generally reaches a larger audience, even the whole population under analysis, and is perhaps more appropriate for statistical significance, but it suffers from a relatively low response rate and normally is unable to capture adequately any substantive information to support the answers given by respondents. If poorly constructed or tested, ex post it can be very difficult or even impossible to validate the answers. In the present case, there was an additional and significant problem concerning its workability: the population to be analysed includes firms from all the EU member states, which involves many different languages. This means the logistic problems of administrating the questionnaire would be very significant.

4.4.2 Limitations of the data

The present study is aware that the data collected through the face-to-face interviews have some limitations which are intrinsic to the data collection process and are not easily avoidable, even following scientifically rigorous procedures when collecting the information. Five possible limitations have been identified and are explained below. They tend to be relevant only in specific parts of the questionnaire.

First, limited perception. Some firms performed a minor role in the whole process of cooperation, and the involvement among partner firms and RTD performers was minimal as well. In such cases, the answers to specific questions, namely those concerning the involvement and attitude of partners, might have been based on insufficient or inadequate

information. This was noticeable, for instance, when the executives were asked to rate the negative factors of cooperation (question B7), i.e. those negative factors related to the partners' competence or commitment to the project. Two or three executives admitted not having sufficient information to answer those questions properly. This problem has a slight influence on the results concerning the implementation of projects.

Second, inconsistency of the answers. This happens when the answers to later questions do not express exactly the same perspective of the previous ones, if related. It is not always possible to detect the presence of inconsistency between the answers during the interview and it may cause problems at the time of interpreting the results. For example, there appears to exist some inconsistency between the answers of twelve executives who affirmed that the overall impact on the firm performance is irrelevant (cf. variable D1.18) and fifteen others who disagreed with the statement concerning the possibility of a positive impact on firm performance (cf. variable C1.4). The answers of those executives who affirmed having had direct and indirect benefits but do not expect any effect on firm performance appear to be also inconsistent. This inconsistency is minimised because the study is able to provide an explanation.

Third, poor recall problems. This may have happened in questions such as D1 which aims at comparing information on the same subject from two different periods. The answers may have been distorted because the respondent was unconsciously influenced by the actual circumstances, (s)he did not quite recall what the initial expectations were, did not want to look foolish, etc. "The respondent in an interview may have a faulty memory; he may distort unconsciously for a number of reasons; or he may deliberately mislead the interviewer" (Richardson et al., 1965: 26). To a few respondents, recalling initial facts or situations accurately proved to be a difficult exercise, and sometimes the answers from different partners of the same alliance do not entirely match (e.g. whether or not a formal contract was signed), which can be due to asymmetric information.

Fourth, truncation problems. This may have happened in questions where a full answer could not have been given at the moment of the interview because further outcomes would continue to arise in the future. This problem affected primarily the understanding of the future consequences for firms which could not have been fully predicted at the time of the

interviews. The type and amount of benefits (question C1) and the real impact on the performance indicators (question D1) are examples of questions that require a certain period of time to be fully assessed or at least assessed more accurately. In these situations the collected information is the best assessment possible given the circumstances.

Fifth, field notes limitations. The process chosen to store the information generated during the interviews has (human) limitations. According to Miles and Huberman (1994: 51), "field notes taken during an interview usually contain half or less of the actual content. [...] But a write-up[55] usually will add back some of the missing content because the raw field notes, when reviewed, stimulate the field-workers to remember things said at that time that are not in the notes." In addition to the write-up and in order to minimise this problem, the answers were sent back to the interviewees for validation and further comments. The field notes limitations were minimised also by the fact that the questionnaire was structured and had relatively few open-ended questions.

4.4.3 Generalisation limits

Much like any other research study, it is important to understand whether the validity of the thesis's findings are context-bounded or can be generalised. The specific characteristics of the alliances under analysis suggest some caution in interpreting the findings and the following factors should be taken into consideration when doing so. First, these alliances are "government-sponsored" R&D alliances, meaning that their formation was "encouraged" by the European Union. To what extent is this important for the alliance outcomes? Would "market-driven" alliances (those with no government intervention) get different results? For instance, Sciberras (1987: 21) suggests that firms will be prepared to engage in research projects on which they themselves place only a marginal value and on strict commercial criteria they may not consider worthwhile, as long as the projects are funded by public money. If this is true, one might expect different results from "market-driven" R&D alliances because the latter tend to be more central to the firms' core activities.

[55] "A write-up is an intelligible product for anyone, not just for the fieldworker" (Miles and Huberman, 1994: 51).

Second, the previous chapter notes some idiosyncratic characteristics of the Portuguese industrial structure, namely its dependence on external sources of technology. Since all the sampled firms are Portuguese, it poses the question of whether this factor will affect the alliance outcomes and, therefore, the conclusions. Third, all firms are industrial firms, mostly SMEs, and belong to a restricted number of traditional industrial sectors. These are firms with scarce internal R&D resources and whose investment in research activities is very limited. The results might change if the characteristics of firms change. Fourth, an R&D alliance is one of the many types of interfirm alliances, thus the conclusions might not be relevant for other types of alliances.

These factors are beyond our control, and in the work described in the chapters to follow we try to avoid any conclusions that would be seriously invalidated by such serious biases. In other words, the generalisations are for the most part limited to the type of sample and the type of industrial structure under observation. At the same time, we do feel that our particular study, for all its particularities, can contribute to overall understanding of R&D alliances. The pros and cons of generalisation are spelled out in the chapters to follow.

4.5 CONCLUSION

Drawing on the theoretical framework developed in Chapter 2, this chapter states the research questions to be tackled here. The chapter describes the research methods which are used in this thesis, identifies their advantages, limitations and constraints, and discusses the generalisability of results. It discusses the relative merits of using a cross-sectional analysis versus a longitudinal analysis and interviews for understanding the impact of research alliances on the performance of participating firms. Our conviction is that the research methods used here maximise the accuracy of the study given the major constraints related to the accessibility of data, time and financial resources that any obvious alternative method would imply. The major methodological limitations have to do with the measurement process and the inadequacy of the research design to address satisfactorily the question of learning from alliances.

The successful combination of the interview and questionnaire methods to collect the data, complemented with the interaction with the respondent, proved to be a robust strategy for

getting deeply into the research projects and simultaneously collecting information for comparative purposes and aggregate analysis. Despite the acknowledged limitations of this study, the data collection method used here permits a more accurate and extended interpretation of the results, thus leading to an important methodological contribution of this thesis.

The research method employed overcomes the problems of the inferential studies that have analysed separately the performance of firms and the number of alliances they were involved with and assume an association between both variables. This study goes beyond the mere association of technology alliances with firm performance and addresses unambiguously the question of causality between the two. Further, it looks back at the implications of the circumstances in which the research alliances were formed and their implementation process for the alliance outcomes and the ability of firms to exploit them. Complementary to this, the thesis addresses the question of organisational learning from alliances.

Despite the above methodological limitations and constraints, we are confident about the adequacy of the method employed here to provide some answers for the matters under analysis.

5 INITIAL CONDITIONS

5.1 INTRODUCTION

This chapter is concerned with the circumstances in which the CRAFT research alliances were formed. By characterising the initial conditions, the chapter aims to capture some essential structural features of the alliances, the importance of the projects to the Portuguese firms, and their motivation to participate in the alliances. It attempts to identify potential strengths and weaknesses, which may help towards a better understanding of the implementation process and alliance outcomes. The underlying supposition is that the alliance outcomes and the impact on firm performance can be partly explained by the initial conditions of alliances and alliance partners. The case studies presented throughout the chapter illustrate different alliance contexts and show that alliance outcomes may be completely different even when starting conditions are similar.

The chapter is structured as follows. Section 1 draws attention to the nature and structure of the research alliances, the contractual relations and the number of alliance partners. Section 2 analyses the prior experience in interfirm cooperation of the Portuguese firms, the way they became partners and their initial contribution to the project's structure. Section 3 looks at the importance of the research projects for the Portuguese firms, examines some important factors which helped the decision in favour of an alliance, and looks at the feasibility of alliances in the context of absence of public financial intervention. Some conclusions close the chapter.

5.2 THE R&D ALLIANCES

5.2.1 Nature and structure

The R&D interfirm alliances under analysis were sponsored by the European Union (EU). Most of the partner firms are small and medium-sized enterprises with little research capabilities, which thus are permitted to engage a third party – the RTD performer – to perform research on their behalf. All the research costs of the research activities carried out by RTD performers are covered by the EU funding. Partner firms are able to set up research projects to meet their specific needs by covering only part of the project costs.

The structure of these EU-sponsored R&D alliances involves two different kinds of partners. On the one hand, there are firms seeking solutions for their specific needs, but generally lacking at least some of the skills or competencies to carry out the whole research project autonomously. Partner firms are normally the end users of the alliance outcomes and their ability to participate actively in the research activities depends on how much the projects fall within their competencies. On the other hand, there are RTD performers (universities, R&D institutions or firms) with adequate skills and research capability to execute the research projects. RTD performers are not meant to be end users of the alliance outcomes, but only to carry out research.

A main advantage of having both types of partners together appears to be their complementary role in the whole process of cooperation. RTD performers provide the knowledge and research capability firms do not have. In most cases, firms could hardly achieve the project objectives without the contribution of the RTD performers. However, this may represent an important drawback as well, depending on how far is the "distance" between the two types of partners; that is, how much interdependence is needed to execute the project and how much can firms participate in the research activities. A large "distance" between technology producers and technology users tends to polarise their contribution to the project, minimise their interdependence and reduce the interaction between them. Consequently, firms are less capable of actively participating, controlling and influencing the research being done. Too large a distance between them is also likely to generate communication problems within the partnership and create barriers to the acquisition of

knowledge and skills from the alliance.

In general, local RTD performers may help in partly bridging the gap, however about one-third of the R&D alliances did not include any Portuguese RTD performer. “Even though the quality of the periodic meetings was good, the technical discussions about the technology under development could not be followed by our staff given their lack of competence in the area, but then we could count on [the local RTD performer] to support us”, said a production manager of a textile firm. Two executives of a tanning SME emphasised that without the assistance of the local RTD performer the firm was not able to implement the new technology successfully.

Box 5.1 *Case study A*

A foundry SME (with 45 employees) was invited to enter an R&D alliance to develop a new, better heat-resistant coating to substitute for the traditional alcohol-based formulations. The project was seen as a natural technological evolution with advantages over the traditional process, and not participating would imply waiting for the market, the usual way of innovating in this industry. The firm did not know any of the alliance partners and there was no Portuguese RTD performer in the alliance. The project was structured when it reached the firm, there were no pre-project meetings and no initial contribution to the project on the part of the firm, because it had no technological competence or human resources available to do so. The firm entered its first joint research project under major constraints to assess the competencies of partners, their objectives and the technology to be developed. The CEO said, “[The firm] recognises that a Portuguese RTD performer with adequate technological capability was essential to assist the firm over the execution of the project and particularly at the implementation stage.” The technology producer has shown no interest in sharing the new knowledge. “The alliance partners were merely informed that the new process works, but they [the technology producers] did not make themselves available to demonstrate it,” he added. The firm was given a technical dossier of the project but it still does not know whether the alliance has attained its technical objectives because it has no technical competence to read the dossier and implement the project.

Source: Interview.

These two examples and the Case study A in Box 5.1 illustrate how important a local RTD performer can be to small firms lacking adequate competencies to participate in joint research projects, over both the execution and implementation stages. None of the firms in the sample regarded local RTD performers as unimportant partners; on the contrary, firms felt more comfortable with their presence. The presence of a local RTD performer in the alliance structure is not, however, absolutely necessary even when the firm lacks specific competencies on the technology under development, as the Case study C in Box 5.3 below

demonstrates. In this example, trust, commitment of partners and the financial capability of the firm were the main critical factors of success.

5.2.2 Legal binding

The CRAFT alliances are contract-based. Contracts are an important aspect of partnerships and they "must be precise enough to allow commitment, but not so precise as to leave no room for learning and interpretation" (Doz, 1988: 326). The contracts the firms signed with the EU were quite general and the alliance partners were advised by it to establish more detailed formal contracts among themselves. In approximately 45% of the research alliances, partners signed a contract concerning the research activities in addition to the contract signed with the EU, and in about 45% of the alliances partners signed an agreement on the intellectual property rights and/or commercial rights. In about 30% of the alliances only one of the agreements has been signed.[56] Some contracts, particularly those on the intellectual property rights and commercial rights, were drafted and signed in the course of the relationship when firms realised the potential value they had created together. In some other cases, however, the contracts never became effective because some key partners refused to sign them. Some contracts were informally established and remained informal until the end of the relationships.

Many firms recognised the importance of formal contracts as an adequate way of establishing the rights and obligations of partners, protecting the technological achievements against potential users, and defending the partners' interests in the commercial exploitation of the alliance outcomes (see Case study B in Box 5.2). However, many of the signed research contracts were not exhaustive about things such as the partners' rights, obligations and responsibilities, timetable and tasks, of both firms and RTD performers. Typically, agreements on the intellectual property and commercial rights consisted of a few clauses of the research agreement or the agreement signed with the EU. Luukkonen (1998: 604) argues that "In EU consortia, the problem of intellectual property rights is especially pertinent, because the statutes require that all participants share the results obtained." Thus, this leads firms to adopt a defensive strategy to prevent leakage of

[56] Vertica's (1998) study found that only about 25% of firms participating in the CRAFT programme or Exploratory Awards have signed a consortium agreement before signing a contract with the EU.

sensitive information.

Box 5.2 *Case study B*

A CRAFT R&D alliance was set up to develop a new automatic system for the detection of defects in the textile printing process. This new system would have benefits for textile firms at the productivity and production costs levels, by replacing the traditional method – human vision, which detects only between 10% and 30% of the printing defects at a machine speed of 30m/min. (and much less at higher speeds) – for a complex automatic process which would be 100% effective. A textile firm with about one thousand workers, rather big by Portuguese standards, entered the alliance with no prior knowledge about the alliance partners, except the local RTD performer. There were no pre-project meetings with all the partners, the local RTD performer being responsible for the "bureaucratic" aspects of setting up the project and finding the local partner firms. Only a standard agreement was signed between the alliance partners and the EU. In the words of its technical director: "There was no pre-alliance agreement on the intellectual property rights and this probably was the major negative factor of this partnership. There was only an informal agreement which was truly insufficient." The consciousness about the importance of a formal agreement arose only after realising the potential economic benefits of the project. The inexistence of a formal contract, detailing the individual responsibilities and participation in the benefits, as was required by the firm but without the other partner firms creating the conditions to be signed, led to an atmosphere of distrust among them and uncertainty about the future behaviour of the partners. As a result of this disagreement, the EU cancelled the project, though prematurely according to the interviewee. Retrospectively, the firm accepts that not paying enough attention to the selection of partners and setting up the project phases was extremely important for the alliance outcome. The firm believes that the lack of experience in cooperation explains most of the negative aspects of cooperation; had it prior experience it would have never entered a joint project under the same conditions as it did.

Source: Interview.

Besides the refusal to sign the contracts by one or some of the partners, many other reasons were given for not signing a formal contract, including: friendship between partners; too much bureaucracy ("it involves lawyers"); the contract signed with the EU was adequate and sufficient; it was not perceived as useful or necessary; maybe it would complicate the relationship between partners; it was just an exploratory project and only in a subsequent stage will a contract be signed. Concerning the contract on the intellectual property rights, the reasons for not signing are rather different: there was a clear distinction between technology producers and technology users, therefore there was no doubt about who was the technology "owner"; the expected technological progress was rather small and hardly could it be the subject of a contract; was not important given the small expected impact on the production process; deemed not necessary given its ineffectiveness to control the diffusion of knowledge; there has been no concern, no discussion or lack of interest in it; the diffusion of the new knowledge was one of the objectives of the project.

Despite the plausibility of the justifications given for not signing a formal contract, two other aspects are of relevance here. On the one hand, there are substantial transaction costs involved in making contracts, especially for inexperienced SMEs and alliances involving several international partners. It requires time and energy to negotiate with potential partners; for small firms, collaboration often means crucial time taken away from key players (Peterson and Sharp, 1998: 151). On the other hand, the way that most firms entered the alliances - by invitation - and the non-essential role of some of them weakened their position to make demands and establish contracts.

Executives were also asked about the importance of contracts in the whole process of cooperation. They have established a relationship between the importance of contracts on one side and the amount and type of problems faced during the implementation of projects and their outcomes on the other. If no major problems occurred during implementation or alliances were not successful, contracts have not been considered especially relevant. But the executives were concerned about what would have happened if the technology under development had proved to be successful and no contract had been signed.

5.2.3 Number of alliance partners

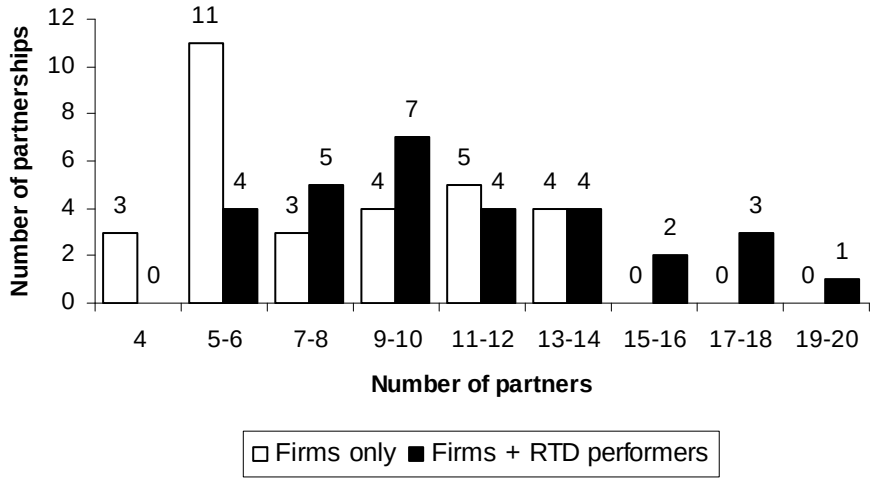
There is no definite guideline about the optimum number of partners an alliance should have, given the unique circumstances of each joint project, but each partner should have a distinct contribution so as to make itself essential and avoid becoming redundant. According to Killing (1988: 61), “the more partners there are in an alliance, the greater is the potential for organizational complexity. [...] An alliance with more than three partners may be quite unmanageable unless each partner has a well-defined role and sphere of influence from the outset, which may include one or more partners agreeing to play a relatively passive role.” The complexity and costs of managing alliances increase with the number of players involved (Dussauge and Garrette, 1995: 512). Therefore, the number of alliance partners is likely to affect the alliance outcomes and cannot be disregarded.

The average number of partners of the 30 R&D alliances under analysis is 8, considering the partner firms only, or 11, if partner firms plus RTD performers are accounted for. Figure 5.1 breakdown the alliances according to the number and type of partners. Almost

50% of all alliances had more than ten partners, four of them exceeded the number of sixteen and one alliance had twenty partners. Adding to this picture the fact that, on average, each alliance had partners from four different European countries, these were projects that were potentially difficult to manage. Two questions are important to ask at this point: What are the reasons behind this apparently high number of partners? Did it in any way influence negatively (or positively) the expected outcomes?

It is a legal requirement of the European Union that partnerships under the CRAFT II programme should have at least four non-affiliated eligible SMEs, from at least two different Member States (or from at least one Member State and an associated State) (European Commission, 1994). The rationale behind such requirement aims at promoting international linkages within the European Union and neighbouring countries, however it is questionable if it really helps the formation of better alliances. Additionally, the EU's dominant thinking seems to consider that larger partnerships means better use of the EU funding, since a higher number of firms will benefit directly from the alliance outcomes. Consequently, there are no reasons for the EU to impose limits to the number of partner firms that freely want to associate in a joint undertaking.

Figure 5.1 *Breakdown of the research alliances by number of partners and according to partner status*



Sources: Interviews and CORDIS database.

The question of whether the number of partners have influenced or not the outcomes of the alliances is rather difficult to answer because of the contradictory information collected,

which is noticeable in the following quotation. “Perhaps there were too many partners in the alliance because the contribution of some of them was not essential to the project; although that did not affect negatively the project, it is easier to have a relationship between a smaller number of partners”, said an executive of a stone sector firm. On the one hand, the average score of the answers given to question B7.7 - the importance of the number of alliance partners as a negative factor - is just 1.36[57], which basically means that the alliance outcomes have not been negatively influenced by the number of partners. On the other hand, looking carefully into the answers, one finds pieces of information that help to understand the former answer and, more significantly, lead to a somewhat different conclusion. An important aspect referred to by 12 interviewees (representing 11 alliances) is that some partners were not absolutely essential to the project, because of their marginal contribution to the project (in performing activities) or no contribution at all. However, such non-positive contributions were not perceived by most respondents as being a negative factor, despite the fact that a larger group of partners tends to increase the transaction costs and the management difficulties of alliances. A second point worth mentioning is that 13 firms (of which 5 are part of the previous group of 12) reported having had a strong interaction with the local RTD performer during the preparation and implementation phases of the project, but a weak or no interaction with the other alliance partners. Therefore, these firms were not particularly well positioned in the partnership to clearly assess the contribution of the other partners or evaluate whether the number of partners affected in any way the alliance outcomes. A third point, referred to by some executives, relates to the logistic problems of organising meetings with a large number of partners and from several different countries. Finally, three out of four interviewees who mentioned that some partners quit the alliance did not consider it a negative factor capable of influencing the alliance outcomes. These issues suggest that the number of partners was relevant indeed, although not perceived as so by many firms.

5.3 THE PORTUGUESE PARTNER FIRMS

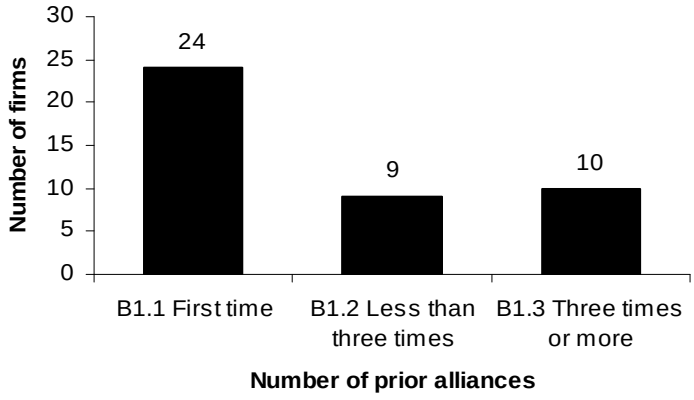
5.3.1 Prior experience in interfirm cooperation

[57] For n = 36 since six firms have considered the number of partners to be too few and one observation is missing.

The level and kind of prior experience of the Portuguese partner firms in interfirm cooperation are rather diversified. In Figure 5.2 below, which classifies the firms according to their experience in cooperation, it is observable that less than half of the firms affirmed they had prior experience in interfirm cooperation, but about 23% had already participated in three or more partnerships. Also very significant is the fact that for more than 55% of all firms this has been their very first experience, although four of them had had joint research projects with universities or research institutions beforehand (see Table 5.1). Of those firms who had prior experience, four had participated in just one project and seven had experience in commercial/business cooperative projects only. No more than 12 out of 43 firms reported they had prior experience in research cooperative projects, sometimes involving universities or research institutions along with firms, however not all the cases included international partners. Only two firms had participated in the preceding cooperative research programme (CRAFT I).

The results demonstrate that in general the Portuguese firms had little experience in interfirm cooperation, particularly in R&D cooperative projects and projects involving partners, firms and RTD performers, from other countries. The level of prior experience reported by the respondents is not related to the size of the firms, therefore it cannot be assumed that smaller firms had less prior experience in interfirm cooperation than the larger ones or vice-versa.

Figure 5.2 *Prior experience in interfirm cooperation*



Note: Two firms are being counted twice because they participated in two projects each.
Source: Interviews (question B1).

Table 5.1 *Prior experience in interfirm cooperation - breakdown by type of projects*

Group (prior alliances)	Fre-quency	Type of projects			Remarks
		Commercial /Business	Research	Both	
B1.1 (= 0)	24				Four firms had had research projects with universities or research institutions. Two firms were involved in two projects simultaneously.
B1.2 (< 3)	9	2	7		Four firms had participated in one joint project only.
B1.3 (≥ 3)	10	5	4	1	One firm had participated in informal client-supplier projects only.

Source: Interviews (question B1).

Harrigan's (1988: 223) results suggest that the dissimilar venturing experience levels between partners tend to have a negative impact on the venture success. And Ciborra (1991: 59) argues that "a firm can learn how to set up and fine-tune alliances per se. The result of such learning is the institutionalization of the organization's rules and routines aimed at managing alliances." Hence, to what extent did "prior experience" affect the alliance outcomes? And, how far did it affect firms' ability to derive benefits from alliances? It is very difficult to answer these important questions objectively, given the complexity in isolating one factor among many others that have influenced alliance outcomes. Table 5.2 below contains the average scores for the variables "Overall assessment of the performance of the alliance" (C1.1), "Lack of experience as a negative factor" (B7.14) and "Importance of the experience gained for firms" (C2.8), according to the level of experience reported by firms.

Although the average level of satisfaction with the alliance of group B1.1 (first-timers) is rather similar to that of the full sample (3.61 and 3.69, respectively), the average importance attributed to the "lack of experience as a negative factor" is considerably higher for group B1.1 than for the full sample (2.39 and 2.02, respectively). The difference is even greater between groups B1.1 and B1.3 concerning the variable B7.14 (lack of experience as a negative factor), despite the level of satisfaction with the alliance being higher for group B1.1. The average scores for the variable B7.14 of groups B1.2 and B1.3, 1.44 and 1.70 respectively, are considerably lower than that of group B1.1. These figures suggest that prior experience positively influences the ability of firms to capture benefits (or avoid problems) from interfirm relationships. Unexpectedly, the group of firms with less experience (B1.1), on average, ascribe less importance to the experience gained with the

alliance (C2.8) than the other groups do, despite the interest of the former in entering new partnerships being higher than all other groups, including the sample average.

Table 5.2 *Lack of experience as a negative factor versus level of satisfaction with the alliance, according to firms' level of interfirm cooperation experience*

Group	C1.1		B7.14		C2.8		
	Average scores	SE	Average scores	SE	Average scores	SE	n [%]
B1.1 (n = 24) *	3.61	0.20	2.39	0.25	2.94	0.23	18 [78 %]
B1.2 (n = 9)	3.89	0.33	1.44	0.40	3.67	0.32	9 [100 %]
B1.3 (n = 10)	3.50	0.31	1.70	0.38	3.57	0.36	7 [70%]
ALL (n = 43) *	3.69	s = 0.98	2.02	s = 1.20	3.26	s = 0.96	34 [81 %]

Notes: (*) One observation is missing. (s) Sample standard deviation. (SE) Standard error ($= s/\sqrt{n}$).
Source: Author's elaboration based on the answers to questions B1, C1, B7 and C2.

Many executives considered prior experience in cooperation important but the multiplicity of situations found in this particular sample does not allow one to identify a clear pattern of causality. Firms with no experience in interfirm cooperation tended to play a more passive role within the relationship, but not in all cases. Some of these firms were able to establish a link between the alliance outcomes and lack of experience, and two of them came to the conclusion that they would have never entered the alliance had they prior experience in cooperation, given the number of problems faced during its execution which could have been prevented from happening at the beginning (see Case study B in Box 5.2 above). The general director of a foundry firm said that they would be "more confident and less passive" had they experience in cooperation. Experienced firms appear to have a different perception about the implications of alliances, but the following cases of two firms with experience in R&D alliances show that experience alone may not be enough for a successful outcome. In a very successful alliance, which is reported in Box 5.3, the interviewee clearly emphasised the importance of prior experience in successfully dealing with an unexpected increase in total research costs that would have prematurely ended the alliance otherwise. Another firm was successful in an attempt to reduce an oversized project to a smaller one fitting the firm's needs but the project eventually failed. The firm's intervention occurred only when the research activities were already under way, though it could have done it much sooner, but the firm rejects that the alliance outcomes were in any way the consequence of lack of experience in cooperation (see Case study E in Box 5.5 below). Prior experience may not have been an important factor for the alliance outcomes

in all cases, however the lack of experience has surely been significant in many unsuccessful alliances.

Box 5.3 *Case study C*

As a natural product, cork contains microorganisms and chemical properties that are responsible for the so-called "stopper flavour" in bottled wine. A CRAFT project was set up to develop a technological process to eliminate or at least reduce substantially this problem, which is damaging the market, but keep the characteristics of the cork. Besides being disagreeable for wine lovers and the wine industry, this problem is also explored by synthetic stopper producers for competitive purposes. A Portuguese cork stopper producer (with 170 workers) was invited to join the project but the firm made little contribution to structuring the project and setting up the alliance. It did not have the technological expertise required to do so. There were no Portuguese RTD performers in the alliance but there was trust between the firm and the project's prime proposer, as a result of good prior commercial and personnel relationships. One major negative factor could have ended the alliance prematurely: a substantial rise in the research costs when the project was well under way. Based on the potential benefits of the project and the trust in the prime proposer, the firm decided to proceed with the project and assume the extra costs. The financial director affirmed that "if it was not our prior experience in cooperation probably the project would have stopped at that stage". Eventually, the alliance was a great technical and economic success. The European Patent Office granted a patent on the new technological process (rather unusual for Portuguese firms) and the firm has now an important competitive advantage. Three aspects are important to emphasise: the strong commitment of partners to the project, the trust between them (for instance, they signed an agreement on the intellectual property rights only after realising the potential benefits of the project), and the financial capability of the firm to support the extra research costs and particularly to acquire the novel equipment and make the necessary changes in the production layout. This was a major investment for the firm.

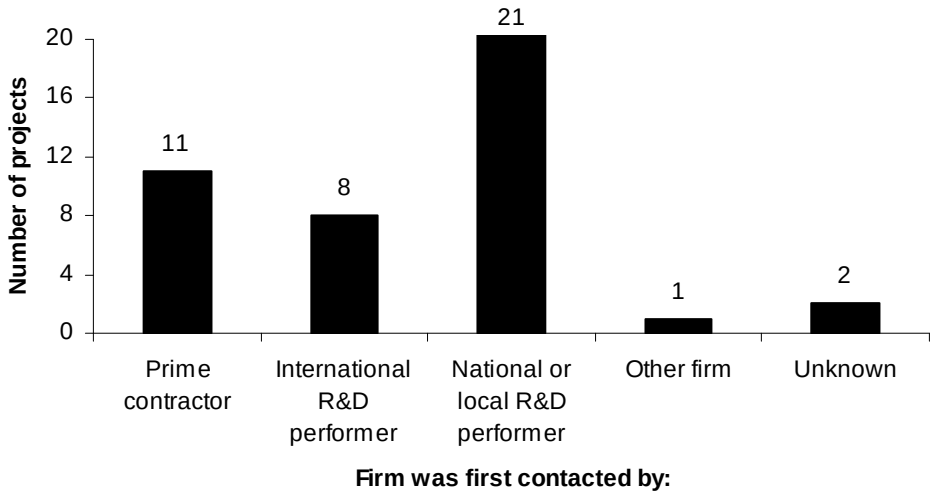
Source: Interview.

5.3.2 Selection and prior knowledge about the partners

Having information about the partners before embarking on any inter-firm relationship is widely regarded as an important factor for its future success. Prior information about partners' culture, technological strengths and objectives, among other things, is extremely important to assess the compatibility and potential advantages and disadvantages of working together. Dodgson (1992b: 237) is emphatic on this point when he states that "partner selection is the most critical decision affecting the success of collaboration." It requires time and energy to negotiate with potential partners and small firms often lack the time and/or resources to identify external sources of knowledge (Rothwell and Dodgson, 1991; Peterson and Sharp, 1998).

RTD performers played a central role in most partnerships on this matter. Besides the R&D activities, they frequently carried out other activities, such as project co-ordination, searching for partners and "persuading" them to participate. Figure 5.3 elucidates their pivotal importance in the partner selection process. It reports that 29 out of 43 partner firms were first contacted by RTD performers, and only 11[58] were contacted by the prime proposer. Apparently, there is nothing wrong with this practice. However, partners should be "chosen" according to their potential to strengthen the partnership, and not just for convenience, to share part of the research costs or merely to take part in, as seems to have happened in many cases. An important sign that substantiates this suspicion is the fact that many firms have been contacted when the project was already structured, thus restricting the room for negotiation and further contributions.

Figure 5.3 *Who did first contact the Portuguese partner firms?*



Source: Interviews.

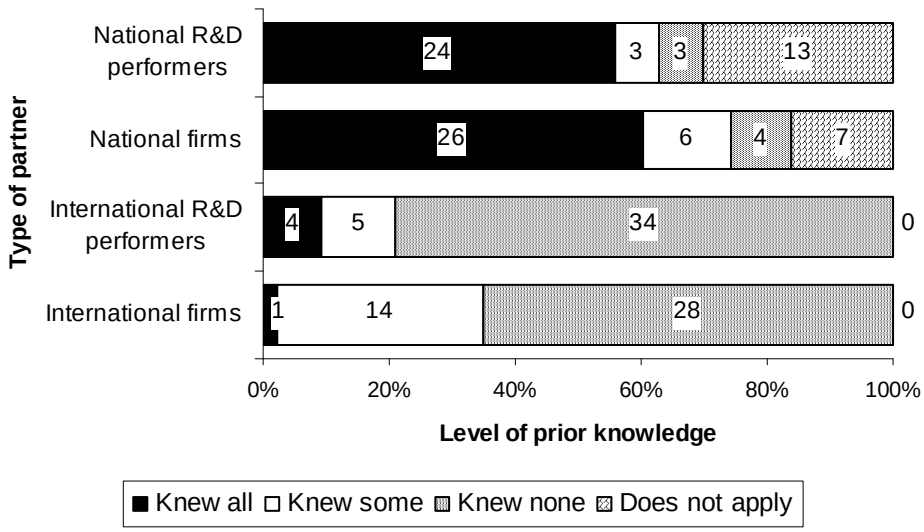
In many cases, it appeared that the question was more about being "invited" to participate than to have the chance to choose the partners. One selection method consisted in sending an emissary directly to pre-selected firms with the mission of making a presentation of the research project and inviting them to enter the alliance. In other cases, that role was carried out by the local RTD performers. In general, the Portuguese partner firms "easily" accepted the conditions being offered by others, without imposing their own conditions on

[58] Two out of the five Portuguese prime proposer firms are included here. The other three were first contacted by a local RTD performer.

participation, namely concerning the type and number of partners involved, but also by making no substantial contribution to the project. Such passivity about the partner selection process is likely to produce negative consequences on the alliance outcomes since this is widely accepted as being a particularly important task.

Most firms seemed to disregard the importance of the partner selection process or, possibly, they just failed to notice its importance given their scarce experience in interfirm cooperation. Another explanation, valid for some cases, relates to the fact that the potential benefits on offer easily surpassed the costs of participating, thus relegating to secondary importance the issue of partner selection. For some firms, however, the partner selection was important. In one case, the executive stressed that the compatibility among partners was guaranteed since the local RTD performer knows the firm well and it would not invite the firm to enter an alliance if the partners did not match the firm's philosophy and culture. Two other firms imposed as a condition to enter the partnership that no other Portuguese and no other Portuguese and Spanish competitor firms, respectively, should participate.

Figure 5.4 *Prior knowledge about the partners: breakdown by type of partner*



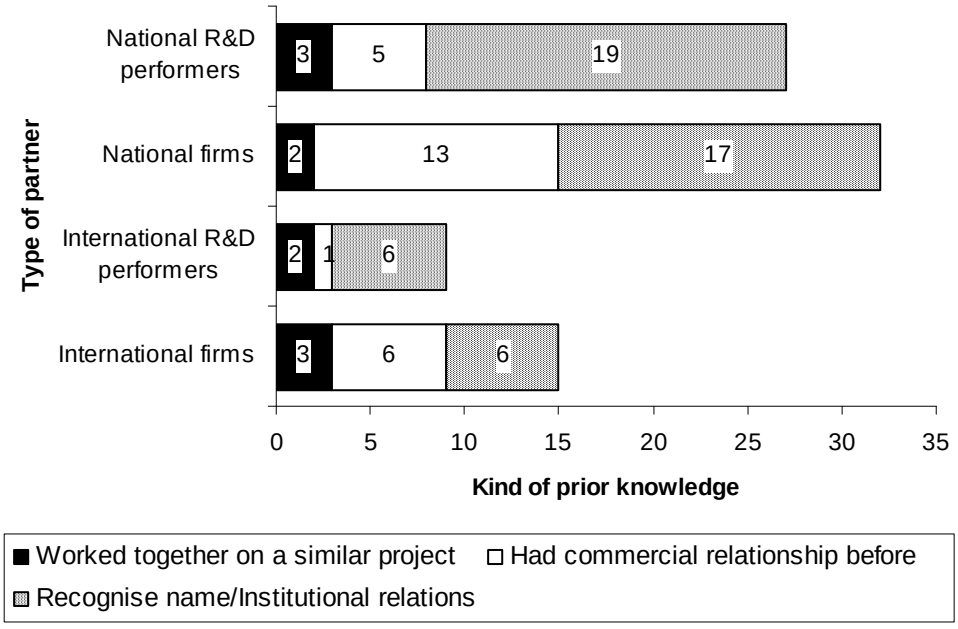
Note: The category "Does not apply" refers to the number of alliances which included one national firm only (7 cases) and the number of alliances which did not include national RTD performers (13 cases). The "Knew all" category is applied even when the alliance includes just a single partner of a given type.
Source: Interviews (question B2).

Figure 5.4 clearly shows a sharp contrast between what firms reported knowing about the

national and international alliance partners. As was indeed quite expected, the international partner firms and international RTD performers were completely unknown to 65% (28) and 79% (34) of the firms interviewed, respectively. Conversely, the national partner firms and national RTD performers were all known to 72% (26) and 80% (24) of them, respectively. In 15 alliances the executives knew at least one international partner firm, but only in 9 alliances was an international RTD performer known.

However, of all firms that reported having had some prior knowledge about the partners, what kind of knowledge were they referring to? Figure 5.5 breaks down the prior knowledge about partners according to the type of knowledge. Only a very small proportion of those firms had worked together in a similar cooperative project (e.g. business or technology alliances), some had had commercial relationships (e.g. client-supplier relationships or the development of technical studies by research institutions), but the majority of them had had relations at an institutional level only (e.g. as a member of an association) or they merely recognised the partner's name. Proportionally, firms that worked together in similar projects with international partners outnumber those that worked together with national ones.

Figure 5.5 *Prior knowledge about the partners: breakdown by kind of knowledge*



Source: Interviews (question B2).

As we have seen, prior knowledge about alliance partners was, in general, rather limited and most Portuguese firms accepted entering the partnerships without having any further knowledge about them, since pre-project meetings with the purpose of getting to know each other were very rare indeed. Very few interviewees said there were preparatory meetings with all partners to discuss things like the project's structure, individual objectives and specific needs, the RTD performers' technological competence to carry out the research activities and their responsibilities, and, very importantly, to assess the partners' compatibility in the future joint undertaking.

To what extent did prior knowledge about the partners influence alliance outcomes? The answer is rather complex since there is no unique pattern in the sample. Indeed, at least three different situations emerge from the answers. Some firms did not establish any particular link between the two, which is understandable if the relationship ran smoothly and has reached the pre-defined objectives, but surprising if not. Other firms stressed that prior mutual knowledge greatly helped the partners in generating trust and understanding among them, which facilitated the implementation of the projects. A third group of firms, which have in common the failure of their projects, emphasised the initial lack of knowledge of alliance partners and their objectives as a major negative factor for the alliance outcomes (see Case study B in Box 5.2). Incompatible objectives came out in the course of the relationship and, in some cases, firms also found that the project had been prepared to meet the needs of a specific partner; that is, they did not perceive at the beginning the partners' hidden agenda. Furthermore, some RTD performers have been accused of not having adequate competencies to carry out the research activities or, even if they did have such competencies, the research activities have been intentionally biased towards the benefit of some partners, or they did not seriously commit themselves to the project.

5.3.3 Initial contribution to the project and bargaining power

The initial contribution of the Portuguese partner firms in structuring the projects was rather modest, which is symptomatic of the absence of earlier discussions among alliance partners. About 74% of these firms entered the alliance without giving any significant contribution to the project's structure (see Figure 5.6 below). In most situations, projects

have been set up by somebody else, frequently an RTD performer, and were completely structured when the Portuguese firms learnt about them. Despite the fact that some firms reported that the projects were well structured or they lacked the (technological) competence to make any changes, in many partnerships their opportunity or possibility to make changes to the project was blocked as well. It was a question of accepting or rejecting it, as an executive put it. In other cases, firms "delegated" to the local RTD performer the responsibility to set up the project and act on their behalf. Eight firms made small contributions, such as providing (requested) technical data or searching for partners, and only three out of 43 firms took major responsibilities in setting up the alliance (see Case study D in Box 5.4). This is too little taking into consideration that the number of Portuguese prime proposers alone is five and it was naturally expected that their contribution would be more significant.

Box 5.4 *Case study D*

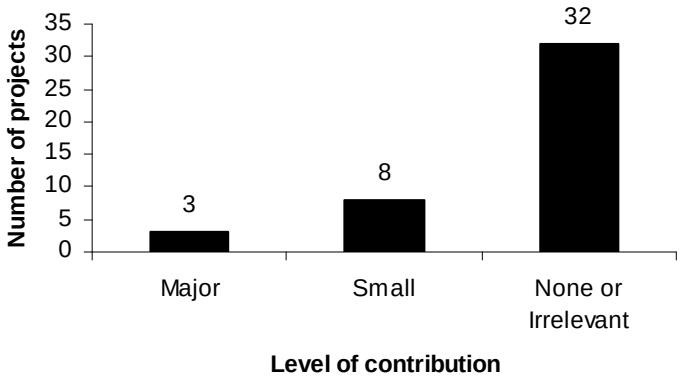
A project was set up to recover the slate waste, which represents about two-thirds of the total material extracted. The objective was to assess the technical and economic feasibility of creating ceramic products of high quality by using slate powder as the raw material. To the prime proposer, a Portuguese slate SME (about 30 employees), the project was not economically or strategically very important but the firm put great effort into setting up and accomplishing the project, even though it was the first it entered a partnership. The firm's director said, "At first the project was only moderately important. There was great expectation about its technical and economic success but there was also great technical and market uncertainty. Furthermore, the new products should have innovative characteristics to be competitive with traditional ceramic products."
With no competencies in material engineering and knowledge about the ceramics industry, an alliance seemed to be the best strategy because it could include partners with complementary competencies, such as slate firms, ceramics firms and research institutions. Eventually, the project was technically successful and the new product is competitive. The commitment of partners to the project and friendly relationship between the firm and an important ceramics firm, which is also very important for the subsequent stages of production and commercialisation, are important factors of success to refer to. An application for a patent has been submitted.

Source: Interview.

In a specific case, the firm accepted participating without making any substantial contribution to the project, despite knowing that it was over-sized and could not be fully concluded within a two-year period. In the first meeting, the firm suggested and its partners accepted a reduction of the project's objectives in order to take advantage of the firm's prior research and adjust it to the firm's existing products. However, the firm did not have

much control over the research activities to be performed and the project eventually failed. It agrees that not acknowledging the importance of the pre-project stage, namely the compatibility between the project's objectives and the firm's needs, was a crucial mistake for the alliance outcome (see Case study E in Box 5.5 below). Two firms not included in the sample quit their alliance precisely because there was no compatibility between their specific needs and the objectives of the projects.

Figure 5.6 *Firms' initial contribution to the projects*



Source: Interviews.

Many projects reached firms via the local RTD performer (in general a specialised technological centre), instead of originating within firms and being tailored to solve their specific problems. Despite the advantages of the latter approach, firms stressed that they lacked adequate R&D structures or financial resources for research, and they are not always aware about existing technological solutions that fit their needs.[59] On the other hand, the local RTD performers have easier access to new knowledge and new technologies and know quite well the firms' problems, therefore they are in a good position to identify and recommend research projects that suit the firms' needs and meet their financial capability. A financial director of a foundry firm summarises the perspective of SMEs: "Given the lack of resources for research, it makes every sense that R&D projects not close to the firm's core business should be set by research institutions."

When firms do not commit enough time and resources to structuring a cooperative project

[59] This is consistent with Delapierre et al.'s (1988: 23) work on cooperation between firms and research institutes, where they refer to the "inability [of small firms] to formulate [their] requests for assistance."

and make themselves essential for its implementation, it is likely they will not have enough control over it and there will be no strong interdependence among partners. In many cases, the bargaining power of partners was unbalanced from the very beginning, penalising those who, for any reason, accepted playing a relatively passive role in the whole cooperative process. Additionally, the lack of knowledge about the partner firms and RTD performers and their objectives created adequate conditions for hidden agendas and opportunistic behaviour.

Box 5.5 *Case study E*

A CRAFT alliance was set up to develop an automated lay planning system for leather shoe upper parts to be interfaced to a manual cutting system. A machinery and equipment sector Portuguese SME (about 20 employees) participated in the alliance. This firm had a large experience in joint R&D projects with firms and R&D institutions, had good knowledge about another Portuguese firm of a different sector, and did not make any substantial contribution to the project's structure. Initially, the prime RTD performer's idea was to develop the entire machine from scratch, something hardly possible to accomplish in two years given the technological complexity of integrating several different technologies that the project required, some of which took the firm some years to perfect. In the first meeting, the alliance partners accepted a proposal from the Portuguese firm to reduce the project to the development of the lay planning algorithm which would be adapted to the firm's existing leather cutting machine. In the words of the firm's computing director: "Retrospectively, an active participation in the pre-alliance stage would have been useful to tailor the project to be adapted to the machine the firm already makes." However, the firm's capacity to influence the course and intensity of the research being carried out was very small. "The RTD performer refused the firm's offer of expertise and specialised staff (in some cases better than the RTD performer's) and that impoverished the relationship, repeated research already done and thus limited the alliance outcomes", he added. Eventually, the alliance was a failure. The main negative factors were the weak interaction amongst the partners, their refusal to share knowledge, and different expectations about the alliance. "Some partners wanted to create something innovative and useful, others were only (possibly) interested in the acquisition of the new technology, and yet others regarded the project as a source of funding for their research activities but without the required commitment to attain the project's objectives." Ironically, the firm had adequate competencies and could have developed the algorithm autonomously but it would have to allocate 2 or 3 people on a full-time basis to the project for a minimum period of two years, a substantial effort for a very small firm. Now, the firm will do that!

Source: Interview.

5.4 IMPORTANCE OF THE ALLIANCES

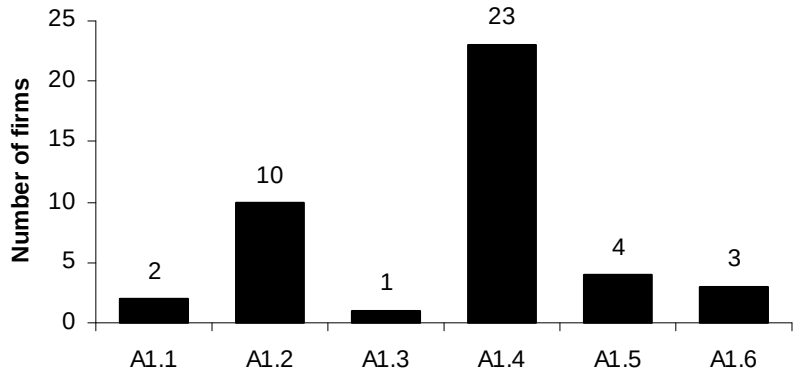
5.4.1 Strategic importance and main goals of projects

The perception of how important projects were to the firms is likely to be a helpful

indicator for a better understanding of the role and commitment of partners in the relationship. It is also relevant for a better assessment of the relationship between alliance outcomes and firm performance, since a low impact on firm performance may be simply the consequence of little initial interest in the project.

Figure 5.7 identifies the main strategic importance ascribed to projects by the Portuguese firms at the beginning of the relationship. More than half of the projects were primarily aimed at strengthening the firm's existing core products by improving or adding new features and, fundamentally, by introducing innovations to the production process in order to increase productivity, diminish the production costs or improve the quality of products. About 25% (A1.2 and A1.3) of all projects aimed at launching a new line of business, consisting of one or a range of new products. Some firms (A1.1 and A1.6), however, regarded the alliance chiefly as a means to attain individual objectives, including getting experience in interfirm cooperation, establishing international contacts, establishing linkages with universities, and keeping an eye on the research being done which might be of interest to the firm. Five executives have chosen one of the options listed despite admitting not having real interest in the alliance objectives and, if they had not been invited, their firms would not have entered the partnerships.

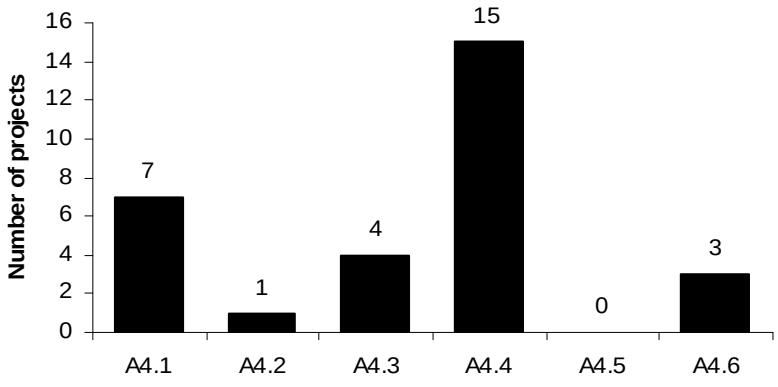
Figure 5.7 *Strategic importance of projects*



Key: The project:
A1.1 Was mainly seen as a way of getting experience in interfirm cooperation;
A1.2 Aimed at launching a (major) new line of business;
A1.3 Aimed at launching a subsidiary line of business (e.g. reusing a by-product);
A1.4 Was to strengthen the firm's existing core products/services;
A1.5 Aimed at preventing/diminishing environmental damage;
A1.6 Other.
Source: Interviews (question A1).

Figure 5.8 categorises the 30 research projects according to their main goals. Half the projects aimed at improving an existing production technology and about 25% aimed at developing a new product. Normally, the latter projects also required the development of a new production technology or at least the improvement of the existing one. Three projects aimed at developing a new process for dealing with the waste resulting from the production process.

Figure 5.8 *The main goal of projects*



Key:
A4.1 To develop a new marketable product/service;
A4.2 To improve the features of an existing product/service;
A4.3 To develop a new production technology;
A4.4 To improve an existing production technology;
A4.5 To adapt an existing production technology from other sector(s);
A4.6 Other.
Source: Interviews (question A4) and project's synopsis.

5.4.2 Importance versus urgency of projects

This section attempts to understand if the urgency of a project is related to its importance for the firm or if the two variables are independent from each other. Table 5.3 compares the importance of the projects for the firms with its urgency. It demonstrates that only 4 projects were of marginal importance but 19 (45.2%) were not urgent at all; 19 projects were very important but only 12 (28.6%) of them were in fact urgent; 19 projects were moderately important but 12 of them were not urgent at all; and just 17 out of 42 projects were urgent indeed. Only twelve executives classified the project as being simultaneously urgent and very important. No project has been considered fundamental for the firm's survival with, perhaps, the exception of one case (see Case study F in Box 5.6). The results

indicate that the firms were able to distinguish the importance of projects from their urgency.[60] Projects were not regarded as being more urgent just because their potential advantages were greater, and vice versa.

Table 5.3 *Comparison between the importance of the projects and their urgency*

Urgency of the project	Importance of the project			Total
	Very important	Moderately important	Marginal importance	
Urgent	12 (28.6%)	4 (9.5%)	1 (2.4%)	17 (40.5%)
Not very urgent	3 (7.1%)	3 (7.1%)	0 (0.0%)	6 (14.3%)
Not urgent at all	4 (9.5%)	12 (28.6%)	3 (7.1%)	19 (45.2%)
Total	19 (45.2%)	19 (45.2%)	4 (9.5%)	42

Notes: One observation is missing. Percentage figures refer to the total number of observations (42).
Source: Interviews (questions A2 and A3).

Box 5.6 *Case study F*

A cork sector SME entered a CRAFT alliance to develop new building materials by using a mixture of organic materials, particularly cork, and concrete. The firm was invited to enter the alliance by the prime proposer, who structured the project and with whom the firm had prior commercial relationships. The firm considered the project strategically very important, perhaps fundamental for the firm's survival, because at the time the cork sector was in crisis and the firm was considering a diversification strategy. Two factors were menacing its economic stability. On the one hand, synthetic stoppers were becoming important substitutes for its main product – cork stoppers. On the other hand, the cork was too unvalued because the cork waste in the cork stopper production process is about 50% of the total cork used and only a part of the total cork produced is suitable for stoppers, representing a strong disincentive for the cork tree producers to keep looking after the trees and thus a serious problem for the cork industry in the medium term. The new range of products was of great economic potential and, by using all the cork produced, would certainly raise the cork's economic value.
The project was implemented according to plan and it was technically very successful. However, the firm decided not to exploit economically the alliance outcomes due to a major change in raw material prices over the project execution, which made the new product economically unfeasible even before it had reached the market. On the one hand the firm was not completely satisfied with the alliance because the project has not been implemented. On the other hand, it was very satisfied since the diversification strategy had been "imposed" by the market conditions and was not something genuinely wanted by the firm. The new economic circumstances allowed the firm to keep itself in its area of business with no need to acquire competencies in a completely different area, and to develop and market products of a very

[60] A χ^2 test has been run to test whether or not there is an association between the level of importance and the urgency of projects (i.e. test if the answers were or were not in proportion). The χ^2 statistic obtained (9.643) is just greater than the $\chi^2_{0.05;4}$ critical value (9.49) but well below $\chi^2_{0.01;4}$ critical value (13.3), meaning that the null hypothesis of no correlation would be accepted for the 1% level of significance and rejected for the 5% level of significance. Thus, there is some evidence to reject the null hypothesis at the 5% level of significance, however the difference between the χ^2 statistic and χ^2 critical value is so tiny that the weak association between the variables it represents is likely to be related to the fact that some expected values are smaller than five, one of them being smaller than one.

different kind. Also important to note is the fact that they have signed a contract on the intellectual property rights at the end of the relationship, after realising the economic potential of the alliance outcomes, and they are applying for a patent.

Source: Interview.

Table 5.4 *Reasons supporting the importance versus urgency of the projects*

	Very important	Moderately important and Marginal importance
Urgent	**1** – 12 firms – • Firm was seeking a technological solution of the kind to add value to its products; • For environmental reasons; • The project fitted the firm's policy on innovation and product quality; great market potential; • The traditional process being used was not satisfactory and the firm was receptive to novel solutions; • Expected a great impact on the firm's production process or product quality; • The project had great economic and/or competitive potential; • Firm was seeking a new product to overcome the crisis in the sector;	**2** – 5 firms – • The firm was seeking a new solution but was not convinced it would work; • The project fitted the firm's strategy on innovation and search for new products/technologies but this was just an exploratory stage; • The firm feels the need for a new production technology but the expectation about its workability was low; • The economic and competitive benefits would be great if successful but the best expectation was that the project would confirm the firm's prior research results; • The new system was technically feasible but its economic success demands novel equipment and depends on the users' technological upgrading;
Not very urgent and Not urgent at all	**3** – 7 firms – • The new automated and flexible process only applies to a small percentage of the total production and the firm already had a solution; • It is a longer-term solution and more environmentally friendly but with little economic impact and the firm already had a solution; • The firm was not seeking the project but working with an R&D institution and its economic potential made the project important; • Was a needed innovation but the firm did not know about the technology; • The firm needs to comply with environmental demands but the new process has no economic advantage over the existing one; • Was an important technological improvement if successful but the existing technology was near to its potential;	**4** – 18 firms – • Important for environmental reasons but there was no interest in the project; • Important to add value to by-products but the firm does not depend on it; • Important for the firm's image but the potential market for the new product was too small; • Important to learn about a new technology but the expectation about its success was very low; • The firm's small size made the project less important and the firm already had a solution; • The firm was not interested in exploiting the results but it was a duty to collaborate; • The innovation is only important to a small part of the total production and the firm had already a solution; • Some advantages but the expectation was very low - not interested in the project if not invited; • Not interested in the results of the project; • No immediate interest in the project; • The project was less important than the opportunity to work with RTD performers; • Low expected impact but it is important to take part in projects of this kind; • Was a political decision not supported by economic or technological benefits; • Fits the firm's innovation policy but the expected economic impact was very low;

Source: Interviews (questions A2 and A3).

Table 5.4 contains the main reasons given by the interviewed executives in support for their answers concerning the relationship between the importance and the urgency of projects at the beginning of the relationship. Some of them admitted they have changed their opinion in the course of the implementation of the project, after becoming aware of its potential benefits. It comprises four sections, representing the different combinations of importance versus urgency of projects. Some of the variables have been aggregated for the benefit of the analysis. Table 5.5 below provides four examples to illustrate each of these four combinations that represent the strategic importance of projects.

In section 1 in Table 5.4, projects were considered urgent and very important because the firms were already seeking or were receptive to novel solutions, the firm's strategy was based on innovation and product quality, or the projects were expected to render substantial economic and competitive advantages. In section 2, both the firms and projects basically share similar attributes to those in section 1, however the expectation of firms about the success of the projects was quite low, at least in the immediate future. Projects were considered urgent due to their potential advantages but not so important because of the pessimistic expectation about their success. Firms were not optimistic that the projects could meet the technical goals set out at the beginning. In section 3, the projects were important for a number of different reasons but the expected advantages were quite small. Consequently, these projects were not considered urgent and several firms stressed the fact that they had already a technical solution. Section 4 combines low expectation about the success of the projects with low expectation about its advantages, plus lack of interest in the alliance outcomes. Therefore, to this group of firms the projects were neither urgent nor important.

These findings above demonstrate that many projects were hardly worthwhile and probably would not be accomplished outside the framework of an R&D alliance publicly funded. This is likely to affect the commitment of firms to the projects and, consequently, have an influence on the alliance outcomes.

Table 5.5 *Importance versus urgency of the projects – illustrative examples*

	Very important	Moderately important and Marginal importance
Urgent	**1** Case study G An SME of the construction sector (precast concrete) entered a research project to develop a prototype of a new GRC (combination of glass-fibre and cement) product, with great market and economic potential. The interviewee concluded: "In a sector where the R&D investment is very small and innovation essentially a reverse-engineering process, this firm has a market culture of innovation in order to best serve our clients and beat competition."	**2** Case study H One of the most important mould-making SMEs in Portugal entered an alliance to acquire expertise in a novel, potentially disruptive, production process. The firm and the mould-making industry have been using a similar technological process to produce moulds for fifty years. The perception that a new production process based on novel technologies may be about to come up led the firm to enter the alliance to acquire knowledge which might be strategically important. However, the project was regarded as a first approach to assess the potential of the new technology and the expectation about its success was relatively low.
Not very urgent and Not urgent at all	**3** Case study I In a project aimed at developing a water-based dye coating for the foundry industry, an SME participated in it for reasons which have to do with legal requirements to comply with environmental legislation. Foundry firms will have to adopt the water-based dye coating in their production process and they were interested in learning about it, however the new technological process has no economic advantages over the traditional one.	**4** Case study J A project was set up to develop a prototype of a wood product which would be water- and fire-resistant, and simultaneously environment friendly, aiming at reaching a rather small market niche. The quality director of a wood sector SME considered the project neither urgent nor important. In the words of the interviewee, "The decision to enter the alliance was political, because it was not supported by any future economic or technological benefit."

Source: Interviews.

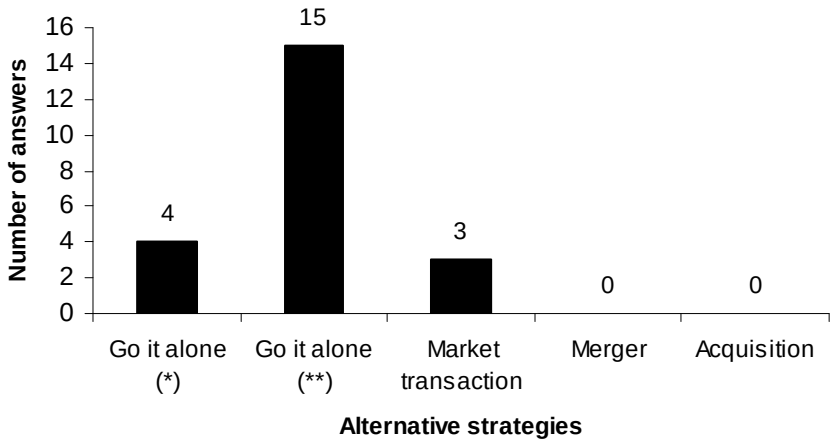
5.4.3 Cooperation instead of alternative strategies

A cooperative project is complex, involves negotiation, sharing of the decision-making and demands a minimal degree of trust and commitment of all alliance partners throughout the relationship. As it is a rather different process from a firm's internal procedures and routines, the question of "why cooperate?" remains important as long as an alternative strategy is available. Firms were asked whether the project they were involved with could have been accomplished by other means than through cooperation. Of those who answered affirmatively, Figure 5.9 shows which alternative strategies could have been used instead of an alliance.

More than half of the firms considered that there was an alternative way of carrying out the project. Four firms had the capability to carry out the project alone, solely using internal

resources, fifteen firms could have done it in cooperation with the research institutions, and three others said the intended objectives could have been achieved through a market transaction. The fact that many projects were relatively small in scope and aimed at changing or having an impact on a (small) part of the firm's overall activities is the major reason why the variables "Merger" and "Acquisition" have not been considered alternative strategies by any firm. Figure 5.10 below shows that the merger or acquisition strategy received the highest average score and lowest standard deviation (question A7.9: the scale of the project would not justify a merger or acquisition policy). Only three firms admitted that merger or acquisition was a possibility, although it had never been considered before the alliance.

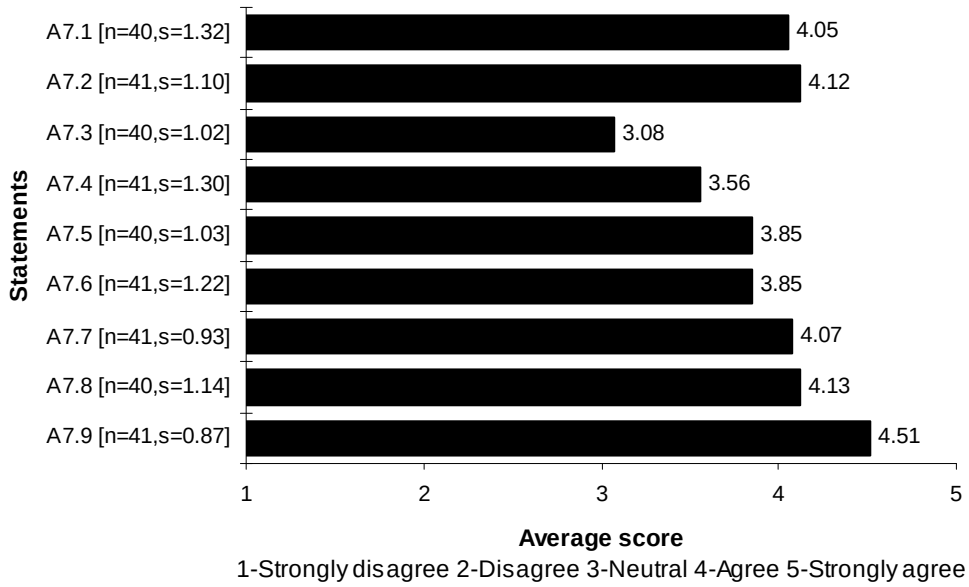
Figure 5.9 *Alternative strategies to cooperation*



Notes: (*) Using internal resources. (**) In cooperation with RTD performers. Two observations are missing.
Source: Interviews (question A6).

To most firms, however, neither the idea of carrying out the project alone (or in cooperation with RTD performers), nor the analysis of possible alternative strategies has ever been under consideration. In fact, as explained elsewhere, the majority of firms were invited to enter the alliance, most of the projects were already structured, and few firms had the possibility or capability to suggest changes. Therefore, an alternative strategy to an alliance has rarely been pondered.

Figure 5.10 *Factors that supported the decision to cooperate*



Key:
A7.1 The costs of the project were too high for the firm to carry it out alone;
A7.2 Lack of in-house expertise to carry out the project alone;
A7.3 We were expecting to get benefits that go beyond the scope of the project;
A7.4 The expected benefits would not justify the costs if carrying out the project alone;
A7.5 The kind of technological solution we were looking for was not available in the marketplace;
A7.6 The risk of failure was too high if carrying out the project alone;
A7.7 We were seeking to learn from our partner firms and RTD performer(s);
A7.8 An independent strategy would have taken too much time;
A7.9 The scale of the project would not justify a merger or acquisition strategy.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Interviews (question A7).

Executives were asked to provide their opinion on a number of statements related to the option to cooperate and the average scores for such statements are shown in Figure 5.10. The reasons given by firms in favour of a cooperative research project include the sharing of costs and risks that the research activities always involve, and the possibility of joining firms with different technological competencies around the same project. The CEO of a construction firm added, "The contribution with and confrontation of different perspectives to solve a common problem is deemed very important by this firm." The complementarity of partners' activities and competencies was referred to by many firms as an extremely important aspect of cooperation, because it increases the likelihood of technical success and enhances the research outcomes. The opportunity to work with R&D institutions on an international research project was also extremely appealing to SMEs.

The high average scores of all variables is indicative of the difficulties that the firms would have faced, especially had they attempted to carry out the project alone or in cooperation with the research institutions. The lack of financial and of research resources seem to be the two major obstacles for these firms to carry out research projects; the CRAFT programme has been created precisely with the objective of helping small and medium-sized firms to develop research projects by partially funding the research activities. Of the four firms that had the capability to carry out the project alone, two said the costs would be too high since it would be necessary to deploy more than one full-time researcher to the project and for a long period of time.

Generally, the research capability of firms was very weak and rarely could a research structure (e.g. R&D department, laboratory, equipment) or people performing research activities on a full-time basis be found. Most firms lacked the resources, namely qualified people, to participate actively in the research projects, particularly when they involved technologies where the firms had no competencies. Variable A7.2 - lack of in-house expertise - has one of the highest average scores because 33 firms (A7.2 = 4 or 5)[61] stated not having in-house expertise to perform at least part of the research activities. But in many cases, firms were able to carry out only a very small part of the research activities which the projects involved. Furthermore, many firms were not interested in acquiring competencies in areas not related to their core activities. Examples of this happened when the project involved the making of a new machine or a new control system; firms were interested in what the machine or the system could do for the business and not about the technologies necessary to built them. That placed many firms in a situation of dependence on the research performers without having the means to monitor or give any contribution to the project's technical progress. This also explains why 30 firms considered the risk of failure to be too high (A7.6 = 4 or 5) and 33 firms said the project would have taken much more time (A7.8 = 4 or 5) in the hypothetical case of being accomplished independently.

Figure 5.10 also shows that variable A7.3 got the lowest average score (3.08), meaning that many firms were not expecting to get benefits that went beyond the scope of the project. Calculating the average score for this variable according to the level of experience in

[61] See Table A2.3 in Appendix 2 for a breakdown of the answers by category.

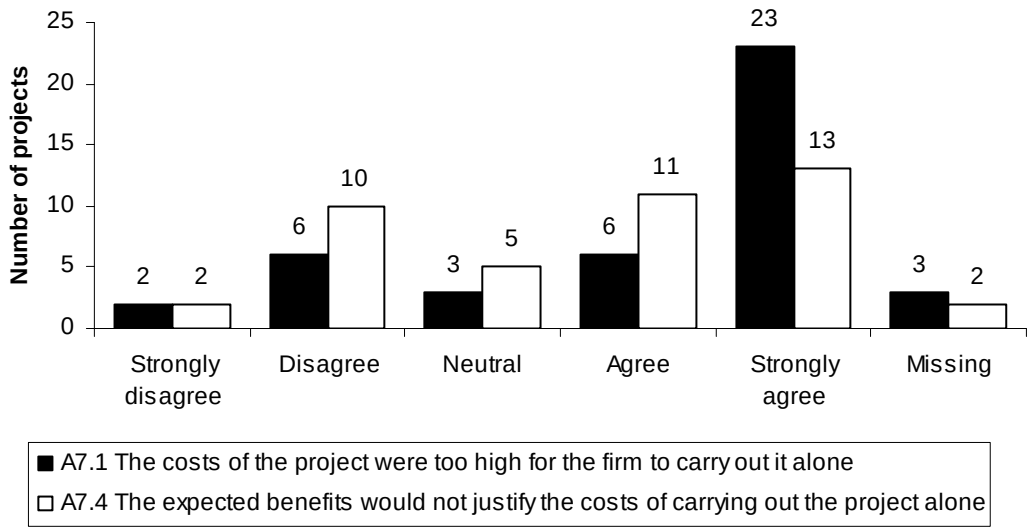
cooperative projects reported by firms, it results that the group of firms with less experience (B1.1) got the lowest average score ($A7.3_{B1.1}$ = 2.91; $A7.3_{B1.2}$ = 3.33; $A7.3_{B1.3}$ = 3.22), suggesting that past experience matters when firms define their objectives. The average score of variable A7.7 - want to learn from partner firms and RTD performers - is much higher than that of variable A7.3, 4.07 and 3.08 respectively, because firms were especially interested in accessing the know-how related to the project and less concerned about the know-how that went beyond the project goals. Firms were interested in accessing knowledge necessary to the future use of the alliance outcomes.

Generally, the size of projects demanded resources and competencies that the firms alone were not capable to provide. Even those firms that indicated a possible alternative strategy to the alliance did not have all the necessary conditions to pursue such strategy, or the alternative strategy could not meet all the benefits of the alliance, namely the benefits deriving from the complementary role of partners. In most cases, the alternative strategies to an alliance have not been considered a priori and de facto alternatives.

5.4.4 Would these research alliances go ahead without public funding?

When asked about the firm's financial capacity to carry out the project independently, about two-thirds of the interviewees agreed that such undertaking was beyond any possibility (see Figure 5.11). Many of them have admitted a certain difficulty in assessing accurately the total investment that the research project involved, partly because the prospect of carrying out the task alone has never been considered, but they were certain it was out of reach. Furthermore, to more than 55% of the interviewees the expected benefits from the project would not justify its cost in the hypothetical case of being accomplished autonomously. Some projects were simply too large, in others the expected advantages were quite small and in some other cases firms were not interested in the specific objectives of the alliance. More than half of the projects were considered by firms neither financially feasible nor rewarding. Sharing the research costs appeared to be not just a desirable strategy to pool resources and share the risk but an essential condition to make feasible many projects which would be dropped otherwise.

Figure 5.11 *Importance of cost of projects and their expected benefits*



Source: Interviews (question A7).

Only eight firms affirmed they would have enough financial means to carry out the research project alone (A7.1 = 1 or 2), but either the firm is part of a group or the cost of the project was not particularly high. One of these firms, a chemical firm, even said that forming an alliance increased unnecessarily the total cost of the project. The director of operations of this firm said: "If the project was to be developed autonomously, its total cost would be certainly smaller because the firm's personnel salary is only one-third of that of people from the research institutions and because the red tape associated with this kind of projects would surely be minimised. Besides that, the research institutions take advantage of this kind of project to get equipment, thus raising the cost of projects." Generally, however, firms had scarce financial resources, especially for research activities, and many have admitted they would refuse participating in the alliance had it not been financially supported by the European Union. The attractiveness of many projects was dependent on the amount of financial (and other) resources the firms would have to devote to join in. The EU funding permitted a substantial reduction of the partners' contribution and in some cases "alleviated" quite substantially the firms' financial burden such that the decision to participate in the alliance became rather simple and almost risk-free. In such situations the potential benefits easily surpassed the cost of participation, even taking into account the fact that the project had been set up elsewhere and the "fitness" problems that entailed. Establishing international contacts, participating in a research project with international

firms and research institutions, and acquiring new knowledge are examples of advantages which could compensate for participating.

Taking the firms' point of view, an interesting finding comes out: eventually, the EU funding turned infeasible projects, had they been carried out autonomously, into cost-effective ones, and sometimes irrespective of the outcomes. The EU funding "allowed" some firms to participate in cooperative projects which they would otherwise not have considered. The CRAFT programme had the effect of creating new collaborative links between firms.[62] To many firms, not entering the alliance would mean waiting for a solution provided by the market, which is still regarded by them as the most important source of innovation.

5.5 CONCLUSION

The chapter provides a detailed analysis of the initial circumstances in which the R&D alliances were shaped. Despite some clear advantages such joint research projects have to offer to the alliance partners, there are several weaknesses as well which might negatively influence the alliance implementation process and its outcomes and, ultimately, the ability of firms to achieve benefits and experience performance improvements. Figure 5.12 summarises the potential strengths and weaknesses of the R&D alliances which derive from the analysis of the initial conditions. While the "potential strengths" side emphasises the diversity of partners and their complementary aspects plus the relevance of the EU financial support, the "potential weaknesses" side mainly reflects structural problems of the alliances, lack of resources of the Portuguese firms and their cultural aspects. The categorisation of the initial pros and cons is an attempt to single out relevant factors in a complex picture which characterises partnerships where similar circumstances may not lead to similar outcomes and vice-versa, as the several case studies presented throughout the chapter demonstrate.

The EU funding allowed many SMEs to participate in international research projects that most of them would not have done otherwise. The participation of RTD performers and

[62] Peterson (1993: 254) reached a similar conclusion for the Eureka programme.

firms with complementary competencies created adequate conditions to carry out research on a scale generally not possible for individual SMEs. This allowed firms to structure larger projects and define more ambitious goals, thus enhancing the possibility of generating additional benefits for them. The presence of partners from different countries and partners with complementary competencies generated an excellent opportunity to learn and acquire knowledge and skills from partners.

Figure 5.12 *Potential strengths and weaknesses of initial conditions for the alliance implementation process and outcomes*

Potential strengths	Potential weaknesses
• Projects join partner firms with different but complementary competencies; • Projects involve RTD performers for carrying out research; • Projects join firms and RTD performers from different countries; • EU financial support makes possible the execution of research projects that would likely be dropped otherwise;	• Distance between technology producers and technology users; • On average, the number of partners seems to be too high for the alliance to be efficiently managed; • Disregard for formal contracts in many cases; • Little prior knowledge about partners; • Little interaction of all partners in the pre-project stage; • Little contribution of partners in structuring the projects; • Limited importance and urgency of projects; • Imbalance of power among firms and between firms and RTD performers; • No participation of local RTD performers in some projects; • Firms' inadequate research capabilities; • Lack of interest in the alliance objectives and outcomes by some firms;

Source: Author's elaboration.

Figure 5.12 also identifies many important weaknesses. Too large a "distance" between technology users and technology producers cause difficulties for the former to participate in the research activities. This combined with the low research capabilities of SMEs constitute important barriers to the transference and assimilation of technology, particularly when involving tacit knowledge. The fact that many alliances did not include a local RTD performer further complicates the position of the Portuguese firms. That "distance" between alliance partners also creates an imbalance of power within the partnership favourable for opportunistic behaviour.

The contractual relationship of partners has been overlooked by many firms and is likely to

represent an important weakness of alliances. Partners who already trust each other find it easier to handle things in an informal way (Doz and Hamel, 1998). However, trust mainly comes from previous relationships and most of the Portuguese SMEs did not know their partners beforehand. The degree of trust between partners influences the link between alliances and firm performance (Stuart, 2000: 809). Establishing formal contracts involves substantial transaction costs for SMEs, but not doing so in the context of unknown partners is more risky.

The lack of interaction in the pre-project phase and the limited contribution of many firms in structuring the research projects led to the formation of a group of "associated" firms who accepted playing a more peripheral role. These firms did not make themselves essential to the projects and entered the alliances in a weaker position. The fact that several firms regarded the project as neither important nor urgent, arguably the consequence of not setting up their own research projects adjusted to their specific needs and resources, while others were not interested in the alliance objectives, represented an important obstacle to the full commitment of firms to the alliances.

6 ALLIANCE IMPLEMENTATION PROCESS AND OUTCOMES

6.1 INTRODUCTION

The previous chapter focused on the initial circumstances in which the CRAFT alliances were formed, and identified several potential strengths and weaknesses which are relevant for the subsequent alliance stages. This chapter is concerned with matters related to the alliance implementation process and outcomes, aiming at understanding the type and importance of the benefits achieved by the Portuguese firms from alliances, assessing the alliance performance and examining a range of factors which had a negative impact on the alliance outcomes. Most of the weaknesses identified in the previous chapter emerge through the analysis of the negative aspects of cooperation, though with varying degrees of importance. The matters discussed in this chapter help to a better understanding of the impact of alliance on firm performance, which is the subject of the next chapter.

The chapter is structured as follows. First, it looks at the importance of the investment made by firms, both the research investment and the investment necessary to exploit the alliance outcomes. Second, the chapter examines a variety of factors which influenced the attainment of better results, and attempts to understand their relative importance. It proceeds with an assessment of the performance of alliances, including the degree to which the initial objectives were attained, the firm's level of satisfaction with the alliance performance and the firms' motivation to enter new partnerships. Before the conclusion, the chapter analyses the direct and indirect benefits obtained by the Portuguese firms, here interpreted as determinants of performance.

6.2 INVESTMENT ANALYSIS

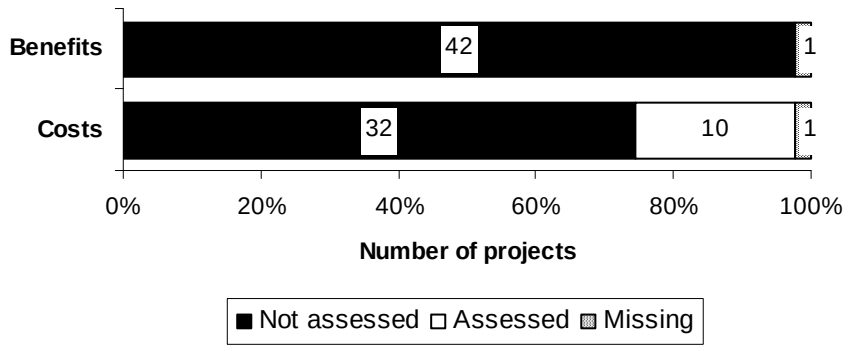
One line of inquiry attempted to capture the importance of the amount of resources the

firms assigned to the research projects, i.e. assess how significant was the research investment to the Portuguese firms. This was done by taking into consideration two different types of costs. On the one hand, the direct costs of participation in the alliance and exploitation of the alliance outcomes, such as the costs of personnel, training, travel and subsistence, acquisition of equipment, etc. On the other hand, the extent to which these projects affected the accomplishment of other projects or the normal activities of the firms. Before examining the above, however, it is important to understand the position of firms on the assessment of alliances' costs and benefits.

6.2.1 Importance of assessing the costs and benefits of projects

Is it worthwhile to assess the individual costs and (prospective) benefits of research alliances? Although not expected, the large majority of the executives answered no to this question. According to Figure 6.1, which addresses the concern of the Portuguese firms in measuring the project's costs and benefits, only 10 out of 43 firms have opened any form of cost accounting to measure the (financial) costs of participating in the alliance, and none of them did a similar thing for the (potential) benefits. Most firms did an elementary cost-benefit analysis at the beginning of the relationship, however none of them had it in mind to do a rigorous assessment.

Figure 6.1 *Assessment of the costs and benefits of projects*



Source: Interviews (question C7).

Two main reasons were given to justify this general lack of interest about the alliance assessment. On the one hand, such an assessment would be worthless because the figures involved were very small indeed and would not justify a specific assessment procedure. On

the other hand, most firms achieved a number of intangible benefits (e.g. image improvement, international contacts) which, naturally, are extremely difficult to assess in quantitative terms. The cultural attitude of firms and the effort required to assess alliances in greater detail appear to be the factors behind these justifications. A general perception about the costs and benefits of projects seemed to be sufficient for the accounting needs of many firms. A stricter analysis was not deemed necessary and sometimes was even inappropriate, since it is a time-consuming activity that would provide little additional information.

The fact that the EU covered the RTD performers' research costs made the assessment of costs in the research phase much simpler. But the costs of exploiting the alliance outcomes and the expected tangible benefits of many projects are sufficiently significant to deserve a rather more rigorous assessment. In any case, the above suggests that a methodological approach aiming at obtaining quantitative data would be difficult to operationalise because most firms would have difficulties in collaborating.

6.2.2 Research investment vs. investment to exploit alliance outcomes

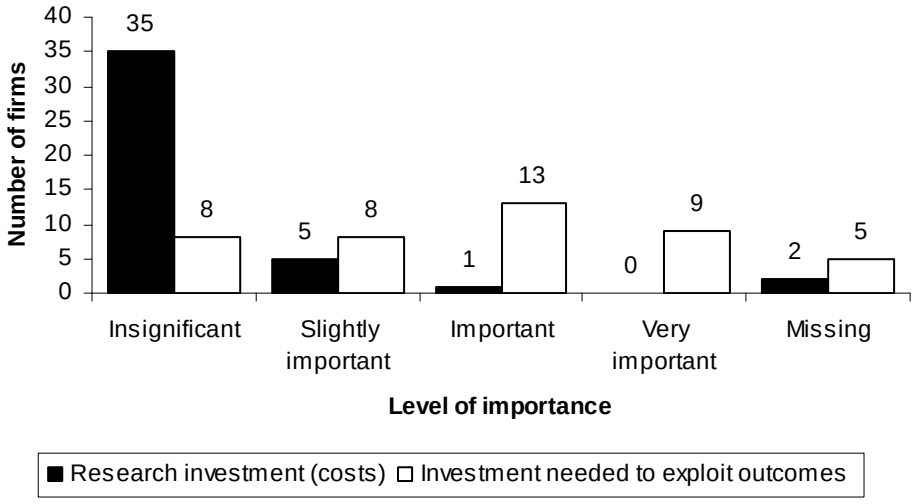
Figure 6.2 compares the importance of the investment (such as personnel, time, production capacity and money) allocated by firms for the research phase with the importance of the investment necessary to exploit fully the alliance outcomes. The latter includes the unsuccessful projects and projects which will not be exploited by firms, for reasons explained in the next chapter.[63] The aim is to emphasise the difference between the relative investment requirements in each stage. The research investment has been considered important only by one firm, not because of the amount itself, but due to financial problems the firm was experiencing at that time. "The total cost/investment has been irrelevant", was the most common answer for the question concerning the cost of participation in the alliance. To 35 firms (81%) the total amount of resources allocated for the research activities was regarded as insignificant. Eventually, as a result of public financial intervention, the firms' position about the research costs "shifted" from a condition of financial impossibility to a situation of a completely bearable financial contribution.

[63] In these cases, the analysis took into consideration an estimation of the amount of investment that would be necessary to exploit the outcomes had the projects been successful.

Furthermore, some of them came to the conclusion that their contribution had been so small that they would be satisfied with the alliance regardless of its outcomes. The relatively small amount of resources required from firms greatly facilitated their decision to enter the research alliances, and relaxed their initial demands and commitment. It also explains to a great extent the low percentage of firms unsatisfied with the alliance (as we will see below).

Among the different categories of costs concerning the research activities, those referred to as most relevant were (in no particular order) "Personnel" (management time in most cases), "Travel and subsistence" (for attending meetings in other countries), "Raw material" (to carry out in-house experiments) and "Financial contribution" (in some cases). The cost categories "Training" and "Acquisition of equipment" were relatively less important at the research stage. The relative importance of each cost category differs from firm to firm but in general they are indicative of the role played by firms in the alliance (e.g. attending meetings, carrying out in-house experiments). They benefited from the RTD performers' equipped laboratories and thus avoided the acquisition of expensive equipment necessary to carry out the research.

Figure 6.2 *Importance of the research investment and importance of the investment needed to exploit the alliance outcomes*



Source: Interviews.

Conversely, Figure 6.2 also shows that half of the firms regarded the investment needed for

fully exploiting the alliance outcomes (or the investment that would be necessary had the project been successful) as being at least important. Acquiring expensive machinery, setting up new plants, making substantial changes in the production process or protecting the knowledge (patents) are the types of investments firms have referred to as being important or very important. For instance, in one case just the acquisition of the novel equipment cost around 10% of the firm's previous year's turnover, while in another case that figure has been estimated to be about 50%. In absolute numbers, the former investment is fifteen times greater than the latter, meaning that the financial capability of firms in the post-research period is very important in joint projects of this kind. Some firms had to postpone the acquisition of the novel equipment due to lack of financial resources to acquire it immediately. One of the five missing observations could have been classified either as very important or insignificant, depending on whether the firm will carry out further research or not.

In some unsuccessful alliances, the Portuguese firms were nevertheless satisfied, even taking into account the expected long payback period of the research investment. But other firms were unsatisfied because there will not be any payback at all. On the other hand, in successful alliances the amount of post-research investment was not a big concern if the expected payback period was short, but an important deterrent in case of being long.

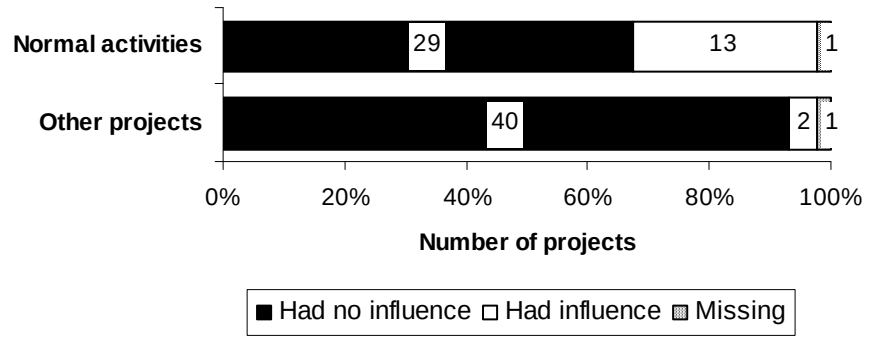
The evidence above shows that unlike the research investment (that was subsidised), the post-research investment necessary to exploit the alliance outcomes is important and sometimes represents a significant constraint against cumulative competence development.

6.2.3 Opportunity costs

Besides the amount of resources directly allocated to the projects, a second line of inquiry looked at the implications of project participation for the normal activities of firms and the implementation of other projects, here called opportunity costs. Figure 6.3 clearly shows that the resources assigned to the vast majority of the projects under analysis have not impeded, postponed or in any way affected the implementation of other research projects (or projects of other kinds). Actually, most firms did not have any other (research) projects in progress or planned, and those who did stressed that those projects were not (negatively)

influenced.

Figure 6.3 *Influence of alliances on firms' other projects and/or normal activities*



Source: Interviews (question C8).

Figure 6.3 also tells us that firms' normal activities have been somewhat affected in 13 cases, although in general only slightly and for a short period of time. Typically, the normal activities of firms were affected at the time of performing in-house experiments, installing new equipment or making layout changes. The use of management time to carry out alliance activities, such as attending meetings in other countries, had a negative impact on the firms' normal activities as well, especially in the case of smaller firms which rely heavily on one or two key persons. The fact that the RTD performers carried out most of the research activities and some of them rejected a greater participation of firms in the research process partially explains why firms were not much affected. In many cases, the firms' peripheral role in the alliance or the non-strategic importance of projects are part of the explanation as well. The opportunity costs were not substantial because many firms carried out a relatively small number of tasks.

6.3 NEGATIVE ASPECTS OF COOPERATION

This section is intended to look at the negative side of cooperation, particularly over the project implementation phase. It analyses a number of factors that had a somewhat negative influence on or limited the alliance outcomes, looking at their relative (negative) importance. In addition, the negative factors are aggregated by means of factor analysis and an interpretation of the results is provided, taking into consideration the information

collected in the interviews. To achieve this, the interviewees were asked to rate a list of possible negative factors on a five-point importance scale and invited to add other negative factors not included in the list when appropriate. Then, they were asked to clarify the meaning of their answers.

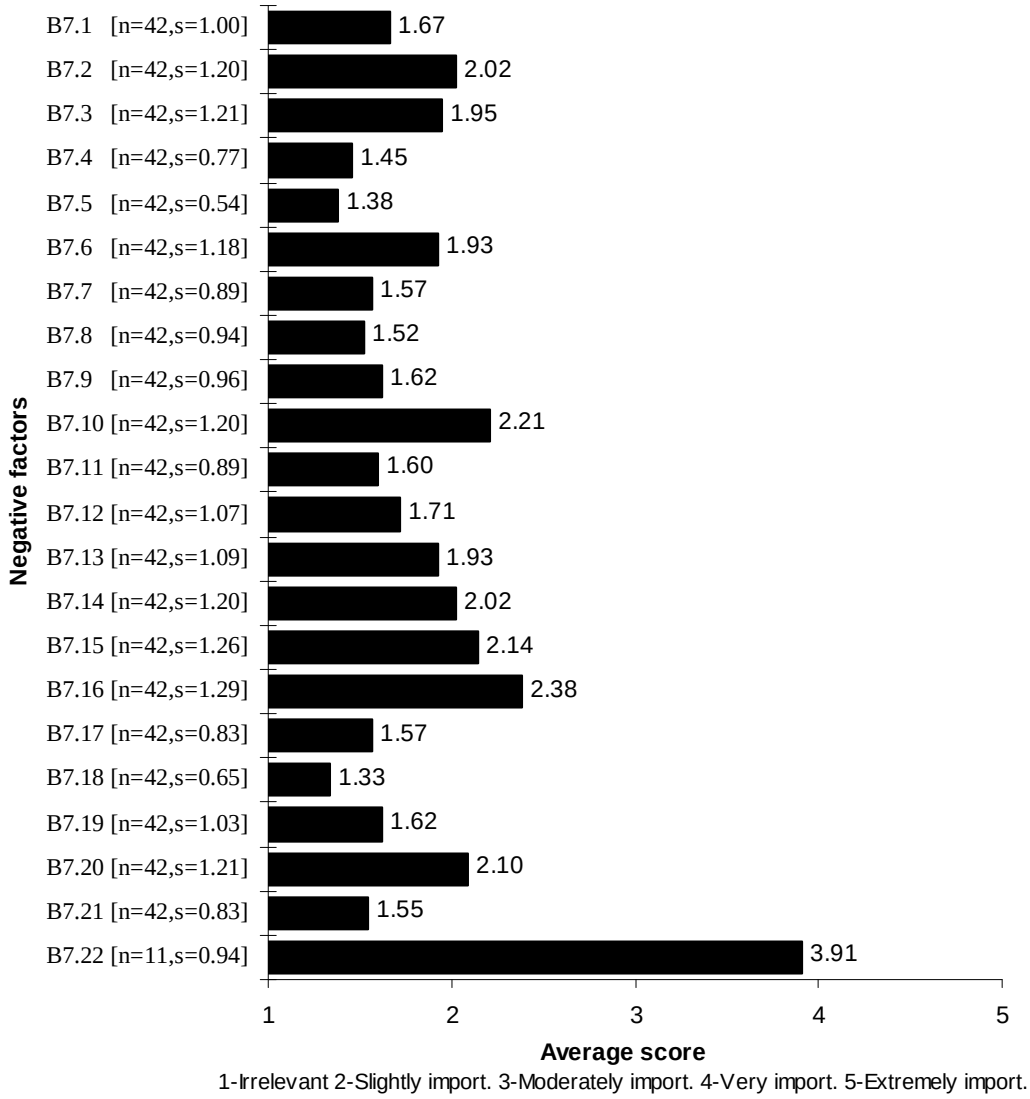
There are two important aspects with direct implications for the results that can hardly be exposed through the interpretation of the data, but were visible during the interview process. First, many firms, voluntarily or not, performed a minor role in the whole process of cooperation and only a small number of firms had enough technical competence to participate actively in the research activities or be able to monitor the research being carried out. Frequently, the firms' main task was to perform in-house tests of the equipment, process or product under development. Second, the interaction between partners (firms and RTD performers), with some exceptions, has been rather small and in several cases restricted to the periodic formal meetings at a firm's or RTD performer's premises. These two factors have negatively affected the firms' capability to assess satisfactorily the negative aspects of the joint undertaking. Therefore, the real picture of the negative aspects of cooperation would likely be different, presumably more negative than the one that can be drawn from the existing data.

6.3.1 Relative importance of the negative factors

Figure 6.4 depicts the average scores of the negative factors on a five-point importance scale. The average scores are mostly rather small[64] and well below the scale's mid-point, i.e. below the "Moderately important" point. The relatively low average scores of all but one variable are indicative of the interviewees' general perception that the alliance outcomes have not been much negatively affected by such factors. It seems, nevertheless, there is a group of negative factors that stands out - those with an average score around two or above - and the difference between averages suggest that they are not equally important.

[64] The variable "Other" has an average score well above all the others because, as a residual variable, it comprises a mixture of negative factors not included in the list provided, and to which individual firms generally attributed greater importance.

Figure 6.4 *Importance of the negative factors*



Key:

B7.1 Language/communication problems;
B7.2 Number of interactions between the partner firms and RTD performers;
B7.3 Quality of interactions between the partner firms and RTD performers;
B7.4 Cultural differences among the partner firms;
B7.5 Difference in size between the partner firms;
B7.6 Lack of willingness of partner firms to share know-how;
B7.7 Number of alliance partners;
B7.8 Written contract among the partner firms;
B7.9 Prior agreement on intellectual property rights;
B7.10 Technological complexity of the project;
B7.11 Lack of in-house technological expertise to exploit the project outcomes;
B7.12 Lack of or scarce financial resources to exploit the project outcomes;
B7.13 Lack of or scarce management time;
B7.14 Lack of experience in similar projects;
B7.15 Different expectations/conflicts of interest among the partner firms (and/or RTD performers);
B7.16 Lack of commitment or delay in accomplishing tasks by partner firms (and/or RTD performers);
B7.17 Miscalculation of the risk involved in the project;
B7.18 Inflexibility of the objectives of the research project;
B7.19 Lack of expertise of the RTD performer(s) to carry out the research project;
B7.20 Too much optimism at the beginning;
B7.21 Dependence on the European Union;
B7.22 Other

Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.4 in Appendix 2.

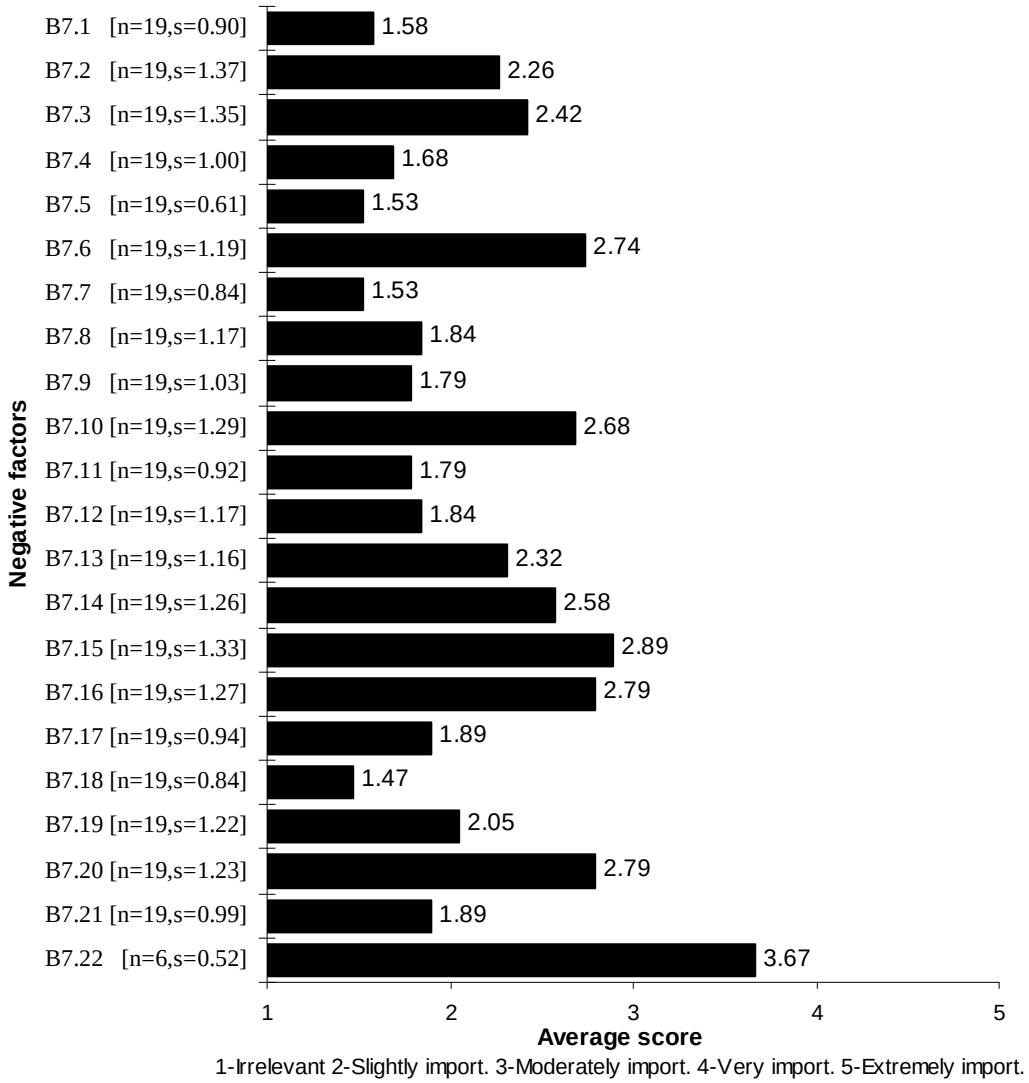
Figure 6.4 includes information about successful and unsuccessful research alliances. The

former tends to mitigate the visibility of the negative side of cooperation, because the negative aspects tend to be perceived as less important. In an attempt to minimise this problem, Figure 6.5 contains only those observations which the interviewees declared the objectives of the project were not fulfilled, i.e. those cases where C1.2 ≤ 3.[65] Such a procedure reduces the number of valid observations to nineteen, representing 14 out of the 30 research alliances under analysis, but enhances the visibility of the most important negative factors. All the average scores increased except three, and the relative importance of the negative factors is clearer now. Figure A2.2 in Appendix 2 represents the average scores of the remaining observations, which correspond to the cases where the alliance objectives were achieved (i.e. those where C1.2 ≥ 4). As expected, the average scores are substantially smaller and the difference between them is much less visible. The factor "Language/communication problems" (B7.1), surprisingly, is the only factor with a higher score. It is interesting to note that the factor "Lack of commitment or delay in accomplishing tasks" (B7.16) stands out with the highest average score.

The most important negative aspects of cooperation, as represented in Figure 6.5, are related to the commitment, different expectations/conflicts of interest and transparency of partners, the complexity and risk of projects, and the initial conditions of firms, namely the lack of experience and too much initial optimism. Also important are the number and quality of interactions among partners. The least important negative factors are related to the language and communication problems, the number and different size of partners, and the inflexibility of the project objectives. The standard deviation values increased (except in three cases) and some become relatively high. It indicates that the importance of the negative factors tends to vary considerably across alliances, i.e. the negative factors were not equally important in all unsuccessful alliances.

[65] A similar analysis has been carried out for the "Level of satisfaction with the performance of the alliance" (question C1.1) and the findings are not much different (see Figure A2.1 in Appendix 2). That is not so surprising since there is a significant correlation between the level of satisfaction with the alliance and the attainment of the pre-defined objectives (r = 0.783, n = 41).

Figure 6.5 *Importance of the negative factors - alliances that did not achieve the objectives (C1.2 ≤3)*



Key: See Figure 6.4 above.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.4 and Table A2.5, both in Appendix 2.

A different way of looking at the relative importance of the negative factors takes into consideration each answer on a yes/no-type scale instead of the five-point importance scale used hitherto. This transformation can be done by summing up all the answers of each negative factor which have some associated degree of importance (i.e. categories 2 to 5).[66] Following such procedure, the negative factors have been re-classified as "Irrelevant" or "Important" and the results, sorted according to the latter, are presented in Table 6.1. Comparing the results of the two approaches, one realises that the nine most important

[66] Variable "Other" has been excluded due to its different nature.

negative factors identified in Figure 6.5 (i.e. those with the highest average scores) are exactly the first nine factors ranked in Table 6.1 (i.e. those which were important to a larger number of firms).

Table 6.1 *Negative factors of cooperation*

	Irrelevant	Important		Overall (*)
	(a)	(b)	Avg. score	Avg. score
B7.16 Lack of commitment or delay in accomplishing tasks by partner firms (and/or RTD performers)	13	29	3.00	2.38
B7.10 Technological complexity of the project	16	26	2.96	2.21
B7.15 Different expectations/conflicts of interest among the partner firms (and/or RTD performers)	17	25	2.92	2.14
B7.2 Number of interactions between the partner firms and RTD performers	19	23	2.83	2.02
B7.14 Lack of experience in similar projects	19	23	2.87	2.02
B7.20 Too much optimism at the beginning	19	23	3.00	2.10
B7.13 Lack of or scarce management time	20	22	2.68	1.93
B7.6 Lack of willingness of partner firms to share know-how	21	21	2.86	1.93
B7.3 Quality of interactions between the partner firms and RTD performers	22	20	3.00	1.95
B7.1 Language/communication problems	25	17	2.65	1.67
B7.9 Prior agreement on intellectual property rights	26	16	2.63	1.62
B7.11 Lack of in-house technological expertise to exploit the project outcomes	26	16	2.56	1.60
B7.19 Lack of expertise of the RTD performer(s) to carry out the research project	26	16	2.63	1.62
B7.21 Dependence on the European Union	26	16	2.44	1.55
B7.4 Cultural differences among the partner firms	27	15	2.27	1.45
B7.5 Difference in size between the partner firms	27	15	2.07	1.38
B7.7 Number of alliance partners	27	15	2.60	1.57
B7.12 Lack of or scarce financial resources to exploit the project outcomes	26	15	2.87	1.71
B7.17 Miscalculation of the risk involved in the project	27	15	2.47	1.57
B7.8 Written contract among the partner firms	29	13	2.69	1.52
B7.18 Inflexibility of the objectives of the research project	31	11	2.27	1.33

Notes: Number of answers based on the number of observations of question B7: (**a**) of category "1-Irrelevant"; (**b**) of categories "2-Slightly important", "3-Moderately important", "4-Very important" and "5-Extremely important". (*) Scores from Table 6.4.
Source: Table A2.4 in Appendix 2.

An important finding that comes out is the strong and positive correlation ($r = 0.975$, $r^2 = 0.950$) between the total number of "Important" observations of a given negative factor (Table 6.1, column 3) and the overall average score of that factor (column 5). It basically means the average scores of the negative factors are directly related to their number of "Important" observations. The higher the number of "Important" observations, the higher the average scores tend to be. This suggests that the negative factors which are important to a higher number of firms tend also to be the ones which firms consider, on average, the

most negative. Or, taking a rather different point of view, it simply means that the apparent difference of the average scores comes from the different number of “Irrelevant” observations of each negative factor. In this case, lower average scores are the result of a higher number of “Irrelevant” observations and vice-versa.

Another important aspect worth analysing is the pervasiveness of the negative factors, i.e. how common are they. The negative factor “Lack of commitment or delay in accomplishing tasks” was regarded as important by two-thirds of the executives, while the factor “Inflexibility of the objectives of the research project” was considered important by only about a quarter of them. No negative factor was important to all executives or even in all research alliances, and no negative factor was unimportant as well. The substantial difference in the number of “Important” observations across the range of negative factors suggests some kind of hierarchy among them but the pervasiveness of a given negative factor cannot be dissociated from its nature, the attributes of firms and the context of each alliance. Besides that, the interviews carried out with different partner firms of the same research alliance were important for understanding that the executives frequently have different perceptions about what might be considered a negative factor of cooperation and its relative importance. The assessment is subjective and thus is subject to different interpretations, but it is unlikely to explain significantly different perceptions about the same phenomenon. Asymmetric information and different commitment to the project are factors which also help to explain the different perception about the importance of negative factors.

Finally, it is relevant to understand whether the most common factors correspond to factors with the highest scores. An intuitive answer would be no, but many of the highest scores correspond indeed to the negative factors with the higher number of “Important” observations, and the correlation between the two is quite significant ($r = 0.745$; Table 6.1, columns 3 and 4). Therefore, the relative importance of a given negative factor is not just explained by the position at which it is ranked.

6.3.2 An interpretation of the negative factors of cooperation

The number of negative factors of cooperation affecting the alliance outcomes is

considerable and they touch upon a large variety of matters, whose relevance tends to vary from firm to firm and alliance to alliance. By means of factor analysis and for the benefit of interpretation, this complex picture is simplified to a smaller number of relevant variables (Factors), each representing a set of negative factors with some affinity among them.

Table 6.2 shows the results of the factor analysis (only absolute values higher than 0.5 are shown), which has generated six factors.[67] The Bartlett Test of Sphericity is significant at the 0.001 level and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy equals 0.575, although a few individual MSA values are lower than 0.5[68]. The six factors extracted recovered about 74.4% of the total variance.

Below is an interpretation of the results of the factor analysis which takes into consideration the additional information provided by the executives. It focuses on each Factor individually for the sake of the explanation but there is some interdependence of many of the negative factors. Indeed, cross-references are hardly avoidable in the interpretation of the Factors. The six Factors can be labelled as follows:

- Factor 1: Commitment of partners;
- Factor 2: Cultural aspects;
- Factor 3: Lack of internal resources;
- Factor 4: Unperceived risk;
- Factor 5: Communication problems
- Factor 6: Structural problems.

Factor 1: Commitment of partners. Factor 1 involves most of the negative factors concerning the relation among partners, both firms and RTD performers, and their attitude toward the research project and the other alliance partners. It unfolds chiefly at the project implementation stage when the commitment, competence, individual interests and expectation of partners become clear. Those firms that experienced problems at this stage frequently stressed their lack of experience in similar projects and high initial optimism to

[67] The SPSS 9.0 outputs can be found in Appendix 3.

[68] When in presence of MSA values lower than 0.5 some authors (e.g. Hair et al., 1998) suggest that one or more variables should be excluded from the analysis until all MSA values reach a minimum of 0.5. In the current situation it would be necessary to exclude a total of three variables, however it is our conviction that such a procedure would not provide better results.

partially justify situations that otherwise could have been prevented or at least attenuated from the very beginning.

Table 6.2 *Results of a factor analysis upon the set of negative factors*

Variable	Mean	Factor loadings						Communality
		1	2	3	4	5	6	
B7.15 Different expectations/conflicts of interest amongst the partner firms (and/or RTD performers)	2.14	.839						.871
B7.20 Too much optimism at the beginning	2.10	.760						.737
B7.6 Lack of willingness of partner firms to share know-how	1.93	.721						.621
B7.16 Lack of commitment or delay in accomplishing tasks by partner firms (and/or RTD performers)	2.38	.719						.565
B7.14 Lack of experience in similar projects	2.02	.586						.795
B7.3 Quality of interactions between the partner firms and RTD performers	1.95	.558						.511
B7.19 Lack of expertise of the RTD performer(s) to carry out the research project	1.62	.532				.521		.691
B7.8 Written contract among the partner firms	1.52		.838					.783
B7.9 Prior agreement on intellectual property rights	1.62		.830					.828
B7.4 Cultural differences among the partner firms	1.45		.799					.741
B7.21 Dependence on the European Union	1.55		.608					.675
B7.11 Lack of in-house technological expertise to exploit the project outcomes	1.60			.807				.779
B7.5 Difference in size between the partner firms	1.38			.708				.737
B7.12 Lack of or scarce financial resources to exploit the project outcomes	1.71			.692				.761
B7.13 Lack of or scarce management time	1.93			.683				.774
B7.10 Technological complexity of the project	2.21				.741			.793
B7.17 Miscalculation of the risk involved in the project	1.57				.722			.750
B7.2 Number of interactions between the partner firms and RTD performers	2.02				.657			.800
B7.1 Language/communication problems	1.67					.902		.870
B7.7 Number of alliance partners	1.57						.810	.817
B7.18 Inflexibility of the objectives of the research project	1.33						.630	.721
Percentage of the variance explained		30.8	13.7	10.3	7.2	6.7	5.7	74.4

Notes: Extraction Method: Principal Component Analysis. Rotation Method: Quartimax with Kaiser Normalization. The results of the Varimax rotation method are quite similar to the Quartimax, the major difference being the change of position of variable B7.19 from Factor 6 to Factor 1. The Quartimax rotation method results seem to be more adequate.
The variable "Other" has been excluded because it comprises only 11 observations.
Source: Based on the answers to question B7.

An important negative factor has been the lack of commitment or delay in accomplishing tasks by the partners. Delays in performing research tasks happened quite frequently but the importance of this was often disregarded if projects did get through within the allotted time. The lack of commitment is clearly visible in many of partners' attitudes described below, but the RTD performers were particularly targeted on this matter, which is not so surprising given their central role in all projects. Important is the fact that five firms

understand their passive role in the alliance as a lack of commitment. Of those interviewees who were unsatisfied with the behaviour of the RTD performers, some strongly criticised them for their lack of commitment to the projects and sometimes lack of competence in carrying out the research. In some cases, they stressed, these institutions were much more concerned in getting funding for their normal activities and for the acquisition of equipment than to be professionally committed to the research project. And that happens because the quality of the research carried out by the RTD performers is never assessed by the EC (or a third party) and, consequently, they are unlikely to be punished even in the case of poor results due to badly conducted research activities. "The EC has an indirect negative contribution when it 'allows' that research institutions take control of projects, rejecting sometimes the participation and contribution of some partners", said an executive. This has been the main negative remark on the European Commission's role.

Some RTD performers have been criticised for not having the competence or means to carry out the projects they were supposed to, and especially when they took the initiative to set up the project and "sell" it to the firms, suggesting having the capability to do it. "Research institutions have a good theoretical background but are not well prepared to solve practical problems", added an interviewee. Three factors helped to minimise the magnitude of this negative factor. Some firms recognised their lack of competence and qualified personnel to assess both the technological complexity of the project, particularly when it involved unknown technologies, and the RTD performers' technical competence. In four cases (3 projects), the firms affirmed that the project was by no means complex and, by looking at the question on the novelty of projects (see question A7.5 in Figure 5.10 and Table A2.3 in Appendix 2), one realises that four firms affirmed that the technological solution under development could have been found in the marketplace, while nine others were not sure about such a possibility.

The lack of willingness of partners to share their know-how negatively affected many alliances. Perhaps the example that best illustrates this is the case of a certain technology producer who, at the end of the research project, refused to make a demonstration of how the new production process really worked; the alliance partners were just informed that the process works and were given a technical dossier on the project. This is an important problem because the Portuguese partner firm has no competence to decipher the technical

language, meaning that the alliance outcomes are of little use (see Case study A in Chapter 5). Many firms stressed their reluctance in accepting a deeper relationship with competitor partners that would expose their knowledge or technologies. For instance, the single condition to participate in the alliance of a given firm was that it should not include any other Portuguese competitor. Other firm has emphasised it would not be willing to share its technological knowledge and be fully committed to the project in the circumstance of having other Portuguese or Spanish competitors as partners, because the firm regards them as on a lower technological rung. In other case, the alliance partners did not supply their best products for testing because important information could have been passed on to the competitor firm. Conversely, firms were completely available to share information and proprietary knowledge with competitor partners only when their geographic markets did not overlap (and it could not be expected this would happen). This is an advantageous strategy indeed because firms can maximise their joint contribution and the risk of transparency is insignificant.

In many alliances there were conflicts amongst partners which typically appeared in the course of the relationship but often were the consequence of an underestimated importance given to the pre-project phase (perhaps due to lack of experience!). There were two main sources of conflict concerning the contractual arrangement. First, when the (formal) contract did not exist or it was not sufficiently comprehensive about the responsibility of partners and the intellectual property rights and/or commercial rights. Second, when some partners wanted to sign a formal contract in the course of the project but faced the opposition of other partners. The latter generated such a conflict in one case that the European Commission cancelled the alliance (see Case study B in Chapter 5).

Some projects were set up to fulfil the interests of specific partners and the research resources were used primarily for that purpose, however the partners' perception of this happened later in their implementation. In other cases, there were communication problems between firms and RTD performers concerning the required balance between the interest in improving the theoretical knowledge (RTD performers) and the advantage of having a practical application of it (firms). The executive of a chemical firm said, "Firms and laboratories had different expectations. The latter tend to keep doing tests forever, by making marginal changes in the variables, but without a practical aim expected by firms."

Two other firms quit their alliance due to conflicts of interest.[69] In one case the technology to be developed would not suit the firm's needs; in the other case the firm has been given a minor role in the partnership not compatible with the firm's technological capabilities (the firm was invited to invent something else to do!) and there was no prospect of sharing know-how or be able to use their technological capability - the kind of things it was expecting to get from the alliance.

In a number of research alliances, the weak interdependence and poor communication between technology producers and technology users caused some damage to the quality of the interactions between them. Often, the technology producers "assumed" that the technology users were dispensable to the research process, particularly when the latter lacked specific technical know-how or competencies in a given technological area. This attitude of technology producers dissatisfied many technology users and proved to be a wrong approach because a closer relationship between the two would avoid the "sense of exclusion" felt by many partner firms and would benefit the research by preventing errors from occurring. In a specific case, the know-how of a given firm has been rejected by the RTD performer despite being pertinent and superior in many respects to that of the RTD performer's. This illustrates the unbalanced bargaining power and asymmetric information among partners.

Technical discussions at the periodic meetings[70] often created barriers to the participation of technology users and was perceived by executives as a cause for the low quality of meetings. The quality of meetings suffered also from the absence of some partners and non-participation of others. These factors discouraged many firms from attending the periodic meetings and some "delegated" their representation to the local RTD performers. Some firms never attended a periodic meeting! The interaction among partners was hindered from the very beginning because there were alliance partners that never met and few firms sought extra-alliance relations. Rarely did the Portuguese partner firms seek a stronger interaction between them and the development of extra-alliance activities.

[69] These firms were contacted by phone only though were available for an interview. Since both quit the alliance at an early stage and assured us of having nothing else to say besides what they have said, a face-to-face interview appeared to be of no use. For this reason these firms are not included in the sample.

[70] Typically, the periodic meetings took place every six months and gathered together all the alliance partners.

Factor 2: Cultural aspects. It sounds contradictory that firms' cultural aspects represent an important Factor while the "Cultural differences among the partner firms" is ranked one of the least negative factors. Its overall average score of 1.45 basically means that the partners' cultural differences were little more than an insignificant negative factor.[71] At least two things can shed light on this point. On the one hand, the kind of interaction among partners, their well-defined role in the alliance, and the divide between technology producers and technology users minimised the potential for conflicts and blurred the visibility of cultural differences among partners. On the other hand, the problems that firms faced in the course of the relationship seldom were perceived as cultural problems or rooted in the firm's culture. However, many of the issues discussed in this section reflect the behaviour and attitude of firms, i.e. they reflect the organisational culture.

The position of firms towards the formal aspects of the relationship reflect among other things a cultural attitude. Many firms neglected the importance of formal contracts for reasons explained elsewhere, just realising the advantage of having them when conflicts occurred (see Case study B in Chapter 5). The failure of some alliances minimised the dimension of the problem because their expected results, if attained, would generate conflicts among partners since no formal contract was signed. For many executives, the lack of experience in similar projects explains the attitude of firms because it limited the perception of possible consequences and led them to accept conditions that otherwise would have been rejected. On the other hand, when conflicts with the RTD performers came up because they were not being professionally committed to the project or were not treating equally all the partners, firms felt powerless to deal with the situation and criticised the European Commission for not doing anything to protect their interests in the alliance.

Factor 3: Lack of internal resources. The CRAFT programme was extremely important in permitting firms to access the research resources they needed for the research projects, particularly expertise. It reduced substantially the amount of resources demanded from firms to participate in the alliances but only for the research activities. Several firms faced two important difficulties concerning the assignment of human resources for research activities. First, the number of available people was small and it was complicated to

[71] Saxton's (1997: 456) results also contradict the "popular idea that 'culture clash' negatively influences alliance potential."

"release" them on a full-time basis. As a rule, projects were assigned on a part-time basis to someone who frequently had some kind of managing responsibility. Second, they did not have the appropriate background. The lack of qualified people was particularly important when the firm had no competence in the technology under development, and partially explains the existence of stronger ties with the local RTD performers. At least two firms were unsatisfied for not having a Portuguese research institution in the alliance to provide the technical support they needed (see, for instance, Case study K in Chapter 7).

We have seen above that the lack of resources matter in the post-project stage. At that stage, some firms could not implement the alliance outcomes without the help of other partners, and in other cases firms were not capable (and sometimes had no interest) of furthering the research activities alone because it involved knowledge new to the firm or they lacked adequate research resources (e.g. laboratory, equipment or personnel) to proceed with the research. In other cases, firms did not have enough financial resources to exploit the outcomes immediately (e.g. to buy the novel equipment) or the interest of firms in exploiting the alliance outcomes was dependent on the investment involved. Of course, size matters when the problem is the access to resources; smaller firms tend to face greater difficulties in accessing them. Only a small number of executives established a link between the firm's size and the availability of resources, perhaps because the negative factor "Difference in size between partner firms" appeared before the others in the list (which may be the reason for its relatively small average score).

Factor 4: Unperceived risk. Risk was not expected to be an important negative factor, at least in the research period. Firms' financial contributions were relatively small, the projects were far from fundamental research (perhaps with the exception of one of them), and firms were permitted to choose RTD performers with appropriate technological competencies and research facilities to carry out the research. Firms had the opportunity to reach a critical mass of human and financial resources to implement (larger) projects suiting their needs. Many executives showed surprise when asked about the risk involved in the project, however not all risk was taken into account at the beginning of the relationships or perceived as such at the end of it. Most firms were invited to enter the alliance and were attracted by the enhanced benefits of the project and low cost of participating, but overlooked the risks associated with it.

It is possible to identify at least two major categories of risk. On the one hand, there is the risk concerning the technological complexity of projects. It was an important negative factor to many unsuccessful alliances and impeded others from achieving the totality of the expected results. Some projects did not take into consideration the whole complexity of combining several technologies or were oversized for the available time, resources or the RTD performers' technological capability, and therefore could not reach the objectives they set out to achieve (see Case study E in Chapter 5). On the other hand, there were risks related to: (in)compatibility of partners and their objectives due to poor prior knowledge of both; high initial optimism because the project was "sold" as being better than it really was; rising project costs in the course of its execution, and post-project risk concerning the conditions to market the new product; the in-house (im)possibility of taking full advantage of the alliance outcomes or the dependence on a third-party to do so.[72] An important reason why the number of interactions among the alliance partners has been considered too small is because some firms wanted to have a stronger participation in the research activities and be better informed. In many cases both things were denied (or not required) by the technology producers. Such a risk has been identified but not explicitly reckoned as such.

Factor 5: Communication problems. An interesting but unexpected finding concerns the language and communication problems, that apparently have been a minor concern for most firms. Given that the average number of alliance partners is about eleven, on average partners are from four different European countries, and the talks were generally conducted in English, it was expected that these factors would be a serious obstacle to the normal relationship among alliance partners and a handicap to non-native English speakers. Apparently, that did not happen because 25 firms (60%) have considered this negative factor to be irrelevant and 10 others only slightly important.

The low interaction among partners partially explains the phenomenon but it is also likely that the communication problems have been underestimated. As explained above, some firms were refused a more substantial participation in the research process by the technology producers, and others criticised the R&D institutions for not being sensitive enough in dealing with the relative interest of furthering the theoretical development and

[72] This point is thoroughly explained in the next chapter.

the need for practical applications. Some firms were unsatisfied with the RTD performers' attitude that ignored their request to stop putting the interests of some partners ahead of the others. There were communication problems particularly with the RTD performers, which explains why the negative factor "Lack of expertise of the RTD performers" is significant in Factor 5 (factor loading is 0.521). It appears that the language and communication problems were not perceived as so significant because the well-defined roles of partners in most alliances did not demand an intense and dynamic interaction among them.

Factor 6: Structural problems. Problems related to the structure of alliances are dispersed across all the Factors, diminishing their visibility and importance, probably much more than would really be appropriate. The number of alliance partners is possibly a typical example of a negative factor whose average score does not seem to express its actual importance. It would certainly be much more relevant if partners were demanding other kind of participation and interaction, the divide between technology producers and technology users were less striking, and the power balance between the two were not so unbalanced.

Regarding the negative factor "Other", four out of the eleven executives regarded the partners' dispersion across many European countries as a major negative aspect because it increased the transaction costs, including the total cost of projects, caused delays in accomplishing tasks, and involved greater logistic difficulties to organise meetings. Quite irrelevant in setting up a project, given the modern means of communication, the proximity of partners becomes very important during the experimental stage because it requires interaction, close monitoring of results, and a rapid decision-making process.

Other structural aspects were equally important. Regular meetings with all partners was the preferred form of interaction, which usually took place every six months, the minimum imposed by the EC. But, as one executive pointed out, there is no great advantage in spending two or three days attending a three-hour meeting when no other incentives exist, such as visiting the partner's premises, because the access to the meeting's technical reports is guaranteed. Progress meetings tend to be less appealing if they involve only the presentation of intermediate results; the discussion becoming too technical greatly restricts the participation of many technology users.

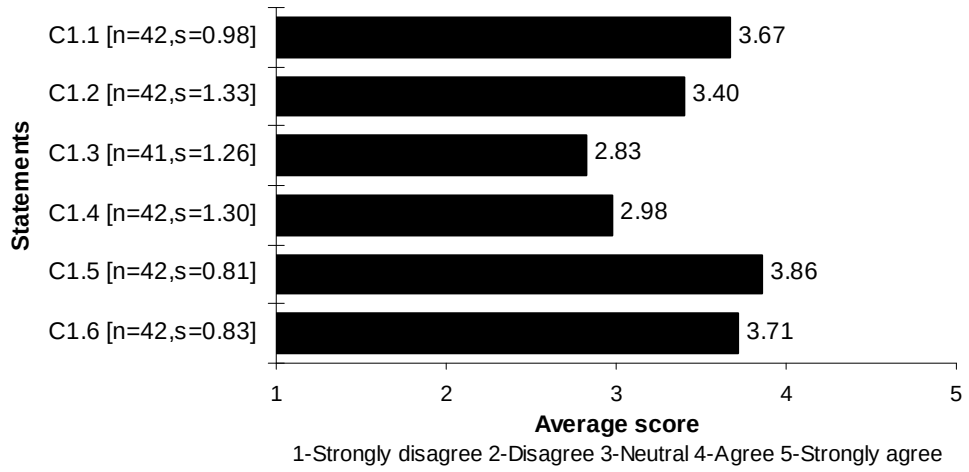
The research alliances under analysis join together firms with RTD performers. The latter are engaged to carry out research on the firms' behalf but are paid for by the EC. As mentioned above, in cases of poor commitment or unequal treatment of partners by the RTD performers, firms do not seem to have enough power or know-how to defend their rights and compel RTD performers to behave professionally.

6.4 OVERALL ASSESSMENT OF ALLIANCE PERFORMANCE

This section addresses the issue of alliance performance. Executives were asked to assess six statements concerning the satisfaction with the performance of the alliances (C1.1 and C1.2), the expected consequences for firms (C1.3 and C1.4), and the intentions of their firms about participation in future alliances (C1.5 and C1.6). The average scores are presented in Figure 6.6.

In general, the results are relatively high and reflect a positive appreciation of the alliance outcomes, but interpreting them is not straightforward. Some answers are conditional, because they were given on the condition that the alliance success would lead to the successful exploitation of its outcomes, which in many cases depend on factors not under the firm's control. Frequently, the alliance partners' perception about the degree to which the objectives were attained differs, which is surely a consequence of a subjective question, but it may also be symptomatic of asymmetric information among partners if the divergence (and sometimes contradiction) of opinion is taken into consideration. Perhaps the alliance partners on the periphery of the alliance, those less connected and performing a minor role, were ill-informed about the progress of the alliance and did not adjust their expectations. Another possible explanation is that the assessment of alliance performance was made according to the initial expectations of firms, which are likely to be different.

Figure 6.6 *Overall assessment of the performance of alliance*



Key:
C1.1 Overall we are satisfied with the performance of this alliance;
C1.2 The alliance has realised the goals we set out to achieve;
C1.3 Now we have a competitive advantage over our direct competitors;
C1.4 This project has/will have a positive impact on the firm performance.
The firm will certainly use interfirm cooperation on a more regular basis:
- C1.5 if European Union funding is available;
- C1.6 even without European Union funding

Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.5 in Appendix 2.

Twenty-eight executives (67%) were satisfied or completely satisfied with the alliance performance (i.e. C1.1 = 4 or 5)[73] and no one admitted being totally unsatisfied with it. Only twenty-three executives (55%) agreed that the alliance has achieved most or all the objectives set out initially (i.e. C1.2 = 4 or 5), and three others admitted that none of the objectives were achieved. The satisfaction with the alliance often depends on the accomplishment of both technical and economic objectives. Normally, executives would not classify an alliance as successful if its outcomes could not be exploited. Interestingly, this "rule" was relaxed in three cases. The executives were satisfied with the alliance performance but the alliance outcomes will not be exploited because during the alliance execution the market conditions changed in two of the cases, and an alternative (and better) technical solution was found in the other case.

There is a substantial and positive correlation between variables C1.1 and C1.2 (r = 0.782) but there are other factors that explain the level of satisfaction with the alliance besides the

[73] See Table A2.5 in Appendix 2 for the breakdown of the answers by category.

fulfilment of its objectives. Apart from those firms that were not concerned with the common objectives, goal-achievement was the point of reference for the alliance performance assessment.

Table 6.3 presents a comparison between variables "satisfaction with the performance of the alliance" and "realisation of the goals set out to achieve". Twenty-five executives rated equally both variables (scores ranging from two to five), denoting the strong relationship between the two. In all five cases where C1.1 < C1.2, the executives affirmed that the alliance achieved all its objectives but they were not completely satisfied because of any specific aspect they did not appreciate (e.g. attitude of partners, delays in setting up the new equipment or change of expectation). One of the firms was not interested in the objectives of the project.

Table 6.3 *Level of satisfaction with the alliance vs. degree to which the objectives were attained*

	C1.1 < C1.2	C1.1 = C1.2	C1.1 > C1.2	Missing
Frequency	5 (11.6%)	25 (58.1%)	12 (27.9%)	1 (2.3%)

Source: Interviews (question C1).

Twelve executives rated higher their level of satisfaction with the alliance performance than the goals that were achieved (C1.1 > C1.2) and all the latter scores are equal to or lower than 3, meaning that the eleven alliances they represent did not achieve satisfactory results. At least two factors explain the executives' position. On the one hand, they recognise the worth of the acquired know-how and other direct benefits despite the low performance of alliances. On the other hand, some indirect and unexpected benefits have been achieved. In favour also is the low cost of participation in the alliances, which was easily counter-balanced by the benefits achieved.

As regards the consequences for firms, the relationship between the firm's level of satisfaction or the degree to which the objectives were attained and the expected impact on firm's performance (C1.4) is not that strong, r = 0.531 and r = 0.601 respectively. Perhaps these results are not in harmony with what one would expect but there is an explanation for this. Some projects will not proceed to the following stages (i.e. exploitation of results),

others did not reach the objectives but the firms got unexpected benefits, and some benefits are quite difficult to assess in terms of firm performance. There is however some kind of connection between these variables, given that only exceptionally was the expected impact on firm performance scored higher than the other two variables, meaning that an expected impact on firm performance appears to reflect only partially the level of satisfaction with the performance of the alliance.

Not all research projects were meant to generate a competitive advantage for the partner firms. Table 6.4 compares the initial expectation of firms concerning a possible competitive advantage with the actual advantage. Eleven executives said that the project aimed primarily at resolving specific technical problems of their firms and any competitive advantage would only indirectly be achieved. In eight cases, the potential advantage would be temporary because imitation would be hardly possible to prevent, or there were plans to diffuse the new knowledge. Eventually, five of those eleven firms mentioned above were indeed able to strengthen their competitive position; conversely, of those twenty-four firms expecting to get competitive benefits from the alliance, eleven were not able to do so.

Table 6.4 *Competitive advantage: initial expectation vs. actual advantage*

Initial expectation			Actual advantage			
A5. Did this project intend to place your firm in a position ahead of competition?			C1.3. Now we have a competitive advantage over our direct competitors			
			Disagree (C1.3 = 1 or 2)	Neutral (C1.3 = 3)	Agree (C1.3 = 4 or 5)	Missing
No	11	⇒	4	2	5	0
Yes, temporarily	8	⇒	2	3	1	2
Yes	24	⇒	12	1	11	0
Total	43	⇒	18	6	17	2

Sources: Interviews (questions A5 and C1).

Regarding the question of whether firms intend to enter future alliances, the high average scores in Figure 6.6 are indicative that there is a great deal of interest in doing so. Thirty-four executives (81%) affirmed their firms are interested in taking part in future alliances if EU funding is available (i.e. C1.5 = 4 or 5) and twenty-nine others (69%) even without it (i.e. C1.6 = 4 or 5)[74]. Despite the similarity of results (i.e. strong intention to enter future

[74] Initially, it was expected that these variables could be used as a proxy to measure the level of satisfaction with the alliance but variables C1.1 and C1.5 appear to be totally independent from each other (r = 0.0).

alliances), these figures do not have the same meaning because the latter has a number of restrictions attached. In general, the limited financial and research capabilities of these firms constrain the size and sort of research projects they are able to carry out alone (or with RTD performers). Funding under the CRAFT programme gives small firms the opportunity to access the research resources needed by taking part in joint research projects at a bearable (sometimes low) cost.

To many executives the availability of EU funding is not a determinant condition to enter alliances, the interest in the project being much more important. One executive of a very small firm even said, "Being at the 'head' of research of an important technology for the firm relegates factors such as cost and source of funding to a second order of importance." However the availability of funding substantially eases the decision-making process to enter alliances and often lessens the firm's demands about the project and/or the partners. Therefore, the attractiveness of this kind of alliance is understandable because the potential benefits can easily exceed the costs. Without funding the interest in research alliances slightly decreases in general but the number and sort of restrictions on participating increase considerably: the size and type of projects become more important and must be adjusted to the firm's availability of resources; the technical and financial aspects have to be carefully pondered; the quality of partners matters more. Without EU funding some firms are not interested in (international) research projects at all.

6.5 DETERMINANTS OF PERFORMANCE

This section is aimed at understanding the type and significance of the benefits that SMEs achieved with the research alliances. The benefits are subdivided into direct benefits - those benefits that are directly related to the project goals - and indirect benefits - those benefits that go beyond the project goals[75]. Benefits are here interpreted as determinants of performance; that is, inputs which are expected to produce an effect on firm's outputs (i.e. on the indicators of performance). Therefore, executives were asked to express on a five-point importance scale the expected effect on firm performance of each benefit achieved.

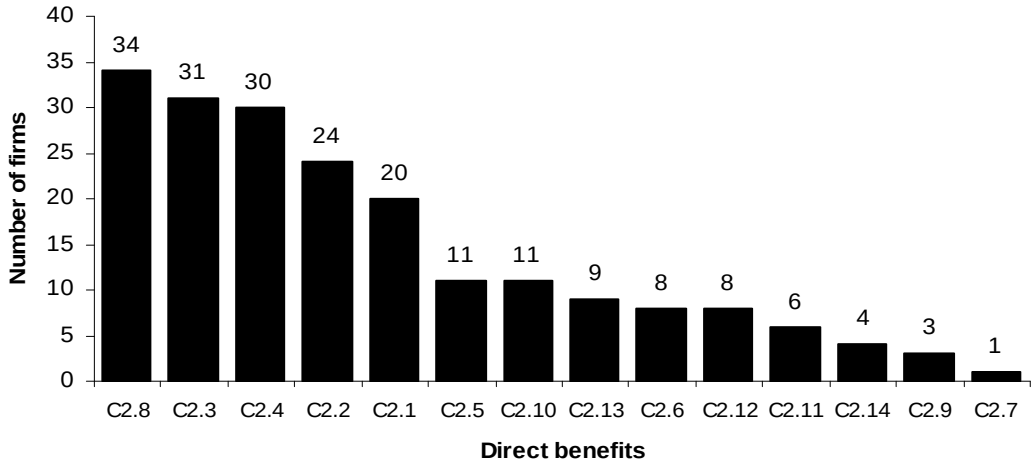
[75] The terminology used here is similar to that of the Beta (1993) study. However, while the Beta study understood the benefits as performance indicators (i.e. sales and cost reductions), the benefits here are considered determinants of performance.

"We [the firm] always learn something with this kind of project, although sometimes it is rather difficult to understand the importance of it to the firm". This expression, heard in various interviews, illustrates how difficult it was for executives to comprehend the exact importance of many benefits, namely those of an intangible nature (e.g. a new friendship).

6.5.1 Direct benefits

The direct benefits are displayed in Figure 6.7 according to the frequency of firms that have achieved them. Perhaps, the most striking aspect that comes out concerns the relative breadth of benefits. The acquisition of experience in interfirm cooperation was considered a benefit to thirty-four firms while only one firm hired qualified personnel (and then just for the research period).

Figure 6.7 *Direct benefits achieved from alliances*



Key:
C2.1 Developed or improved a product/service;
C2.2 Developed or improved a production process;
C2.3 Learned about/had access to the partner firms' technology;
C2.4 Learned about/had access to the RTD performers' technology;
C2.5 A patent was granted to the partner firms (or an application for a patent has been submitted);
C2.6 Specific technical training was (has been) given to employees;
C2.7 Hired qualified personnel;
C2.8 Gained experience in interfirm cooperation;
C2.9 Benefited from temporary personnel; exchanges between partner firms;
C2.10 Acquired new machinery that incorporate new technology;
C2.11 Acquired other equipment that incorporate new technology;
C2.12 Improved /built a new plant/facilities;
C2.13 Created or improved the R&D department;
C2.14 Other;
Source: Table A2.6 in Appendix 2.

It is possible to identify two sets of benefits with different attributes. One set, comprising

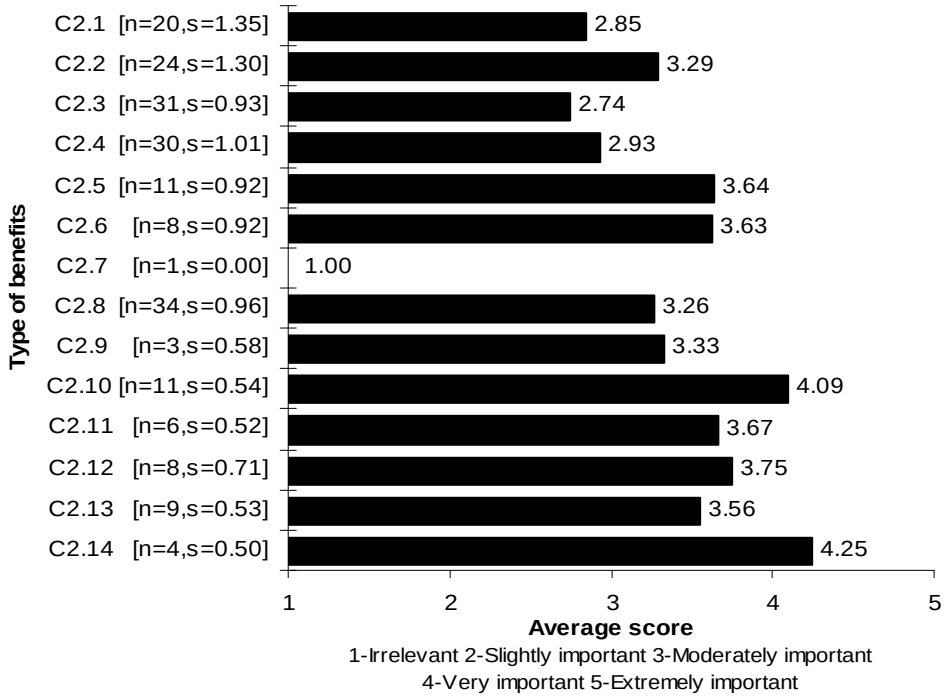
the five most common benefits, involves interaction among partners and is chiefly centred in the research period. The remainder benefits, the other set, have in common a relatively low frequency (all below 26% of firms), many of them have a physical nature (equipment, facilities) and typically occurred later in the alliance implementation stage and especially in the post-alliance period (only exceptionally did the firms need to acquire equipment for the research activities). The achievement of the latter set of benefits depends more on the firm and less on the alliance itself and, unlike the former, relies heavily on the alliance outcomes. Unsuccessful alliances naturally restrain firms from acquiring equipment, giving training to employees or registering a patent, but do not limit the ability of firms to learn from partners or get experience in joint projects. Hence, three factors explain the low frequency of most of the direct benefits (second set): unsuccessful projects, successful projects which do not involve such benefits, and successful projects where the firms voluntarily decided not to exploit the outcomes.

It is not surprising that the acquisition of experience[76] in interfirm alliances has been the most common benefit. Perhaps surprising is why only thirty-three firms have achieved that kind of benefit since half of the remaining firms had no prior experience in cooperative projects. Gaining experience in cooperative research projects was an explicit goal to a minority of firms only; eventually, it became an important benefit to a large number of them because of their interest in entering new alliances. About 70% of all firms had access to the partner firms' and R&D performers' technology (C2.3; C2.4), but it does not necessarily mean there was a huge transference of technology between the alliance partners. Indeed, some firms attempted to prevent any unintended transference of important knowledge to competitor partners. As explained elsewhere, many research projects involved technologies and know-how outside the competencies of technology users and they do not necessarily need to master them in order to use the alliance outcomes. RTD performers' technology is embodied in systems, machinery, products and other alliance outcomes, and many technology users were chiefly interested in their functionality rather than learning how to produce them. This limits the usefulness of certain know-how acquired from alliances.

[76] Although the "acquisition of experience" is an intrinsic benefit of the very act of cooperating, it can also be regarded as an indirect benefit since it is not linked with the project goals.

Figure 6.7 shows how many firms achieved a given benefit but still leaves unknown its expected impact on firm performance and whether that impact varies from firm to firm. Figure 6.8 shows the expected impact of the direct benefits on firm performance. There is no relationship between the number of firms that achieved a given benefit and its average expected impact on firm performance. That is, the average scores of the direct benefits are unrelated to the number of firms who achieved them. In a number of alliances, despite the successful development of a new product, production process or both, firms will not exploit the alliance outcomes at all or will do so partially. Firms had access to the partners' technologies but, if not related to the firm's competencies, this is of limited use. Therefore, in such cases the expected impact of these benefits on firm performance is rather small. On the contrary, when there is intent to exploit the alliance outcomes, the expected effect on the performance of the firms tends to be very significant. This duality explains the relatively low average scores and high standard deviations of benefits such as "Developed or improved a product" or "Learned about/had access to the partner firms' technology".

Figure 6.8 *Expected impact of direct benefits on firm performance*



Key: See Figure 6.7 above.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.6 in Appendix 2.

The post-alliance benefits tend to be highly important to firms that achieve them.

Acquiring new machinery, building a new plant or facilities, giving technical training to employees, investing in R&D or applying for a patent are the kind of determinants of performance that firms expect to have a significant effect on the indicators of performance.

6.5.2 Indirect benefits

The generation of indirect benefits appears to be a normal and potentially important alliance outcome. Only two firms did not achieve any benefit of this kind, though one of them admitted not having any interest in the project. Conversely, three executives affirmed that the importance of the indirect benefits achieved with the alliance exceeds that of the direct benefits, and only in one of the cases was the alliance unsuccessful. The indirect benefits can be classified in at least three different types as follows.

Information- and knowledge-based benefits. Probably the most frequent, this type of benefit materialises when firms make use of the information or knowledge not related to the project obtained in the course of the relationship. Such benefits demand individual action of firms if they are to be really effective. Obtaining new ideas or new skills from partners, getting new knowledge about the competitors or improving the management skills are examples of this type of benefit. These are benefits not easily quantifiable because in most cases it is difficult to capture the (marginal) variation on the indicators of performance.

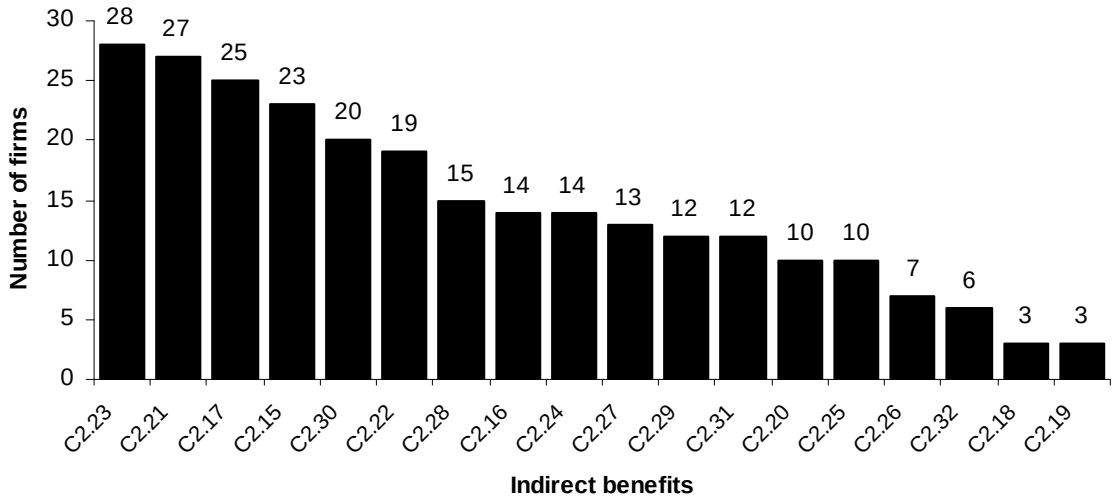
Perception-based benefits. Improving the firm's image, enhancing its visibility or making new friendships are typical examples of benefits that fit in this group. Firms have a perception of the benefit but they are hardly capable of identifying or quantifying its consequences until any other benefit occurs (e.g. a commercial transaction or an invitation to enter new projects) and a causal link is possible to be established. Many benefits in this group are related to the alliance outcomes. A successful alliance is likely to enhance the visibility of the research project and raise the expectations of partners about possible benefits.

Transaction-based benefits. This kind of benefit takes place when the alliance partners decide to establish commercial relations with each other or they establish a formal (or

informal) relationship to carry out further research together.

Figure 6.9 shows the frequency of firms which achieved indirect benefits. Like the direct benefits, the relative breadth of the indirect benefits varies considerably, ranging from three-quarters of firms who acquired experience on how to prepare and implement a (joint) research project, to only three firms which have established commercial relations. The former is a quite surprising finding if one takes into consideration the low participation of firms in structuring the research projects, with some of them delegating to the local RTD performers such a task. What firms have really learned about the organisation and implementation of (joint) projects will be better assessed in future projects, especially if they take the lead.

Figure 6.9 *Indirect benefits achieved from alliances*



Key:
C2.15 Obtained new ideas from partner firms to improve existing products/production processes;
C2.16 Obtained new ideas from RTD performers to improve existing products/production processes;
C2.17 Had access to new techniques and skills (other than those related to the project);
C2.18 Became a supplier of partner firms;
C2.19 Became a customer of partner firms;
C2.20 The firm is applying the knowledge acquired in other products/services;
C2.21 Improved firm's image/reputation/credibility;
C2.22 Improved firm's visibility/exposure;
C2.23 Got experience on how to prepare and implement a (joint) research project;
C2.24 The firm is using the knowledge/experience gained to develop other research projects;
C2.25 Improved management skills/practices;
C2.26 Received proposals for new joint projects from national firms;
C2.27 Received proposals for new joint projects from foreign firms;
C2.28 Learned about an unfamiliar market/customer needs;
C2.29 Developed a formal/informal network to exchange technical information;
C2.30 Found new ways of having access to technical information;
C2.31 Improved the knowledge about competitors;
C2.32 Other

Source: Table A2.6 in Appendix 2.

About two-thirds of the executives believe that the alliance produced a real improvement in the firm's image, and about 45% of them consider that it enhanced the firm's visibility in the environment it operates.[77] Several firms provided information to substantiate their perception but not all of them were able to do so. In general, participating in a joint research project with firms from other countries, R&D institutions and universities is believed to benefit the firm's image because it transmits an innovative posture of firms to the environment where they operate. This is deemed very important to enhancing the firm's credibility to their customers and suppliers. The participation in EU-sponsored R&D projects is also believed to enhance their visibility and credibility at a European level, to both firms and EU institutions. Some firms mentioned as well that it might benefit their position within the (multinational) group they belong to. Three examples illustrate the point and diversity of benefits. One firm proved unintentionally to have the best product amongst its international partner firms and, after the alliance, became the supplier of an important multinational firm. This happened despite the failure of the alliance (see Case study K in Chapter 7). Another firm affirmed it had achieved more benefits with the demonstration of the novel equipment to competitor firms than with the equipment itself. Yet another firm benefited from references in the press to the project success which associated the firm with the project's innovative features.

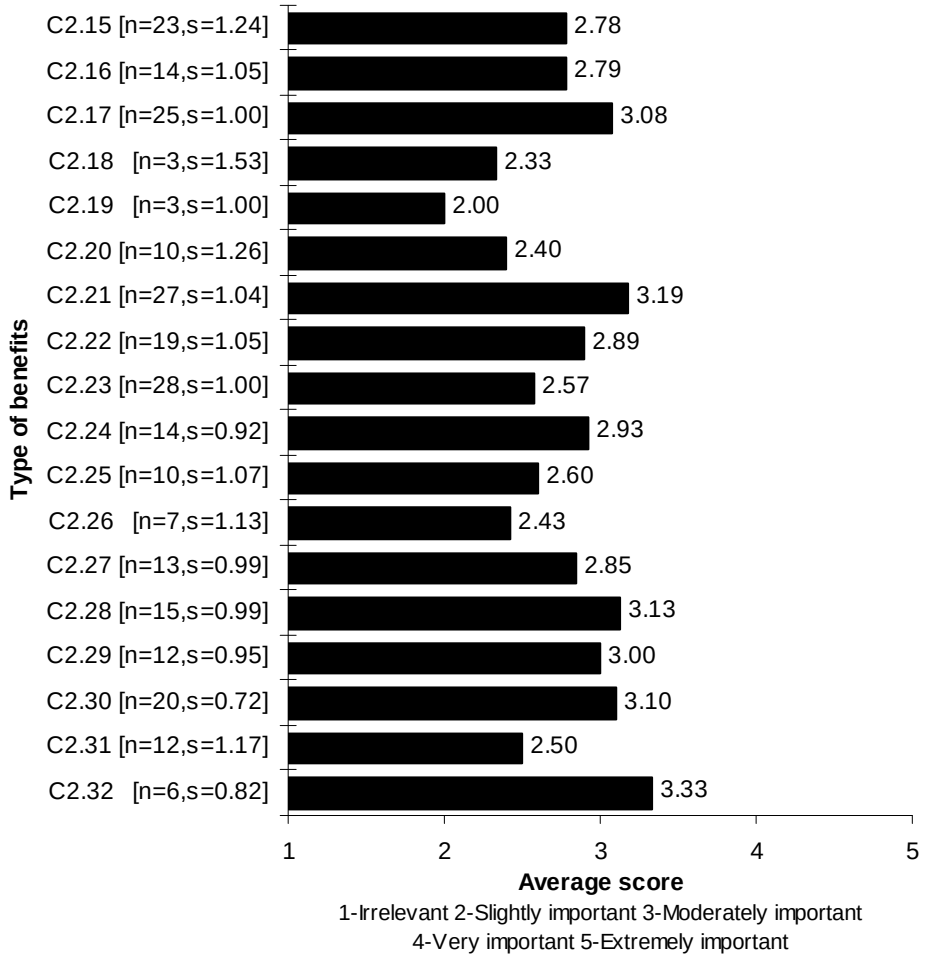
The participation in European projects enhances the visibility of firms, and consequently they are likely to receive proposals for new joint projects, especially when funding is available. Firms received twice as many proposals from foreign firms than from Portuguese ones, which may have to do with the multinational nature of projects. Some of the proposals were from former alliance partners.

Twenty executives said they have found new ways of gaining access to technical information and twelve others affirmed they had developed a formal or an informal network to exchange technical information. Indeed, these two types of indirect benefits are not essentially different from each other. The former basically means that the firms have established contacts with people, firms and R&D institutions which are regarded as an "open door", potentially important for accessing technical information in the future. In the

[77] One firm believes it had improved its image outside the alliance but surely not to the alliance partners, because it lost the interest in the project while being implemented.

latter situation, all but one of the cases are informal relationships among alliance partners who knew each other before this project, some for a long time. Thus, the major difference appears to be the degree of knowledge and trust among the alliance partners. In both situations, firms ascribe great importance to contacts in general and with R&D institutions in particular.

Figure 6.10 *Expected impact of indirect benefits on firm performance*



Key: See Figure 6.9 above.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.6 in Appendix 2.

Figure 6.10 shows the average importance of indirect benefits for firm performance. There is a significant correlation between the number of firms which achieved a particular benefit and its average importance ($r = 0.671$)[78], meaning that the most common benefits tend to

[78] It excludes the variable "Other" because it contains benefits of a different nature to which specific firms tended to ascribe greater importance.

be very important for the firm performance as well and vice-versa.

An important finding is that the experience obtained about how to prepare and implement a (joint) project (C2.23) is far from being the most important indirect benefit despite being the most common. On average, firms do not expect it will have a great effect on performance even though they are very interested in participating in future alliances. This probably means that firms are interested in being involved in alliances but not so enthusiastic about leading the process. Indeed, one executive clearly stressed this. The improvement in the image of firms (C2.21) is another interesting point. It is not just one of the most common indirect benefits but also the one with the highest expected effect on firm performance. A similar situation happens with the skills and techniques that firms had access to (C2.17). This benefit was common to a large number of firms which greatly value the knowledge acquired.

6.6 CONCLUSION

The chapter is concerned with the alliance implementation process and outcomes. It addresses the importance of the investment to the participating firms, examines the negative factors affecting the cooperation process and the alliance outcomes, assesses the alliance performance, and analyses the benefits that firms achieved from alliances.

The data show that unlike the research investment, which was subsidised, the post-research investment necessary for exploiting the alliance outcomes is important and may impede firms from doing so. The amount of resources allocated to the research activities was in general not very significant and the participation in these projects affected neither the firm's normal activities, nor the implementation of other projects. The relatively small amount of resources required from firms to participate in the alliances greatly facilitated their decision to enter them but it is likely it has relaxed their demands and commitment to the project. This probably explains why many firms participated in alliances which the executives affirmed were not strategically important (see Chapter 5).

There were many and diversified negative factors in the alliance implementation process which affected the attainment of better results. They explain many unsuccessful alliances

and thus the ineffective use of resources. The extensive list of negative factors has been reduced to six Factors by means of factor analysis, each of them representing a group of negative factors. The six Factors are “Commitment of partners”, “Cultural aspects”, “Lack of internal resources”, “Unperceived risk”, “Communication problems”, and “Structural problems”. The commitment of partners appears to be the major negative factor of cooperation, but the interdependence of factors makes it difficult to single out a particular Factor and suggests an integrated interpretation of results. Many of the negative aspects of cooperation are rooted in the initial circumstances in which the research alliances were formed, thus confirming the concerns raised in the previous chapter about the weaknesses of alliances.

In general, the results show a relatively high level of satisfaction with the performance of the research alliances. No firm was completely unsatisfied with it. The firm’s level of satisfaction usually reflects the degree to which the alliance objectives were attained, but the overall higher score of the former indicates that the latter does not explain the whole satisfaction of firms. In analysing the satisfaction with the alliance one has to take into consideration the relatively small contribution required of firms, and the importance they attribute to some of the indirect benefits achieved. Just about half of the firms considered that the alliance achieved most or all the objectives set out initially. Most firms have an interest in participating in new alliances, both with and without EU funding; however the latter has a number of restrictions and projects must be adjusted to the firm’s financial and research capabilities.

The vast majority of firms attained direct and indirect benefits from the alliances, even those firms whose project has failed. Most firms gained experience in interfirm cooperation, had access to the partners’ technology, and developed or improved a product or production process. These direct benefits derive from the interaction among partners and are chiefly centred within the research period. Other benefits, such as the acquisition of novel machinery, systems and patents normally require the success of the alliances, and thus were not so common. The generation of indirect benefits appears to be a normal and potentially important outcome of alliances. The most common benefits include gaining experience in preparing and implementing joint projects, having image and reputation improvements, obtaining new ideas from partner firms, and having access to new

techniques not related to the alliance objectives.

The findings of this chapter and those of the previous one help towards a better understanding of the impact of alliances on firm performance that will be addressed in the next chapter.

7 IMPACT ON FIRM PERFORMANCE

7.1 INTRODUCTION

This chapter attempts to bridge technology alliances with firm performance, by focusing on the ability of the participating firms to turn the alliance outcomes into economic benefits. The chapter aims to understand the extent to which the Portuguese SMEs had performance improvements due to participation in the CRAFT R&D alliances and to examine the link between alliance success and firm performance.

The structure of the chapter is the following. First, it looks at the measurement of the impact on several indicators of performance, both using a five-point importance scale and the variation in percentages. Second, it focuses on the ability of firms to exploit the alliance outcomes and identifies the factors impeding them from materialising the potential benefits into performance according to their level of importance. The chapter proceeds with a discussion of the relationship between the satisfaction with the performance of alliances and the impact on the performance of participating firms. Finally, it looks retrospectively at the conditions in which the alliances were formed and implemented, which affected the alliance outcomes and the possibility for firms to benefit from them.

7.2 IMPACT MEASUREMENT

Before proceeding to the detailed analysis of this matter, a few remarks are important at this point. An attempt has been made to capture the variation between the expected impact on the performance indicators, as predicted by firms at the beginning of the relationship, and the real impact on those indicators, resulting from the exploitation of the alliance outcomes. In several cases, though, the latter data could not be collected at the time of the interview because the alliance outcomes were not being exploited yet. Thus, in such cases

the collected information refers to the "updated expected impact" and not the "real impact" on the performance indicators as initially sought. In fact, only a few of those firms that have reported an actual positive effect on firm performance (i.e. D1.18 > 1) were able to provide data on the "real impact" since in most situations there is a time lag (that can be long) between the end of the alliance and the moment of receiving economic benefits from its outcomes (e.g. time for scaling up a prototype, for building a new plant). It is possible that some firms will achieve a smaller amount of benefits than they are currently expecting, particularly those firms which are not in a position to guarantee all the necessary conditions for the successful exploitation of the alliance outcomes. Consequently, in these cases the "real impact" scores are likely to indicate the upper limit of the expected variation on the performance indicators.

One important difficulty occurred with alliances that had ended a long time ago (one year or more). In those few cases the interviewees had to be persuaded to recall the initial expected impact on the performance indicators.

7.2.1 Expected vs. real impact on performance indicators

The study uses eight performance indicators to assess the effect of R&D alliances on firm performance, including conventional and non-financial indicators to better capture the phenomenon. Thus, five of them are conventional performance indicators - productivity, production costs, sales, profit and market share - and the remaining three are non-financial indicators which despite being increasingly important for assessing the new competitive reality of firms still lack a generalised measurement system - customer satisfaction, product/service quality and environment damage. A ninth variable - overall impact - has been used to assess the general effect on firm performance as opposed to the assessment of a specific aspect which the former indicators were intended to address. A list of performance indicators was provided in advance and the interviewees were asked to rate them on a five-point importance scale and then in percentage terms.[79]

[79] The BIE's (1995) study pursued a similar methodological approach in that it asked firms to indicate how much their "key" arrangement affected performance indicators in percentage terms (see Chapter 2). The sample is less homogeneous than the one in this study because firms could choose the "key" arrangement and the arrangements examined were of several kinds.

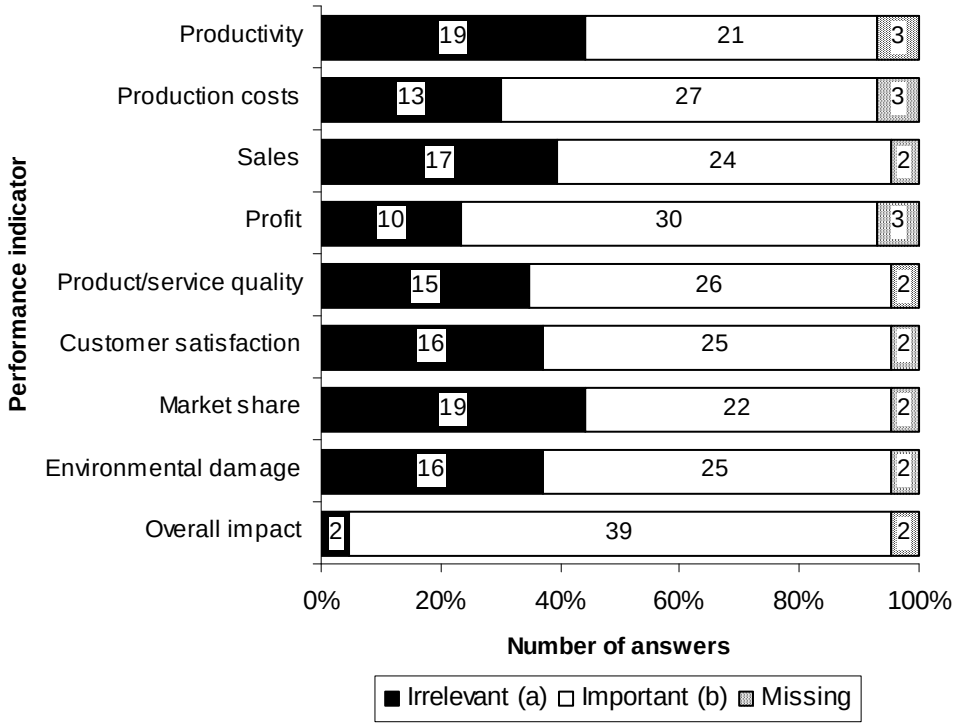
As expected, not all the performance indicators in the list were pertinent to every firm, either at the beginning of cooperation, or at the end of it. Indeed, the performance indicators were relevant to each firm in a particular combination, which could be different even in the case of alliance partner firms of similar activities. The objectives of projects provide a rough indication about the type of performance indicators most likely to be affected but this is far from linear, and the firm's specific characteristics and interests are certainly important factors to take into account as well. The performance indicators were rated "irrelevant" when they were not expected to change. Figure 7.1 classifies the expected impact on the performance indicators as "Irrelevant" or "Important". The latter includes all observations which are associated with a positive expected impact at least in some degree. Two firms were not much interested in the alliance objectives and, therefore, were not expecting to achieve performance improvements from the beginning. A possible third firm could have been included in this group because it entered the alliance for other reasons than the project itself, but even so the firm was expecting a slight impact on performance.

The analysis of the expected performance benefits at the beginning of the relationship helps in understanding the actual performance improvements, but this has not been of much concern in the previous literature. Generally, the expected impact on performance is associated with the initial importance attributed to the projects. However, in some cases, projects deemed "Moderately important" were expected to have a very important impact on performance. This sounds inconsistent and it is possible that the executives were influenced by the alliance outcomes. The major justification for this fact is that businesses were not dependent on the success of the projects but would benefit considerably with the alliance outcomes if successful (see, for instance, Case study D in Chapter 5).

Figure 7.1 shows that to obtain profit was the most common expected performance benefit, but in many cases it was the consequence of some expected impact on other indicators such as the increase in productivity or reduction in production costs. Generally, when the production costs and/or productivity were the intended goals, often involving an innovation in the production process, firms were much less concerned about indicators such as "Product quality" or "Customer satisfaction". If the latter indicators were the goal, namely when the project involved the development of a new product, the former indicators of

performance tended to be less important or not important at all. With the exception of those projects which aimed at diminishing environmental damage, typically to deal with environmental waste resulting from the production process, often this performance indicator has not been considered a goal in itself but something the project has *also* a positive impact on.

Figure 7.1 *Expected impact on the performance indicators*

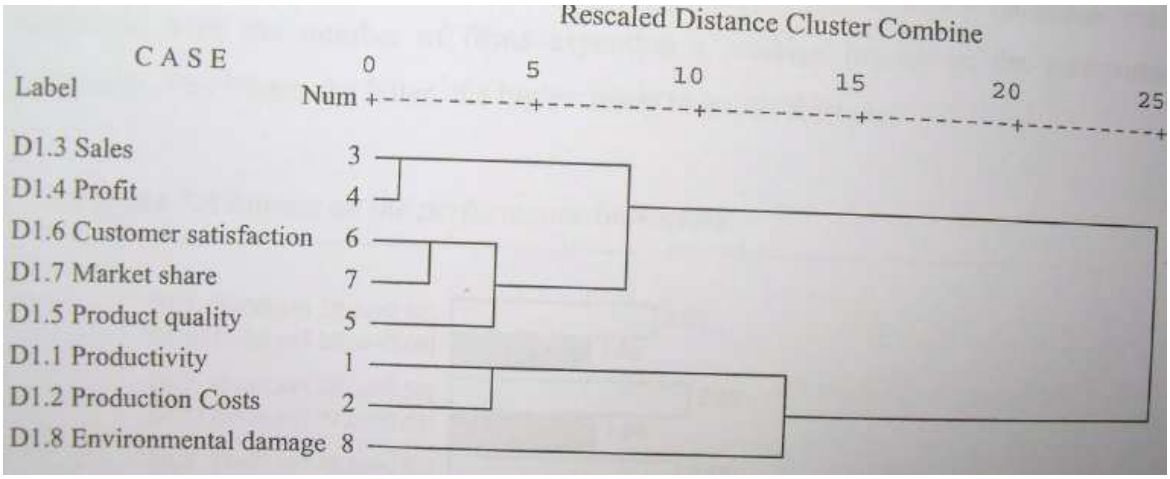


Notes: Number of answers based on the number of observations of question D1: (**a**) of category "1-Irrelevant"; (**b**) of categories "2-Slightly important", "3-Moderately important", "4-Very important" and "5-Extremely important".
Source: Table A2.7 in Appendix 2.

Figures 7.2 and 7.3 present the results of a hierarchical cluster analysis on the expectations about the impact on the performance indicators at the beginning and at the end of the alliance, respectively. They indicate the existence of four clusters for the "Expected Impact" (EI) values: 1-(Sales, Profit); 2-(Customer satisfaction, Market share, Product quality); 3-(Productivity, Production Costs); 4-(Environmental damage). Concerning the "Real Impact" (RI) values, only three clusters are formed since clusters 1 and 2 are blended into a single cluster, forming a now more compact cluster. In both cases, the indicator "Environmental damage" is clearly an outlier, i.e. it did not join until very late, thus confirming its different importance in the context of the performance indicators. In both

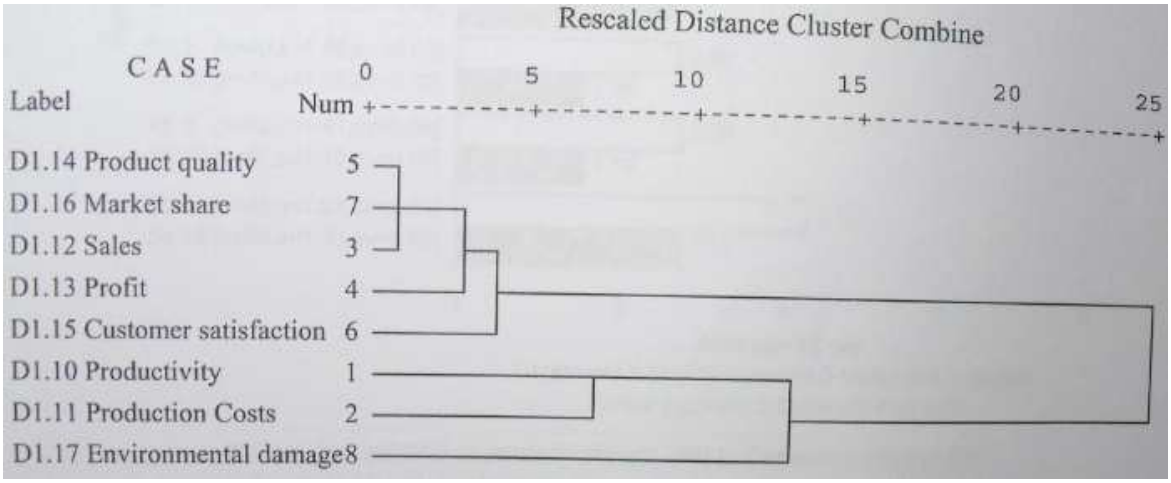
cases, the variable “Environmental damage” clusters with the variables “Productivity” and “Production costs”, showing that the former often involves changes in the latter.

Figure 7.2 *Dendogram for hierarchical cluster analysis (EI scores)*



Notes: Cluster method: Ward’s method. Distance measure: Euclidean distance.
Source: SPSS 9.0 for Windows output using the EI scores of question D1.

Figure 7.3 *Dendogram for hierarchical cluster analysis (RI scores)*

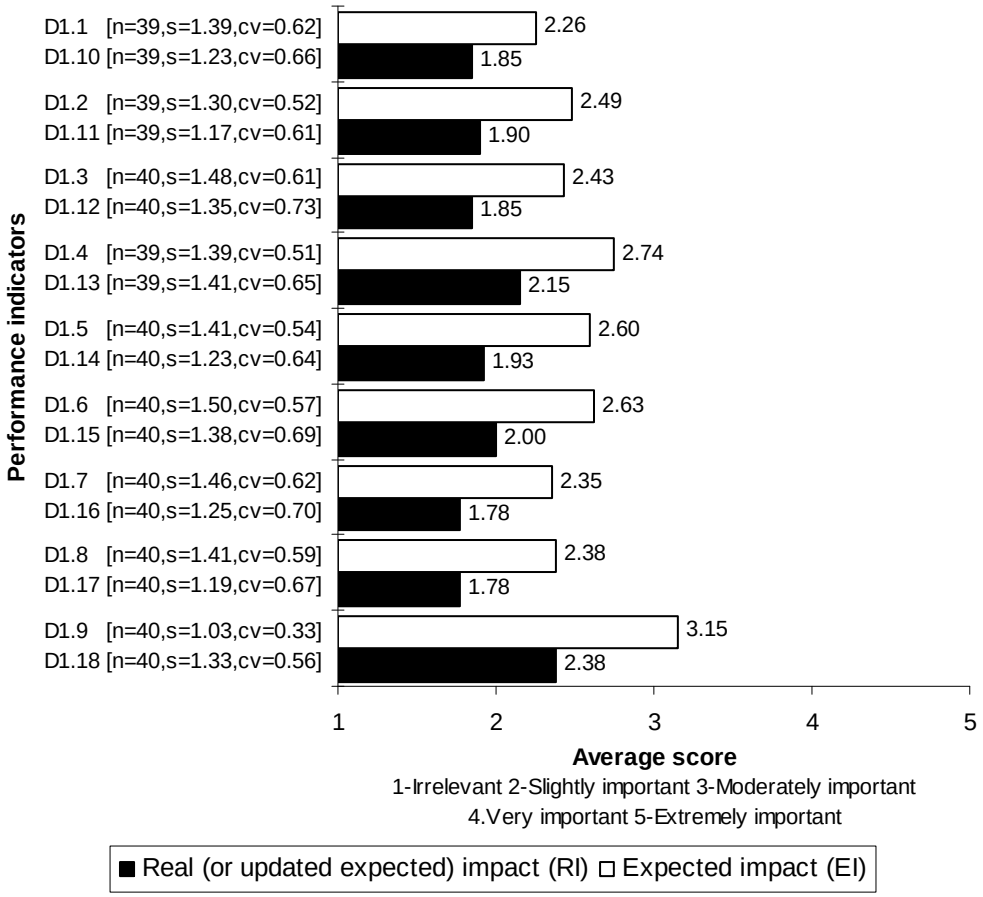


Notes: Cluster method: Ward’s method. Distance measure: Euclidean distance.
Source: SPSS 9.0 for Windows output using the RI scores of question D1.

Figure 7.4 compares the average scores of variables “Expected Impact” and “Real Impact”, which represent the executives’ expectations about the impact on the indicators of performance at the beginning and at the end of the alliance (the latter should read the

moment the interviews were carried out), respectively[80]. The EI average values are relatively small, mainly as the result of the high number of "Irrelevant" observations. The correlation between the number of firms expecting an important impact on the indicators of performance (see Figure 7.1) and the EI average scores (see Figure 7.4) is quite strong, r = 0.924. This means that the average importance of the performance indicators varies positively with the number of firms expecting a positive impact on the performance indicators. The higher the latter, the higher tends to be the former.

Figure 7.4 *Impact on the performance indicators*



Key:

D1.1 [D1.10] Productivity (increase)
D1.2 [D1.11] Production costs (decrease)
D1.3 [D1.12] Sales (increase)
D1.4 [D1.13] Profit (increase)
D1.5 [D1.14] Product quality (improve)
D1.6 [D1.15] Customer satisfaction (improve)
D1.7 [D1.16] Market share (increase)
D1.8 [D1.17] Environmental damage (reduction)
D1.9 [D1.18] Overall impact (improve)

Notes: (n) Number of observations - only (EI,RI) groupings. (s) Sample standard deviation. (cv) Coefficient of variation (=s/mean).
Source: Table A2.7 in Appendix 2.

[80] See Table A2.7 in Appendix 2 for the breakdown of the answers by category.

The sample standard deviation (an absolute measure of dispersion) values of all but "Overall" and "Profit" variables went down as between Expected Impact and Real Impact, while the coefficient of variation (a relative measure of dispersion) values went up across the entire set of performance indicators. The average scores have decreased but the relative dispersion of observations has increased, meaning that the average scores decreased at a higher rate than those of the sample standard deviation. The RI values are relatively more dispersed than those of the EI. For the variables "Overall impact" and "Profit", the observations are effectively more dispersed than they were at the beginning of the alliances.

Figure 7.4 clearly shows a substantial decrease in the average scores from period one to period two across the whole range of the performance indicators. Most important, it shows that the executives were able to distinguish both periods and assess the change in their expectations. The assessment of change in the firm's expectations has not been of concern in previous studies which addressed the question of firm performance through alliances, though it is an important matter and the change noticeable in Figure 7.4 is big enough not to be ignored. Generally, the expectation of firms about the impact of the alliance on the performance indicators did not happen.

As is observable in Table 7.1, which presents the variation in the number of answers per category and per indicator between the two periods, every single category higher than two (i.e. "Slightly important") of every performance indicator has registered a smaller number of answers in the latter period of analysis, denoting a downward adjustment in the executives' expectations. Conversely and consequently, the figures in column two represent the additional number of firms (in relation to those in Figure 7.1) expecting an irrelevant impact on the performance indicators at the end of the alliances.

Twelve firms are now expecting an irrelevant impact on performance. According to the data presented in Table 7.2, which focuses on the variable "Overall impact", twenty Portuguese firms achieved a smaller impact on performance than that initially expected; these firms were partners in sixteen different projects, more than half of the research

partnerships under analysis.[81] Fifteen firms considered that the results achieved basically correspond to what was previously foreseen and only five admitted a positive variation in the amount of expected benefits.

Table 7.1 *Net difference between the RI and EI number of answers*

	1-Irrelevant	2-Slightly important	3-Moderately important	4-Very important	5-Extremely important	n
Productivity	5	1	-2	-3	-1	39
Production costs	9	-2	-1	-5	-1	39
Sales	8	1	-4	-4	-1	40
Profit	9	-1	-3	-4	-1	39
Product/service quality	8	2	-3	-5	-2	40
Customer satisfaction	7	3	-3	-6	-1	40
Market share	7	2	-3	-5	-1	40
Environmental damage	9	-1	-4	-1	-3	40
Overall impact	10	7	-13	-4	0	40

Notes: (n) Number of observations - only (EI,RI) groupings. For each performance indicator and each answer category, the net difference is obtained by subtracting the EI to the RI number of answers.
Source: Table A2.7 in Appendix 2 and interviews (question D1).

Table 7.2 *Overall impact on the performance of firms: real vs. expected impact*

	RI < EI	RI = EI	RI > EI	Missing
No. of firms satisfying the condition	20 (46.5%)	15 (34.9%)	5 (11.6%)	3 (7.0%)
No. of alliances these firms are from	16	13	4	3

Notes: (RI) Real impact. (EI) Expected impact.
Source: Interviews (question D1).

The downward movement in the firms' expectations described above has a variety of causes, as the case studies presented in this chapter and in Chapter 5 attempt to show. Several research alliances ended up with poor technical results that do not permit any economic application of the new knowledge acquired (see Case study E in Chapter 5); other alliances achieved interesting and useful technical results, however smaller than expected due to problems faced during the research activities or just because the technology under development reached its physical limit (see Case study M in Box 7.3 below). Technology-related causes are common to about 60% of those 20 cases where RI < EI. In the other two cases, despite the technical success of the alliances, the small size of

[81] In Table 7.2, the sum of the second row, 36, is higher than the number of alliances under analysis, which is 30. This is evidence that the alliance outcomes do not have a similar importance to all the partner firms of a particular alliance. Indeed, there are several factors influencing the ability of firms in identifying potential advantages and having access to them. With firms naturally different from each other and having different sets of objectives, their ability to perceive and/or appropriate the alliance outcomes tend to vary as well.

the firms impedes them from taking full advantage of the potential benefits generated by the alliance. The dependence on external factors not under the firms' control, such as market conditions or the customers' decision on whether to get technologically updated, is a great obstacle to the ability of four firms to benefit from their alliances (see Case study F in Chapter 5). Finally, one firm lost interest in the project in the course of its execution and the EU cancelled another project (see Case study B in Chapter 5).

In general, when alliances achieved results comparable to the initial expectations, the executives scored variables RI and EI identically, but at least four out of these fifteen executives affirmed the alliance achieved only partially the goals set out at the beginning. Unplanned benefits in the course of the relationship or the fulfilment of particular objectives, sometimes those firms were really concerned about, compensated for the weaker technical results achieved, leading these four firms to keep the same score, though on different grounds (see Case study K in Box 7.1). Only five firms reported that the real benefits surpassed the initial expectations, and two of them believe that the impact on performance will be extremely important. This is the result of positive effects on some performance indicators that were not expected to change (i.e. the "Productivity" or the "Production costs"), better commercial benefits than expected, or achievement of indirect unplanned benefits (see Case study C in Chapter 5).

Box 7.1 *Case study K*

An R&D project was set up to improve the quality control and performance of retreaded tyres. The alliance included three different aims (or projects): i) to develop a machine for thoroughly scanning the tyres to retread and present results in a way that any unskilled worker could interpret. It failed mainly due to the complexity of software programming. ii) to develop an item of equipment for testing tyres in conditions as close to real as possible. The alliance partners were pessimistic about possibility of achieving this objective and did not commit entirely to the project. iii) to develop a new, environment-friendly water-based glue which is used in the production process. The project was under way when they found out that there was already a product with such characteristics.

This project was oversized to be entirely accomplished within a two year period, and atypically there were twenty alliance partners in total (firms and RTD performers). This was the very first experience in cooperation of the Portuguese retreaded tyres SME, and it lacked specific technical knowledge or qualified people to participate actively in the research activities and assess the RTD performers' quality and the quality of research being done. The firm did not accept any other Portuguese competitor in the alliance and the alliance partners refused a firm's proposal to include a Portuguese RTD performer who could help the firm. "We were given the technical reports from our alliance partners but we had no technical competence to assess them", concluded the firm's manager.

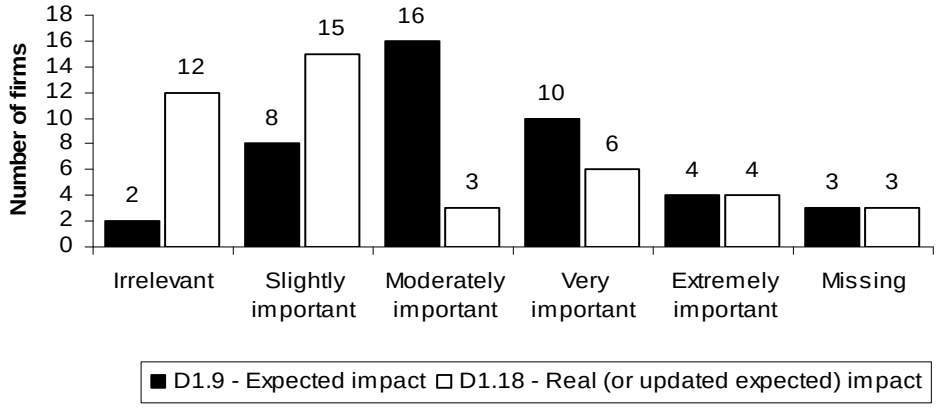
The firm's level of satisfaction is the result of two different outcomes. On the one hand, the technical outcomes were rather poor and the firm will not get any economic benefits. On the

other hand, unintentionally and surprisingly the firm's products were successfully tested against those of its alliance partners and proved to be of higher quality. Just after the alliance the firm became a supplier of a multinational tyre firm, which the manager believes is an indirect consequence of that unplanned benefit and the firm's better image and higher external visibility.

Source: Interview.

Figure 7.5 looks at the category level variations of the variable "Overall impact" between the two periods. An important fact that comes out is the shift of about 43% of the observations from the categories "Very important" and "Moderately important" to the categories "Slightly important" and "Irrelevant". The category "Moderately important" lost thirteen observations, falling from the top to the bottom rank in terms of its relative importance. The overall real impact on firm performance is much smaller than what most of the firms thought it would be. For twelve of them that impact is expected to be irrelevant and for another fifteen is only slightly important. As will be demonstrated below, such small or zero impact on firm performance does not necessarily mean alliance failure or dissatisfaction with the alliance outcome (see Case study L in Box 7.2 below). Puzzling and perhaps inconsistent is the fact that those twelve firms who reported D1.18 = 1 also claimed having had some direct and indirect benefits and were confident that such benefits would have a positive effect on performance.

Figure 7.5 *Overall impact on firm performance - breakdown of the answers by degree of importance*



Source: Table A2.7 in Appendix 2.

One possible explanation for that inconsistency comes out through the analysis of the method used by several executives to score the overall impact on performance. They estimated the answer to the overall impact on firm performance as a kind of an "average

score" of the answers given to the previous performance indicators. Since the questions about the alliance benefits and about the performance indicators were asked separately and in different contexts it might have hindered the link that should have been established between the two. Presumably, those twelve interviewees answered questions D1.9 and D1.18 without establishing such a link. Perhaps a more convincing explanation, as we will see below, lies in the visible difficulty felt by many executives to identify and quantify small intangible benefits.

Box 7.2 *Case study L*

A foundry SME with 150 employees entered an R&D alliance for the first time, aimed at improving the technological process of production of castings (ceramic method). This firm is part of an international group, which is also its main source of technological inflows. The interest of the alliance for the firm was more in the possibility of establishing international contacts with firms and research institutions and getting experience in cooperation than the potential outcomes of research. Its general manager explains: "The project was of marginal importance because we were not expecting any technological breakthrough or even a major technological improvement. It was important to be there and follow closely the research being done but we were not expecting great economic benefits." The firm wanted to "release" itself a bit from the parent-firm's dependence. The alliance was considered technically successful but the results are essentially advantageous for the production of big pieces (bigger than 4 kg), which represents a very small percentage of the total production. "One has to make many calculations to adopt the new process for the production of small pieces", he argued. The firm is nevertheless satisfied with the alliance performance, especially because it has achieved its own objectives.

Source: Interview.

7.2.2 Impact on the performance indicators in percentage terms

Almost all executives were able to assess the impact on the performance indicators on a five-point importance scale. Would they be able to "translate" those scores into a more objective and comparable measure, for instance in percentages? The executives were challenged on that matter and the results are shown in Table 7.3. The exercise has been only partially successful but the findings are meaningful.[82] Of those executives expecting an overall positive impact on firm performance (D1.18 > 1), only a part of them were capable of giving an adequate answer and just one executive provided a complete answer.

[82] Apparently, the BIE (1995) study was more successful in obtaining data about changes in percentage terms. The fact that respondents were allowed to choose their "Key" arrangement (i.e. "the most important cooperative relationship a firm has established" (BIE, 1995: 145)) and the data referred to a period of three years prior to the survey possibly created better conditions to increase the answer rate.

Table 7.3 *Variation of the performance indicators in percentage terms*

Project No.	D1.18 scores	Performance indicators								
		D3.1	D3.2	D3.3	D3.4	D3.5	D3.6	D3.7	D3.8	D3.9
1	5	20	20	15	5	?	?	?		?
6	5			?	?	?	?	?	70	15
11	5	10	?	?	?	?	?	?	?	?
15	5	?	?	35	15	?	?	10	?	20
7	4	20	5	15	?	10	20	10		25
8	4	20	5	15	?	10	20	10		25
12	4	30	15	25	7.5	10	10	20	5	10
19	4	50	15	40	15	50	?	70		40
31	4			?	?	?	?	?		?
41	4	0	25		0.1	?			20	20
13	3	25	18	20	?	15				15
18	3		15		5	?	?	?	?	?
26	3									?
2	2		?		?				?	?
9	2			1	?		?		?	?
14	2		?						?	?
17	2			?						?
21	2	?	?		?	?	?		?	?
23	2	?	?		?				?	?
24	2	5	4	6	?	2	60	2	?	?
28	2					?	?		?	?
29	2									?
32	2	0.1	0.1	0.1	0.1	?	?	10	?	?
33	2		?		?					?
34	2									?
35	2	?				?	?	?		?
39	2	?	?							?
43	2	?	?	?	?	?	?	?	?	?
% of no responses		37.5	47.4	33.3	65.0	66.7	76.5	50.0	80.0	71.4

Key:
D3.1 Productivity (increase)
D3.2 Production costs (decrease)
D3.3 Sales (increase)
D3.4 Profit (increase)
D3.5 Product/Service quality (improve)
D3.6 Customer satisfaction (improve)
D3.7 Market share (increase)
D3.8 Environmental damage (reduction)
D3.9 Overall impact (improve)

Notes: The table includes only those observations for D1.18 > 1. (?) Answer not provided. (blank cell) Answer not expected (because RI = 1 in question D1).
Source: Interviews (question D3).

Furthermore, there is an unbalanced distribution of the answers in relation to the importance of the expected overall impact on firm performance. The executives felt much less comfortable in providing answers for smaller expected impacts (i.e. when D1.18 = 2 or 3). The nature of the alliances does not appear to be an acceptable justification for their inability to answer this question because the research projects were very problem-solving orientated and the alliance outcomes were to be exploited straight after the research phase,

provided the necessary conditions to do so could be met. Executives provided two major reasons for not answering the question. On the one hand, the expected variation was rather small and the cause-effect link was very difficult to establish, thus impeding any attempt to quantify it accurately. On the other hand, some of them admitted they simply do not know how important that effect will be, however in some cases not all elements were available for calculating it.

As regards the relative answer rate per performance indicator (bottom row in Table 7.3), the variables "Environmental damage" and "Customer satisfaction" got the lowest answer rate, both less than 25%, while the variables "Productivity" and "Sales" achieved the highest rates, 66.3% and 62.5% respectively. These figures suggest that the assessment of the impact on the conventional performance indicators is less complicated, perhaps because the non-financial indicators still lack an adequate and reliable measurement technique or because they are not systematically assessed yet. By comparing the subjective assessment of the overall impact on firm performance against the variation in percentage terms (i.e. variables D1.18 and D3.9), there may be noticed some inconsistency between the two. For instance, projects 6 and 13 were given the same overall variation in percentage terms (D3.9 = 15%), but the corresponding overall impacts were assessed rather differently ($D1.18_6 = 5$ and $D1.18_{13} = 3$).

The available data are perhaps insufficient for strong statistical inferences, but are sufficiently significant to realise the potential benefits firms can get by participating in a research alliance of the kind under analysis, if technically successful and the outcomes are exploited. Table 7.4 attempts to compare some characteristics of those projects which the executives expect an impact on performance greater than "Slightly important" (i.e. D1.18 > 2). All the projects for which the executives were able to provide data on the overall impact on performance (D3.9) involve important innovations, some of them about to be patented, and firms had no in-house expertise (and other research resources) to carry them out alone. These firms achieved a competitive advantage with significant impact on their performance as the figures available indicate (in three cases the numbers are based on real achievements, not updated expectations). Unlike the research costs, the investment necessary to exploit the alliance outcomes is considerable.

Table 7.4 *Some characteristics of the projects reporting a real impact on firm performance greater than "Slightly important"*

	Project number												
	1	6	11	15	7	8	12	19	31 (*)	41	13	18	26
Goal-achievement (C1.2)	5	5	5	5	4	4	5	5	5	4	4	5	2
Number of partners	9	9	12	5	8	8	7	7	16	18	9	13	20
Impact on performance (C3.9)	?	15%	?	20%	25%	10%	40%	?	20%	15%	15%	?	?
Importance of Post-alliance Investment	Very	Very	Slightly	Very	Important	Important	Very	Very	Insignificant	Important	Slightly	Insignificant	Important
Prior knowledge about partners (**)	Little	Good	Little	Good	Good	Good	Fair	Good	Fair	Little	Little	Fair	Little
Prior experience	= 0	= 0	< 3	≥ 3	< 3	< 3	≥ 3	= 0	≥ 3	= 0	≥ 3	= 0	= 0

Notes: (*) Admittedly not a complex project. (**) "Good" and "Fair" refer to the level of prior knowledge of at least one alliance partner.
Source: Compiled from fieldwork.

7.2.3 Measurability of the performance variation

An important question deriving from the data above relates to the measurability of performance variation. To what extent can firms associate performance variations with benefits achieved from alliances? While there are some "inputs", e.g. a new type of production equipment, that may have a relatively straight measurable impact on the performance indicators, other types of "inputs", e.g. new knowledge about competitors, are not that simple to establish a cause-effect link with performance. As we have seen before, all executives were able to identify a number of direct and indirect benefits achieved from alliances and they were able to assess impacts on performance on a five-point importance scale, but only a few of them were able to provide a more objective assessment, i.e. the variation of the performance indicators in percentage terms. All benefits are important to the performance of firms but it appears that the causes for performance variations cannot be always tracked down, because of the difficulties of isolating cause-effect relations.

Many of the benefits achieved by the firms had a very small influence on the performance indicators and any attempt at measuring that impact was strongly discouraged by the

opportunity costs involved.[83] For instance, obtaining ideas from partner firms was one of the most common indirect benefits which many executives were prepared to detail, but only a few of them could assess the benefits in terms of performance. There were small changes in the production process that could hardly be quantified. The CEO of a shoe-making firm said, "The alliance has reached its objectives, we have now a competitive advantage and there was an impact on performance. However, it is very difficult to quantify such impact because, in part, this impact is on intangible factors of competitiveness, such as comfort in workplace, image, visibility and quality." This is likely to be the main reason why all the executives reporting an overall impact on performance smaller than "Moderately important" were unable to quantify that variation in percentage terms (see Table 7.3 above). It looks as if there is a threshold in the variation of performance for which the quantification becomes relevant. None of the figures provided by the executives for the overall impact on performance is lower than 10%.

Another aspect concerning the measurement of performance is the relative difficulty of assessing different types of benefits. In general, the executives' perception about the impact on performance of tangible inputs, such as equipment, facilities or products, is more accurate than that of intangible inputs, such as improved image, enhanced visibility or experience in cooperation. Among the latter type of inputs, those directly related to the firm's production activity (e.g. new technology) tend to be better assessed than those of a more general nature (e.g. improving knowledge about competitors). The small expected consequences on performance and the difficulty of assessing intangible benefits are probably the explanation for the fact that 12 executives reported no expected impact on the firm performance but affirmed having had some direct and indirect benefits. Measuring the impact on firm performance is not always feasible or even possible. It depends on the type and amount of variation of the determinants of performance. The Beta (1993) study, the only known study which attempted to quantify all economic effects in currency units, could not quantify about one-third of all identified effects.

7.3 ABILITY OF FIRMS TO EXPLOIT THE ALLIANCE OUTCOMES

The ending of a technology alliance is not the end of the process it implies. At the end of

[83] We have seen in Chapter 6 that firms were not very keen to assess the benefits in great detail.

the research period, partner firms normally have new knowledge and prototypes but they still need to have the capability to exploit the alliance outcomes and, de facto, materialise the potential benefits generated together. This intermediate stage between the research and exploitation of results is very important, even crucial in some cases, and cannot be taken for granted because it involves the risk of failure. Such risk was not taken into account at the beginning of the relationships, and even at the end some firms seemed not to be fully aware of it. Depending on the specific characteristics of projects, this intermediate stage may involve a great deal of collaboration of part or all of the former partners. Some projects end naturally at the end of the research period, others require further actions such as building adequate facilities, scaling up prototypes, meeting market requirements, obtaining technical assistance in setting up the new capability or financial resources. Not all of these factors are always under the firm's control.

Table 7.5 presents a variety of factors which might influence the ability of firms to exploit and benefit from the alliance outcomes (entries are ordered according to variable D1.18). The analysis focuses chiefly on the outcomes related to the alliance objectives, thus excluding any other indirect benefits firms may have achieved. Those factors have been divided into three categories, each of them having a different prospect of turning the research results into economic benefits. The three categories of factors are as follows:

"None"-type factors. To those firms included in this category, the possibility of achieving economic benefits is extremely low. This comprises 35% to 42% of all firms, depending on whether some of the firms falling in the other categories who expressed the intention of not exploiting the alliance outcomes are excluded or not.

The most important factor in this category is the poor technical results achieved by alliances that do not allow any economic use of the knowledge acquired (unless further research is carried out, in some cases). Also in this category are those firms who entered the alliance for other reasons than the project itself, and those who realised over its execution that the expected outcomes did not suit their interests. The EU cancelled one project and one firm participated in the alliance basically to confirm its own research findings, i.e. confirm the limitations of a specific production technology (see Case study M in Box 7.3 below).

Table 7.5 *Prospect of exploiting alliance outcomes - relevant factors*

Project No.	C1.1	D1.18	Outcome exploitation		Prospect of attaining economic benefits											
					None				Limited			Conditional				
			Yes	No	a	b	c	d	e	f	g	h	i	j	k	l
6	5	5		●									●			●
15	5	5	●													
1	4	5		●									●	●		
11	4	5	●													
7	4	4	●													
8	4	4	●													
12	5	4		●									●			●
19	5	4		●								●	●	●		
31	4	4		●			●									
41	4	4	●													
13	4	3		●					●		●					
18	4	3		●									●			
26	3	3		O	●											
2	5	2		●									●	●	●	
9	3	2		●					●		●	●				
14	4	2	●							●			●			
17	4	2		●			●						●			
21	2	2		●	●								●			
23	4	2		●					●				●			
24	4	2	●									●	●		●	
28	3	2	●						●							
29	2	2		O	●											
32	3	2		●			●									
33	4	2		●					●				●			
34	2	2		●					●		●	●				
35	5	2	●						●							
39	4	2		●			●		●							
43	3	2		●					●				●	●		
3	2	1		O	●											
4	4	1		●						●			●			
5	3	1		●			●							●		
10	2	1		O	●											
16	2	1		O				●								
22	4	1		O	●											
25	2	1		O	●											
30	4	1		O		●										
36	5	1		●	●		●									
37	4	1		●								●				
38	4	1		●								●				
42	3	1		O	●											
20	3	?		●									●			
27	5	?		●			●			●			●		●	
40	?	?		●									●			

Key:

[**a**] Poor technical results (its economic use is hardly feasible); [**b**] Research results have just validated the firm's prior knowledge; [**c**] Firm's interest/commitment gradually vanished over the project execution or there was no interest in the its outcomes at all; [**d**] The EU cancelled the project; [**e**] Research outcomes were smaller than expected (but positive); [**f**] Firm is too small to benefit fully from the alliance outcomes; [**g**] Firm (or a Group's firm) developed a better alternative process/product meanwhile; [**h**] Market conditions have changed or are different from expected; [**i**] Dependence on external factors or on the former partner firm(s); [**j**] Insufficiency of financial resources (to exploit the results immediately) or the cost of the equipment (not known yet) is important in the decision to acquire it or not (when it is marketed); [**k**] Lack of resources to exploit the results independently; [**l**] Firm (or the partners) needs to set up a new plant or to make changes to the production layout;

Notes: These factors were relevant at the time of the interviews. In the column "No", the symbol (●) means that the alliance outcomes are not being exploited but that possibilities exist, while the symbol (O) means that such possibilities do not exist, normally due to poor technical results.

Source: Compiled from fieldwork.

Box 7.3 *Case study M*

A project was set up to improve the application of copper alloys in manufacturing injection moulds for plastics. The use of copper parts in moulds instead of stainless steel may increase the production of plastic products up to 20% because copper cools down faster but stainless steel lasts much longer. This alliance included a total of 18 partners, four of which were local competitor mould-making Portuguese SMEs. One of these firms makes moulds for its plastic unit and had done research to improve the performance of copper in moulds prior to this project. This was the first time the firm entered an alliance and the CEO explains how important it was. "The expectation about the alliance outcomes was small given our own research results. Even so, we entered the alliance hoping that any of the alliance partners could contribute something better than what the firm had already achieved. However, the strongest expectation was that the results would confirm only what the firm already knew." Basically, the firm entered the alliance to confirm its own results and learn from the partners but something unexpected happened. "We contributed to the project with knowledge we got from our own research without getting anything useful from the alliance. This only facilitated the sharing of information and knowledge with partners who had much less knowledge about the use of copper than us. This was an advantage for our competitors", he concluded. Indeed, the firm did not benefit from the alliance but its local partner firms did (two of them were interviewed). The firm is relatively satisfied because the alliance attained its objectives and it could confirm the results of prior research. The firm will not have performance benefits, not because the use of copper is not good, but because it has no absolute advantages over stainless steel.

Source: Interview.

"Limited"-type factors. These factors somewhat impede firms from fully taking advantage of the alliance outcomes, or the technical results achieved fell far below the initial expectations, though they are positive and useful. 16% to 19% of the firms fall within this category, because a firm decided not to exploit the alliance outcomes for the moment but perhaps it may be interested to do so in the future.

It happens when the firm's small size (in terms of production capacity) is an obstacle to the entire exploitation of the new technology, which may lead the firm not to exploit it at all (see Case study N in Box 7.4). In such circumstances there is a minimum size required for the new technology to be cost-effective. This category also includes those cases where the new technology is useful only to a fraction of the firm's range of products or processes, and those cases where the alliance outcomes were positive but smaller than expected initially due to the technological complexity of the project or limitations of the technology. Two firms regarded this last aspect as not necessarily a bad thing because they are now technically prepared to explain to their customers the limits of the technology and suggest the best possible solutions.

Box 7.4 *Case study N*

A CRAFT alliance was set up to develop a clean technology to eliminate the waste from the tanning and footwear industries. The leather waste would be burned under controlled conditions, generating heat to warm up water, and the chromium subsequently removed from the resulting ashes in order to become inert. Three Portuguese firms of different sectors entered the alliance. A shoe-making firm with 300 employees adopted the new technology to burn the leather waste, which permitted a substantial increase in productivity, especially in wintertime, and had many indirect benefits as a result of many contacts with competitor firms who became interested in the new process. A tanning firm with 30 employees could not adopt the new process because it does not produce enough leather waste to make the new process economically feasible. A chemical SME was supposed to treat the ashes but the firm entered the alliance for other reasons and was not really interested in doing so. Furthermore, the alliance did not find an economic solution for the logistic problems of collecting the ashes and separating the different types that exist.

Source: Interview.

"Conditional"-type factors. To the firms included in this category, the attainment of economic benefits is normally postponed because it is dependent upon further actions to be taken either by the firm itself or by a third party, or by both of them. It sometimes depends also on the evolution of the economic context in which the firm does business. This category comprises 30% to 35% of all the firms in this study, with varying degrees of dependence and risk of failure.

The range of factors in this category is very diversified, including: firms which have no sufficient means to acquire the novel equipment immediately; the decision to acquire the novel equipment depends on its cost-effectiveness (cost not known in some cases); the new (industrial) equipment, production system or (industrial) product has yet to be produced and marketed by a third party, frequently a partner firm; a new specific plant has yet to be built or the firm's production facilities layout has to be modified; there are important logistic problems of collecting the raw material; the market conditions are different from expected in terms of the raw material prices, production price, market size, etc.; or firms need technical assistance from RTD performers or further research needs to be carried out (see Case study O in Box 7.5 below). In many situations, the potential economic benefits and the time for having access to them are dependent on circumstances that basically escape the firm's control, hence increasing the risk of not achieving the intended objectives. The risk is not negligible, and frequently the firms in this category were not in a position to guarantee the successful exploitation of the alliance outcomes, although they

were optimistic about that. One executive even concluded, “There is the feeling that the partner firms are too small to implement the project only by themselves; it would be advantageous if a bigger firm shows interest in the project.”

There is a remaining group of firms, about 12% of the total, that does not fit in any of the above categories. These firms successfully went through the intermediate stage and were already exploiting the alliance outcomes at the time of the interviews (see, for instance, Case study C in Chapter 5).

There are two other aspects worth stressing about the data in Table 7.5. Those nine cases identified as having had poor technical results (symbol O) correspond to eight research alliances, about 27% of the total under analysis. By analysing the scores of variables “satisfaction with the alliance performance” (C1.1) and “overall impact on firm performance” (D1.18), one realises that smaller scores for the latter variable do not imply smaller scores for the former, even in the case of poor technical results. That is, many of the firms expecting a small or zero impact on performance are nevertheless satisfied with the performance of alliances, meaning they value a great deal the intangible benefits eventually achieved even though such benefits are not easily quantifiable in terms of performance.

Box 7.5 *Case study O*

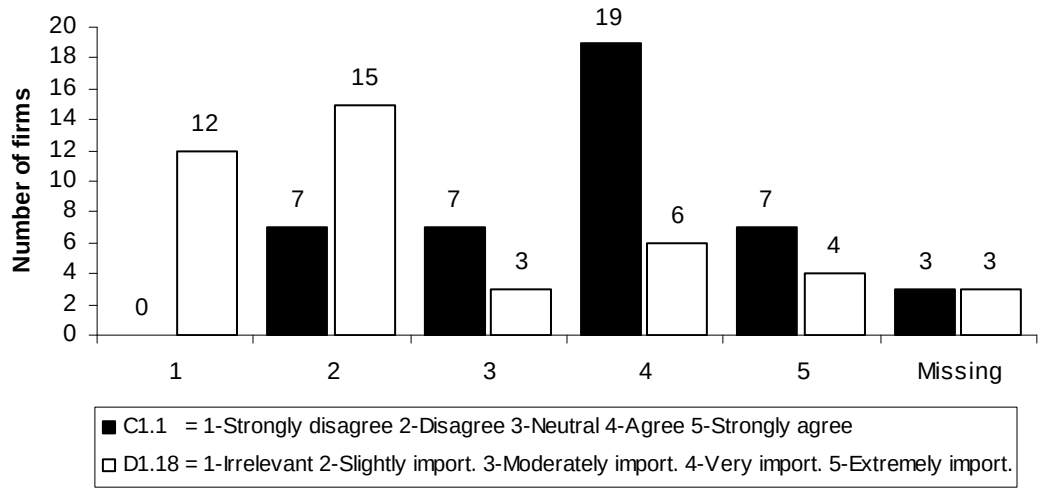
A construction sector firm (with 300 employees) was the prime proposer of a CRAFT alliance formed to study the use of ceramic waste in concrete products. This project was seen primarily as an opportunity to work with the university, coming in second place its economic potential and the fact that it was environmentally friendly. Eventually, the project was technically successful and drew the attention of the local media that gave visibility to the project. The firm greatly benefited from its association with an innovative and “more ecological” project. According to its CEO, the project will be implemented within a year but two important problems have no solution yet: first, there is no guarantee that the ceramic waste (in Portugal) is sufficient to supply a plant which will be built specifically for that purpose; second, the logistic conditions for collecting and selecting the ceramic waste are not met yet. The expectation was high but the firm was aware of the risk involved in the implementation of the project.

Source: Interview.

7.4 SATISFACTION WITH THE ALLIANCE AND IMPACT ON FIRM PERFORMANCE

Is there a contradiction between the reported degree of satisfaction with the alliance performance and the overall positive impact on performance? Does the positive assessment of the former necessarily imply the latter consequence? Figure 7.6 compares the answers to both variables. It shows that these variables apparently do not match with each other and even suggests that there is some contradiction between the two. While about two-thirds of the interviewees positively assessed the performance of alliances (i.e. C1.1 = 4 or 5) and none of them was completely unsatisfied with it, one gets quite the opposite picture reading the overall impact of alliances on firm performance, as two-thirds of the answers indicate that such impact is irrelevant or slightly important (i.e. D1.18 = 1 or 2). Only seven firms were not satisfied with the alliance but many more were expecting a small or no impact on their performance. However, as we have seen before, all the executives expecting a slightly important effect on performance were unable to convert it into a percentage variation.

Figure 7.6 *Alliance performance assessment vs. overall impact on firm performance*



Note: Only (C1.1;D1.18) pairings were included in the analysis. If one of the variables is missing, both are considered as missing observations.
Source: Table C1 and Table D1, both in Appendix 2.

In explaining the results, one cannot rule out some inconsistency[84] between the answers since the two questions were asked in different contexts, but its explanatory power is likely to be minimal. There are several other explanatory factors in support of the hypothesis that alliance success, measured here by the degree of the firm's satisfaction, does not necessarily imply better firm performance.

Taking into consideration the answers of fourteen executives who were satisfied with the alliance performance (i.e. C1.1 = 4 or 5) but reported a small or zero impact on the firm performance (i.e. D1.18 = 1 or 2), it seems unlikely that there is a strong correlation between these two variables. The following factors summarise the circumstances on which the executives based their answers.

Dependence on external factors. The alliance may have achieved technical success but the subsequent economic success depends on external conditions not under the firm's control. For instance, it may happen when the performance (or the use) of an improved component/system relies on the performance of the equipment where it is to be fitted. If the existing equipment is not able to take full advantage of the improved component or if the firms (customers) do not update their equipment, the commercial success of that improved component is unlikely to happen. On the other hand, alliances may have achieved technical success, for instance a new product, however due to changes in the economic context occurring in regard to the project's execution, it is no longer feasible to proceed to industrial production while the current conditions remain unaltered. For example, the raw material price of a new product may have risen so much that the product is no longer competitive even before it is launched (see Case study F in Chapter 5). The manager of a machinery and equipment sector firm said: "The actual results will be smaller than expected because, to take full advantage of this technology, our customers [firms] need to upgrade their machinery and many will not do it. The culture in this sector [textiles] still regards price as more important than quality."

Dependence on internal factors. Firms lack the minimum size required to benefit fully from

[84] Indeed, there appears to exist some inconsistency because twelve executives affirmed that the overall impact on firm performance is irrelevant (cf. variable D1.18) but fifteen others disagreed with the statement related to a possible positive impact on firm performance (cf. variable C1.4, Table A2.5 in Appendix 2).

technically successful projects due to the economies of scale they involve (see Case study N in Box 7.4 above).

Limited use. When alliances do not achieve technical success or only do so partially, some firms may nevertheless be satisfied with the progress achieved and the new knowledge acquired, even if it is insufficient to make changes in the production process or the results have a very limited application on products/production processes. The impact on firm performance is sometimes insignificant or just slightly important because the scope of some research projects was very small indeed and, therefore, the potential to induce change was rather limited. In both cases firms may get additional satisfaction with the alliances in the light of other benefits not directly connected with the objectives of the alliances.

Different objectives. Firms tend to be satisfied if their own objectives, normally different from those of the alliance, are attained. For instance, some firms used alliances as a means to confirm results of research carried out internally, to establish international contacts, to get experience in inter-firm cooperation, or just to participate in joint projects that include partners from their business area (see Case study L in Box 7.2). The quality director of a chemical SME said, “It is an obligation to participate in projects of this kind, involving firms of our area of business.”

In assessing the success of a technology alliance through taking the perspective of a partner firm, it is not just the collective technical achievements and the economic benefits directly arising from the use of the new knowledge that matter. The fulfilment of individual objectives and the attainment of unplanned (or indirect) benefits are important as well. The relative weight that each success element has in the assessment equation differs from firm to firm, as do the reasons for individual satisfaction. Being satisfied with the alliance outcomes does not necessarily mean that firms expect a positive impact on performance.

7.5 FIRM PERFORMANCE AND ALLIANCE CONDITIONS

For a better understanding of the consequences of the research alliances on the performance of participating firms it is convenient to take into consideration the circumstances in which the research alliances were formed and implemented. There is no

way of assuring the “best possible results” even when alliance partners follow religiously all the literature’s “prescriptions” to avoid the many pitfalls of alliances, but failing to observe them increases the prospect of attaining worse results than expected. Chapter 5 identified a number of potential strengths and weaknesses of alliances which could have an influence on alliance performance. In Chapter 6, most of such weaknesses emerged in the analysis of the negative factors of cooperation, which has shown their negative impact on alliance outcomes and the ability of the Portuguese SMEs to achieve better benefits. Retrospectively, one can thus identify several critical factors in the cooperation process that weakened the potential for achieving greater benefits, first jointly and then individually. These factors are presented below according to three dimensions: actors, alliance structure and collaborative programme.

Actors. The (lack of) commitment of partners is regarded in the literature as an important aspect of cooperation and has been identified in Chapter 6 as one of the most negative factors which affected the alliance outcomes. The fact that many projects were neither important nor urgent to several firms (see Chapter 5) influenced negatively their commitment. Most firms did not take full advantage of what was on offer, i.e. the possibility of having access to research resources at a low cost to set up a project to suit their interests. Instead, they accepted to participate in projects structured by somebody else with little contribution on their part. Though this strategy has advantages because firms have access to structured projects that they probably would not have enough knowledge or competence to structure by themselves, its drawbacks may be quite substantial as well since firms cannot customise the research projects to entirely suit their needs and choose the partners (firms and RTD performers) to work with. The CEO of a tanning SME who entered a project already structured said, “As there was in the alliance no other partner firm with similar characteristics in terms of size and product specificity, it was not possible to direct the research activities towards the resolution of the firm’s specific problems, which were different from the other tanning firms.” By setting up their own projects, firms would likely be much more committed and have more realistic expectations about the outcomes and the ability of exploiting them. This explains why only 12 firms considered the project both urgent and very important, while 18 firms admitted that the project was neither urgent nor very important.

Arguably, the Portuguese firms would benefit from a more energetic participation in the alliances, however their lack of resources (know-how, people, financial), capability to set up joint research projects and experience in similar alliances are possible explanations for their acceptance of smaller roles. That means they also accepted a smaller influence on the alliances. By accepting participation in someone else's projects, firms accepted also working with unknown partners. Considering that only in a small number of cases were there preparatory meetings with all partners for the sake of discussing the project and getting to know each other, this was a risky game, which some executives regretted.

The RTD performers were an important part in the whole process of cooperation because the technical success of most projects chiefly relied on what they were capable of doing. The poor commitment and professional attitude of some of them eventually jeopardised the alliance outcomes and the ability of firms to achieve better benefits.

Alliance structure. The alliance structure is likely to have had some influence on the alliance performance. Firms and RTD performers complement each other and getting them together for a research project is, in principle, advantageous. When there is a clear divide between technology users and technology producers, as happened in several alliances, the power within the alliance becomes very unbalanced and the interaction among the partners quite poor. This is not immediately or necessarily a bad thing in itself if the objectives set out at the beginning are achieved, but when the control over the alliance is too unbalanced the risk of misbehaviour is high. In some cases the firms felt powerless to deal with unexpected situations of RTD performers' misconduct. Poor interaction among alliance partners means the specific nature of alliances is being adulterated and the potential contribution of partners is not being maximised. As a result, the alliance outcomes tend not to reflect the joint capability.

In general, the research alliances had a relatively high average number of partners. This again is not necessarily a bad factor, particularly when each partner contributes something unique and makes itself important to the joint undertaking. However, it requires a better coordination effort and is likely to increase substantially the transaction costs, especially when it involves partners from several different countries. Despite the fact that one-third of all alliances under analysis had more than twelve partners, the number of partners has not

been considered a major problem because the partners had very defined roles (some of them of marginal importance) and most projects were structured in way that did not require intense interaction among the partners. Even so, some executives mentioned the logistic problems faced in arranging meetings suitable to everyone and the problems associated with distance when it came to performing tests.

Collaborative programme. This research is primarily focused on firms and then on alliances; however, these are EU-sponsored technology alliances whose characteristics have influence on their structure, implementation conditions and the ability of firms to exploit the outcomes. Two important structural aspects emerge. First, the CRAFT programme has characteristics resembling the old linear model of development and diffusion of technology. The implicit model, i.e. the model in which the alliances actually take place, provides evidence that points to the linear model, such as the divide between different types of partners, the stream of knowledge that is mainly (sometimes totally) unidirectional from the technology producers to the technology users, and the lack of de facto (genuine) interaction between all the alliance partners in several cases. Second, unlike the research investment, which was subsidised, the post-alliance investment necessary to exploit the alliance outcomes is important and often represents a significant constraint for the participating firms (see, for instance, Case study C in Chapter 5). The low cost of participation in an international research project attracts SMEs and often relaxes their demands and commitment, but it may also represent a pitfall because they may not have adequate financial capability to exploit the alliance outcomes.

7.6 CONCLUSION

The chapter discusses the importance of technology alliances for the participating firms' performance and uncovers some difficulties faced by firms to turn alliances into performance. The successful reported cases, though quite few, illustrate the potential benefits SMEs can achieve with the CRAFT model of partnering. In fact, it allows SMEs to access the research resources needed to implement a research project tailored to suit their specific needs at a relatively low cost. If well adjusted to the firm's needs and well implemented, these cooperative research projects can provide substantial benefits for the participating firms, if technically successful and provided the conditions to exploit the

alliance outcomes can also be met. Besides the risk of failure that every kind of alliance involves, i.e. the risk of not attaining the objectives set out to achieve, there is an additional and sometimes significant risk related to the ability of firms to exploit the alliance outcomes, i.e. materialising the potential benefits in firm performance.

There is considerable evidence to affirm that alliance success, measured here by the degree of firm's satisfaction or even by the degree to which the objectives were attained, does not necessarily imply better firm performance. However, better firm performance normally requires at least the partial fulfilment of the alliance objectives. In general, the real impact of the alliance outcomes on the firms' performance indicators fell far behind the initial expectations, and for more than 60% of all firms the real impact is expected to be irrelevant or only slightly important. However, such a small or zero impact on the performance of firms does not necessarily mean alliance failure or dissatisfaction with the alliance outcomes. The outcomes of some technically successful alliances will not be exploited but the firms were satisfied.[85] Of the firms reporting an overall impact on performance lower than "very important", only one executive was able to "translate" that impact into a percentage variation, suggesting that the effect on firm performance is hardly quantifiable below a certain level. Some executives identified benefits they were not able to assess in terms of performance variation. The same way, the Beta (1993) study was unable to quantify one-third of all identified economic effects.

The ending of a technology alliance is not the end of the process it normally implies. After the research period, partner firms still have to have the capability to exploit the alliance outcomes and, de facto, materialise the potential benefits generated together. Depending on the specific characteristics of projects, this intermediate stage between the research period and the exploitation of results may involve a great deal of collaboration of former partners and may require further actions not under the firm's control. It involves the risk of failure. Such risk was not taken into account at the beginning of the relationships, and even at the end some firms seemed to be not fully aware of it, even knowing they were not in a position of guaranteeing the successful exploitation of the alliance outcomes. There are

[85] Studies that attempt to associate the intensity in the use alliances with firm performance, such as the Hagedoorn and Schakenraad's (1994) study, fail to understand the firm's level of satisfaction or even understand whether alliances achieve their objectives.

several factors with varying degrees of influence on the time and ability of firms for turning the research results into economic benefits, including (without being exhaustive): poor technical results, indifference about the common purpose, small size of firms, cost-effectiveness of the new technology, unsuitable market conditions, or the new (industrial) equipment, production system or product has yet to be produced by a third party. From 30% to 35% of the firms were in such a condition. Previous research which analysed the issue of firm performance through alliances did not address the issue of risk involved at the intermediate stage and the ability of firms to turn alliance outcomes into performance. Even the EU research programmes such as CRAFT seem to assume a certain automatism between technically successful projects and exploitation of results.

A number of structural factors explain a great deal of the low performance of many of the research alliances. Many firms were not demanding enough at two crucial periods of the cooperation process, namely the negotiation and project implementation stages. They accepted playing a minor role without any significant contribution, not only in structuring the project but in many cases also at the implementation stage, and did not seek a strong interaction among all the partners. The commitment of partners, or more precisely the lack of it, has been identified as a major negative factor of cooperation, which affected the attainment of better results. Many projects were neither important nor urgent to the Portuguese firms. On the other hand, some RTD performers did not commit themselves professionally to the projects and others took advantage of their dominant position. The CRAFT programme's implicit model allows a clear divide between technology producers and technology users and does not stimulate convincingly the interaction among all the partners. It contains characteristics strongly resembling the linear model of development and transfer of technology.

This chapter attempted to capture the impact of R&D alliances on firm performance. The next chapter addresses the issue of organisational learning from alliances, aiming to complement the understanding of the alliance-performance link.

8 LEARNING THROUGH ALLIANCES

8.1 INTRODUCTION

This thesis set out to establish the impact of R&D alliances on firm performance. It did this by looking at a sample of firms from the EU-funded CRAFT programme. Although these alliances were policy-induced and, hence, were not brought about by a market imperative to innovate on a collaborative basis, the study does present some useful, generalisable conclusions. In particular, since these were SMEs that may not have had the capacity to conduct R&D in the first place, it is possible to look specifically at the impact upon the propensity to learn and innovate of these alliances.

We have seen in the preceding chapters that, apart from a small number of firms, the real direct impact of the alliance outcomes on the performance indicators appears to be very low. The general expectation about the impact on performance decreased substantially between the beginning and the end of the relationships. Paradoxically, there is a relatively low proportion of firms unsatisfied with the alliance performance and a low proportion of firms who did not achieve direct and indirect benefits. This implies that firms may have benefited in ways not immediately reflected in performance, which in turn poses the question of organisational learning and competence acquisition through alliances, which can be viewed as a different way of understanding performance. Learning and competence acquisition go beyond the direct or immediate impact on the performance indicators and are likely to have a more lasting effect on performance, even if it is sometimes difficult to assess that effect.

As pointed out in Chapter 2, alliances are considered a good mechanism for the transfer of knowledge and skills, especially tacit knowledge. They allow firms to learn from partners and renew their competencies. The alliances under analysis are not learning alliances,

whose *raison d'être* is the internalisation of new skills (Doz and Hamel, 1998); they do not configure a "race to learn" (Hamel, 1991) either. Certainly, these alliances require organisational learning, because new knowledge is the product and the goal of alliances (Ciborra, 1991: 59), but the learning objectives of SMEs were rather less ambitious and chiefly project-bounded. The discussion that follows attempts to understand the issue of organisational learning and competence accumulation, bearing in mind, however, the strong limitations of the methodology employed to address the matter in great detail. It is too early to assess fully the learning outcomes and, therefore, it is not possible to understand how much firms have learned through alliances. Rather, the aim here is to interpret the cooperation process from the viewpoint of learning and competence acquisition, two aspects particularly important for a better understanding of the performance implications of alliance participation, especially in the dynamic capability acquisition context.

The methodology employed here was not designed to address the issues of organisational learning and knowledge transfer comprehensively. Therefore, this chapter is more inferential, more speculative, but even so is an important reflection on issues arising out of the research findings that helps towards a better understanding of the impact of alliances on firm performance. Based on the advantages of alliances as a mechanism to learn and acquire knowledge from partners and the internal conditions necessary to do so developed in Chapter 2, this chapter first attempts to show that firms have learned in many ways and then analyse the barriers to learning.

8.2 LEARNING AND KNOWLEDGE TRANSFER

This section attempts to show that firms acquired information and knowledge[86] through cooperation, even in the case of unsuccessful alliances. The amount of learning and the type of knowledge acquired from alliances vary across the sampled firms, apparently with no common pattern. Based on information from the interviews, one can identify at least four different categories of learning, as follows:

[86] Knowledge and know-how are used here interchangeably.

Information and knowledge transfer. Most firms were able to access the technology of both the RTD performers (most of them academic) and partner firms, as Table 8.1 shows, and believe this will have a positive impact on performance. The number of firms who obtained new ideas to improve existing products or processes is rather smaller than the number of firms who had access to the technology of partners, especially the case of RTD performers. This is because some alliances involved technologies unrelated to the firms' core activities, which limited their ability to learn. SMEs regard the information and knowledge acquired as an important outcome of alliances and understand its value, even when its immediate use is not possible for some specific reason (for example, technical failure of the project).

A high proportion of firms revealed an initial intent to learn from partners, that is, they regarded the alliance as an opportunity to learn from partner firms and RTD performers (see Figure 5.10, question A7.7). Many executives mentioned as an advantage of alliances the possibility of joining together firms with different competencies. The general manager of a ceramics SME believes that "The contribution (ideas) of different firms was extremely important to push the technology a step forward." Such learning intent referred essentially to the opportunity to access information and knowledge related to the project; only a small number of firms regarded the alliance as a means to acquire knowledge that went beyond the project, though apparently with no clear strategy to achieve that. Despite not having any strong intent, firms were nevertheless receptive to learning from alliance partners. For instance, visiting the premises of the firm hosting a meeting was considered very important. One executive even questioned the desirability of spending two or three days to attend a three-hour meeting in a different country if there was no possibility to visit the host firm's premises. There are advantages in attending the meetings but since the firm would have access to the meeting's technical information anyway, such advantages were not perceived as being substantial enough to merit the effort.

There are several factors which allow one to conclude that learning has taken place. The general perception of firms is that this kind of project allows them to acquire useful knowledge and information, even in the case of unsuccessful projects. "We [the firm] always learn something with this kind of project", some executives concluded. More specifically, just about a quarter of all firms are using the knowledge acquired through the

alliance in other products/services, which indicates that not just the acquisition but also the assimilation and utilisation of knowledge has taken place. In several cases, the transference of technology was embodied in machinery, systems or industrial products (inputs to production), but the participation in the project allowed firms to acquire privileged information and knowledge not available to other users. One firm emphasised the fact of being now better prepared to analyse the firm's own technical problems and two others stressed that they have now sufficient technical competence to explain to their customers why certain technical solutions do not work.

Table 8.1 *Learning from partners*

	Number of firms	Average score (*)
Learned about/had access to the partner firms' technology	31	2.74
Learned about/had access to the RTD performers' technology	30	2.93
Obtained new ideas from partner firms to improve existing products/production processes	23	2.78
Obtained new ideas from RTD performers to improve existing products/production processes	14	2.79
Had access to new techniques and skills (other than those related to the project)	25	3.08

Note: (*) Average importance in terms of expected impact on performance attributed by firms on a five-point importance scale.
Source: Figures 6.7, 6.8, 6.9, and 6.10 in Chapter 6.

Additionally significant is the number of firms who say they have learned about an unfamiliar market and improved their knowledge about competitors. An illustrative example refers to a firm whose product proved to be better than the competitor partners' in the course of the research activities. As a consequence of this unplanned information about the competitors, the firm became a supplier of a multinational firm. In another case, in the course of the technical studies done for the project, a firm became aware that a local competitor already had a technical solution for the problem which led to the formation of the alliance. The alliance allowed the firm to get to know their competitors better.

Despite the evidence that some transfer of information and knowledge has occurred, it does not imply that all firms will have the ability or opportunity to benefit from such new knowledge. Indeed, in cases where the acquired technology is not related to the firm's core competencies and the project was technically unsuccessful, the possibility of having

performance benefits is quite small.

Experience in cooperation. According to Ciborra (1991), the participation in alliances allows firms to learn how to set up and fine-tune alliances per se. The findings in the previous chapters provide some support for claiming that prior experience positively influences the ability of firms to capture benefits (or avoid problems) from interfirm alliances. Learning about interfirm cooperation is likely to be one major benefit achieved by most firms. The opportunity to learn was substantial because for a high proportion of firms this was their very first experience of cooperation, and the proportion becomes even higher if only firms with prior experience in joint R&D projects involving international partners are accounted for. It is not so surprising that acquiring experience in interfirm alliances was the most common benefit reported by firms; this could be expected to be very useful since most of them are interested in participating in future alliances, with or without EU funding. About two-thirds of the executives claimed to have acquired experience on how to prepare and implement a joint research project. However, the initial contribution of firms in structuring the projects and the type and intensity of interaction among partners may have limited the opportunity of firms to acquire experience about structuring and implementing joint projects.

To most firms, almost everything was new: setting up a common project, participating in a R&D project, interacting with other firms and RTD performers and interacting with partners from several different countries, most of them unknown. It was a major challenge, full of opportunities to learn. For the inexperienced SMEs to cope with such a novel environment, some organisational innovation must have taken place, namely at the management and technological levels. An alliance is itself an organisational innovation (Ciborra, 1991). Interacting with alliance partners in a joint innovative project is essentially different from running a firm (or a project) independently and introducing innovations supplied by the market (markets are regarded as one of the most important sources of innovation).

Learning has occurred at the implementation stage when several firms became aware of the many potential pitfalls of cooperation. For instance, many firms realised that the choice of partners (firms and RTD performers) and information about their objectives is extremely

important and sometimes critical for the success or failure of a relationship. They also understood that it is important to devote enough time to structuring a joint project and taking care over the formal aspects of the relationship. A negative experience is also a great opportunity to learn ('learning by failing'), and some firms will be better prepared to participate in future alliances. Others came to realise that technical success alone is necessary but not sufficient to exploit the alliance outcomes successfully.

Consciousness about intangible benefits. Almost all the firms attributed great importance to intangible factors such as image improvement and contacts, and they were certain that an alliance could be a means to achieve this. The participation in a research project with international partners is believed to enhance the visibility of firms in the national and international context and within the group they belong to. Firms believe that it sends a positive message to the external world about their innovative intent. They like to be seen as innovative firms, who are concerned about product quality and customer satisfaction, but the importance of this varies with the firm. For instance, for the mould-making firms this is important because they have many multinationals as customers, but for the tanning firms the price remains more important to customers. The contacts established with foreign firms and RTD performers represent a doorway to accessing technical know-how and information in the future, something that would be hardly possible outside the framework of an alliance, according to some executives. Many firms recognise the importance of being connected to a network but they were especially satisfied with the opportunity to work with RTD performers, particularly universities.

Change in routines. The participation in alliances produced some organisational changes. Some firms regarded the alliance as an opportunity to break organisational routines and eliminate "bad habits" within the firm. An executive said, "An important benefit of this alliance was a break with the routinised and closed posture of the firm, which has opened up to research and relationships with other firms and institutions." The last point shows that firms are keen to work with other firms and RTD performers. To many of them, interfirm collaboration represents a new way of having access to technical information. It is a different source of technology which they are interested to make use of. Firms were open to new ideas and new ways of doing things. For instance, one firm uses alliances to give "training" to its personnel; that is, give them the opportunity to contact other people, other

cultures, other countries, and thus open up their perspectives on things, something they cannot learn from manuals. Other firms mentioned the opportunity to "leave" the narrow environment where they operate. Yet another firm regarded the alliance as an alternative source of knowledge that could favour its position within the international group it belongs to by way of creating a two-way flow of technology transfer.

Unexpected changes in routines also occurred. The top management of at least four firms became aware of the importance of an R&D department to perform research and be able to participate in R&D projects. These firms modified their attitude towards R&D, which is a sign of innovation and learning.

8.3 BARRIERS TO LEARNING

The previous section attempted to show that firms learned from the alliances and accumulated information and knowledge which might have a positive impact on their future performance. But that does not represent all the learning opportunities offered by the alliances. Indeed, many learning opportunities were lost or foreclosed from the very beginning, however not all of them were the fault of the firm or its inability to learn. The barriers to learning categorised below are deeply rooted in the conditions in which the alliances were formed, the characteristics of partners and the relationship between them, as presented in Chapters 5 to 7.

Alliance structure. The alliance design influences the ability of firms to learn from partners. When there is a strong interaction among alliance partners, there are better conditions for organisational learning to take place. In many of the CRAFT R&D alliances under analysis, there was a clear divide between technology producers and technology users that did not favour the interdependence of partners. On the contrary, some firms (negatively) emphasised their independence from the technology producers. On the other hand, a substantial number of firms had a well-defined role and often performed activities which did not require a great deal of interaction with the alliance partners (for instance, carrying out in-house tests). A "linear"-type structure of technological development characterised many relationships, creating learning asymmetries among partners and especially limiting the opportunity to learn for those firms located around the periphery of alliances. The way

most alliances were formed may explain this to a certain extent. As we have seen in Chapter 5, many firms were “invited” to participate in a structured project with little opportunity for negotiation. The structure of most alliances was prepared for the transfer of explicit knowledge (for instance, written documents or machinery), but much less prepared for the transfer of tacit knowledge between partners, which is often organisation-embedded, much less transparent than explicit knowledge (Lei, 1997) and requiring a much closer interaction to be transferred.

The number of alliance partners may have had a negative effect on learning. A large alliance has the potential to generate greater learning opportunities given the larger number of contributions, but it also creates additional coordination problems and may require better defined roles of partners in order to be manageable (Killing, 1988), thus limiting interaction. Since larger alliances tended to involve partners from a larger number of countries, communication problems arose as an additional obstacle to effective learning. The communication problems were generally regarded as unimportant but perhaps they were underestimated due to incomplete perception of the phenomenon. In their study about the participation of Finnish firms in EU programmes, Luukkonen and Hälikkä (2000: 114) found that 67% of the firms regarded “Cultural differences in communication and working methods” as a problem at least to some degree. In general, to overcome the problem of multi-language in alliances, the talks were conducted in English. It is difficult to assess the extent to which it affect the ability of non-native English speakers to learning, but “[k]nowledge encoded in an unfamiliar language is, for practical purposes, inaccessible” (Doz and Hamel, 1998: 217).

The dispersion of partners was said to cause problems at the experimental stage because this requires the close monitoring of activities and a rapid decision-making process. This was most relevant when the experiments and the analysis of results were carried out in completely different sites, far away from each other. In a number of alliances, both the distance and number of partners influenced the flow of information and knowledge between them.

The project’s structure also created certain barriers to learning and to technology transfer. One could find projects that were oversized for the time and resources available, and

projects that were structured to match the needs of specific partners. This became a source of problems later on which negatively affected the firms' learning expectations. An atypical example relates to a given project which was structured for a two-year period research but part of it alone took a partner firm more than eight years to develop.

Posture of partners. Many barriers to learning are direct consequences of the partners' attitude towards the alliance. Even considering the difficulties of many SMEs in putting together a joint research project and the opportunity to work with certain institutions, firms accepted the participation in alliances perhaps too passively, thus compromising their role within the alliance. Besides that, just under 30% of the firms considered the project as being both urgent and very important, and many projects would not have been carried out without the alliance because they were unimportant or not urgent. This raises the question of commitment to the project. The latter group of firms has fewer motives to be fully committed to projects and to learning. Indeed, the lack of commitment of partners (firms and RTD performers) was identified in Chapter 6 as one of the most important negative factors of cooperation. Some firms changed their interest in the project after realising its economic potential in the course of its implementation, but it is not difficult to admit that the commitment to alliances was largely related to its urgency and importance for firms. In one rare case, it is not an exaggeration to say that the firm's commitment to the project was zero; it only "lent" its name to the alliance.

The structure of many alliances did not favour the partners' interaction, but the partners themselves were rather apathetic about creating stronger ties with each other, even between firms from the same country. There were stronger connections between partners who knew each other beforehand, and between firms and local RTD performers, but most of the Portuguese firms restricted their involvement to a minimum. Some firms acknowledged that point but other factors are equally important for understanding the lack of commitment to promote interaction: no attendance at meetings (often "delegating" it to the local RTD performer), lack of active participation in the meetings attended, very limited knowledge about the alliance partners (in rare cases, some partners were unknown to each other at the end of the relationship!). This explains why only twelve firms said they have created a formal/informal network to exchange technical information.

Competitor partner firms behaved differently when the project involved knowledge about their core activities. The levels of transparency and commitment of competitor partners were much higher when their geographic markets did not overlap, but when they did competitor partners devised ways of protecting their knowledge against unintended disclosure. For instance, in a given alliance the two competitor partners did not supply their best product for testing, to protect vital knowledge from being transferred. Some firms rejected competitor firms as partners and others are interested in future alliances but not with (local) competitor firms. This is consistent with Quintas and Guy's (1995) results. The competitive stance of firms limited the potential for learning within the alliance.

Some RTD performers created barriers to learning when they refused to accept the contribution of firms and when they "assumed" that technology users could not provide any important contribution to the development of technologies far different from their competencies, despite the interest of technology users in a stronger interaction. They barred the reverse flow of knowledge. RTD performers also limited the opportunities for learning when their commitment to the project was lower than expected and when they created learning asymmetries by treating alliance partners differently. One RTD performer even refused to demonstrate the new process to the users! The asymmetric distribution of power within the alliance and the fact that there is no assessment of the quality of the RTD performers' research by the EU allows room for such kinds of behaviour.

Capability to learn. The lack of resources is an important factor determining the SMEs' ability to learn from alliances. SMEs often lack the time and resources to identify and use external sources of scientific and technological expertise (Rothwell and Dodgson, 1991; Rothwell, 1991). For small firms, there are barriers to learning from external sources even before being involved in actual cooperation. SMEs may not even be able to formulate a request for assistance (Delapierre et al., 1988). The identification of areas for cooperation and the selection of partners were two important hurdles identified by several executives to justify the lack of initiative in setting up joint projects. This also explains why an invitation to participate in an international R&D alliance sounds appealing to SMEs, even when the alliance objectives and firm's needs do not entirely match. According to many firms, local RTD performers, namely technological sectoral associations, are better positioned and qualified to identify areas for cooperation and select suitable partners, because they know

the firms' needs and have access to scientific knowledge.

The human factor is fundamental in the capability of firms to learn from alliances. The lack of qualified technical specialists or R&D personnel, common to a large proportion of firms, conditioned the SMEs' ability to make technical changes to the projects, participate in meetings, assess the technical competence of firms and RTD performers to carry out the research. It conditioned firms' absorptive capacity (Cohen and Levinthal, 1989, 1990; see chapter 2 above); that is, the capacity to recognise and assimilate new knowledge from alliances. As a rule, the person appointed to the project accumulated it with his/her normal duties, in many cases running the firm. SMEs had more difficulties in learning when projects involved technologies outside of their competencies. Some RTD performers "assumed" that in such cases the firms' contribution would be unimportant. In the meetings, as one executive pointed out, excessively technical discussions would necessarily exclude the technology users from participating. One firm was not able to exploit the alliance outcomes because it had no in-house competence to read the technical dossier produced by the technology producer. Quite often, firms relied on local RTD performers to minimise their lack of in-house expertise; however two questions remain unanswered: How much can firms learn effectively with this indirect process? How much accessible information and knowledge is not being transferred to firms because of this?

Material resources are also important. As expected, the large majority of SMEs did not have an R&D department to support the research activities. Most of them could not afford having one and in many cases it was not justifiable either. But if SMEs want to participate in joint R&D projects, not having a minimal research structure can be problematic or even ineffective, especially outside a cooperative framework such as CRAFT. As one executive of a firm who created an R&D department after the CRAFT experience pointed out: "Now we have a portfolio of research projects and we can define research priorities, something we could not do before." A research structure substantiates the firm's commitment to research and helps to define research priorities. "The R&D departments of firms provide a major source of learning in an activity which is central to their continuing existence and prosperity" (Dodgson, 1993a: 388).

The costs of carrying out research are often an important constraint for the participation of

SMEs in R&D projects. This is not applicable to the case of the CRAFT R&D alliances because the EU funded them. However, the post-alliance investment necessary to exploit the alliance outcomes was found to be an important constraint, as previous chapters have stressed. It affected the exploitation of acquired knowledge in some cases and the transfer of embodied technology in others.

Finally, the lack of experience in cooperation was an important factor in the firms' ability to learn. As argued before, firms learned a lot about interfirm cooperation because it was essentially new to most of them. So much novelty, however, was possibly an obstacle for firms to devise an effective strategy to learn from alliance partners, to acquire technology and build up new competencies.

Cultural obstacles. Perhaps the most important cultural barrier to learning was the relatively low intent of firms to do so; that is, the propensity to view collaboration as an opportunity to learn (Hamel, 1991). Most firms regarded the alliance not as an opportunity to learn from alliance partners (i.e. to internalise their skills) but rather as a way of solving their own specific problems. Perhaps this was a realistic strategy given the initial conditions to participate and the lack of experience in cooperation. It was not apparent, however, that the firms have changed their strategy during the implementation phase. Indeed, as some executives pointed out, after realising that the project would be a failure, partner firms did not look for alternative joint activities and instead became progressively less committed to it. As mentioned elsewhere, many firms entered the alliance with little knowledge about the partners, their competencies and their objectives. They also disregarded the importance of the formal aspects of the relationship. It is difficult to know how important this was as a barrier to learning, but some late problems could have been avoided or minimised at the initial stage had the attitude of firms been different.

One last point relates to the distinction between individual and organisational learning[87]. We have seen before that some firms were able to use the new knowledge in other products and processes, indicating that organisational learning has taken place. However, four firms refused an interview because the "right" person to interview (that is, the person who had

[87] For information on the process of learning see, for instance, Dodgson (1993a).

been in charge of the project) had left the firm meanwhile and nobody else could replace him/her for that purpose. This is a sign that part of the information and knowledge acquired from alliances has been retained in individuals instead of being transferred to the organisation, which raises the question of individual versus organisational learning. It is not possible to estimate how much knowledge was retained in individuals since it depends largely on how effective the internal routines to disseminate the knowledge throughout the organisation are. But two aspects may have influenced the organisational learning. In SMEs, the fact that few people, sometimes one person, accumulate several key functions might be an obstacle for the transfer of knowledge into the firm given the confusion between individual and organisational knowledge. This is most visible when key people leave SMEs. On the other hand, the existence of a research structure facilitates the organisational learning because learning requires coordination and effective transfer mechanisms (Dodgson, 1993a). As noted before, most SMEs did not have a formal research structure.

8.4 CONCLUSION

The analysis of the cooperation process from the viewpoint of the organisational learning and knowledge acquisition suggests that the amount of benefits achieved by firms just reflects the amount of effort put into alliances. Firms should not expect to get a large amount of benefits when they do not put a lot of effort into the relationship or when they lack appropriate in-house resources to benefit from R&D alliances, and the EU cannot expect large benefits for firms and for the economy just by joining firms and RTD performers together. This general observation holds for learning and the ability of SMEs to innovate in particular.

The few successful alliances suggest that the CRAFT model of partnering has a great potential to generate dynamics of innovation and organisational learning but to be effective it requires conditions which could not be found in many cases. On the side of firms, the weakness of intent, lack of experience, passivity, novelty of cooperation and lack of in-house resources affected their ability to learn and build competencies from alliances. Besides that, the alliance structure, the alliance outcomes and the ability to exploit them also had impacts on the transfer of technology into the firms. These factors conditioned the

type and amount of knowledge transferred between partners. Perhaps more important, most of it is likely to be explicit knowledge rather than tacit knowledge.

The small impact on the performance indicators of most firms is probably a good indicator about the amount of information and knowledge actually transferred into the firms. Most firms will not have substantial direct benefits because the transfer and assimilation of knowledge was poor. The significant expected impact on performance of some firms is essentially due to the transference of embodied technology, such as machinery and systems. This is similar in many respects to the traditional way of acquiring technology from outside and, arguably, will not have a substantial effect on firms' absorptive capacity. But firms have learned in certain ways and to certain degrees from alliances, especially about interfirm cooperation. Its impact on performance is not immediate or even easily noticeable, but it may be lasting.

This chapter addressed an important aspect of R&D alliances, that of organisational learning and competence-building. Its findings help towards a better understanding of the impact of R&D alliances on firm performance, which is the object of this thesis and whose conclusions are developed in the next chapter.

9 CONCLUSIONS AND POLICY IMPLICATIONS

9.1 INTRODUCTION

This thesis is concerned with the relationship between R&D alliances and firm performance. Empirically, it analyses the impact on performance of a sample of Portuguese small and medium-sized manufacturing firms who participated in the EU-sponsored CRAFT (1994-98) programme. The thesis aims primarily to capture the firm's perspective but it is aware that the issue has policy implications since the alliances were formed in the context of public policy to encourage cooperation. Taking into consideration the limitations of the methodology to address adequately the effectiveness of the CRAFT programme or the EU RTD policy, some conclusions are presented in this chapter which have policy implications.

Currently, there is an enormous pressure on firms of all sizes and from all sectors to engage in external relationships. Firms increasingly use alliances as a competitive strategy, governments promote and support inter-firm cooperation, and the literature on alliances greatly emphasises the potential benefits of cooperation, in particular technology-based cooperation. Despite this "favourable environment", the perceived benefits of technology alliances for firm performance are not yet unequivocally supported by empirical studies. The successful cases described in the literature are insufficient to explain the phenomenon because several studies reported a high failure rates of alliances (e.g. Duysters et al., 1999) and the limited number of studies that attempted to link alliances with firm performance have not reached consistent results (see Chapter 2). As a result, this issue is largely unexplored in the literature on alliances in general and in R&D alliances involving SMEs in particular. But, managers, policy-makers and academics cannot be satisfied with the potential benefits of alliances; it is fundamental to understand more deeply the actual impact of alliances on firm performance.

Taking into consideration the facts outlined above, this study was concerned with the following main question: *Do (successful) technology alliances cause better firm performance*? The assumption behind this question is that the achievement of technical success, here measured by the degree to which the objectives set out the beginning are achieved, causes better firm performance. This question has a number of implications attached, raising a set of additional questions which the study attempted to provide some answers: *To what extent do the initial conditions and the alliance implementation process affect the alliance outcomes*? *Does satisfaction with the alliance imply better firm performance*? *To what extent can firms turn technology alliances into performance*? and *What are the factors behind the unsuccessful exploitation of alliance outcomes*? In a complementary way, the thesis addressed the question of organisational learning, an important aspect linking R&D alliances with firm performance.

The findings are based on the experience of 41 Portuguese manufacturing SMEs who participated in 30 technology alliances under the CRAFT programme, sponsored by the European Union. The data were collected through face-to-face interviews, using a questionnaire for guidance. The executives were asked to express the impact of the R&D alliance on nine performance indicators, first on a Likert-type scale and then in percentage terms.

The chapter proceeds with a discussion of the main findings of the thesis, followed by the implications for policy, the generalisability of results and suggestions for further research.

9.2 SUMMARY AND MAIN FINDINGS OF THE THESIS

The thesis can be divided into two main parts. The first part - Chapters 2 and 3 - is concerned with some conceptual issues, the theoretical framework, and the context in which the CRAFT alliances took place. The second part - Chapters 4 to 8 - presents the findings of the empirical research.

An important characteristic which is common to the three major concepts analysed in Chapter 2 (i.e. inter-firm alliance, alliance success and organisational performance) is the lack of consensus in the literature regarding their definitions and boundaries, for different

reasons though. Perhaps more precisely, there are several ways of addressing them. Authors have used a profusion of terms to refer to inter-firm alliance, which certainly is a consequence of the multiplicity of alliance types and objectives, but it can also be interpreted as a lack of "analytical precision" (Chesnais, 1988). The concept has evolved to capture the phenomenon's complexity but without enough effort to integrate all contributions because disagreement about its boundaries and wording still persists. It is widely accepted in the literature and it is explicitly stated in some definitions that R&D alliances represent a subclass of inter-firm alliances, though again there is no consensus about a single definition or terminology. In accordance with many authors, government-sponsored R&D alliances are here considered a subclass of R&D alliances.

It is difficult to find a single definition for alliance success because of the large spectrum of alliance types, the multiplicity of purposes and diversity of results. Ultimately, the notion of alliance success must reflect the individual perspective of alliance partners, irrespective of the common achievements. Concerning the notion of organisational performance, there is not a unique set of indicators or a "best way" to measure it. The notion of organisational performance is, thus, based on individual preferences of those involved in measuring it. In any case, traditional financial indicators seem no longer to suffice because they are essentially good at measuring past performance, but rather poor at assessing the firm's future competitive stance.

Based on an extensive literature review, Chapter 2 discusses in detail several different perspectives of examining performance in the context of alliances. One perspective is to look at the alliance performance, an issue that has been a concern of researchers for a relatively long time, especially the assessment of joint venture performance. Several approaches have been used to assess the alliance performance, including perceptual measures (i.e. the partners' own assessment), alliance instability, duration, termination, mortality rates and financial performance. Each measure does not capture fully the phenomenon and not all measures are adequate to assess the performance of all alliance types because virtually every alliance has a different set of objectives and outcomes. A multidimensional approach is likely to be more effective but, as mentioned above, the individual assessment of alliance performance is perhaps essential. A general conclusion that can be drawn from prior studies is that the rate of failure is high. For instance,

Harrigan (1988) reported that 66.7 % of alliances were considered unsuccessful at least by one of the partners.

A second perspective on analysing performance consists in assessing the impact of alliances on firm performance. Some studies analysed the stock-market reaction to the alliance formation announcements, other studies examined the importance of alliances to the firm survival. Another group of studies looked at the relationship between alliance intensity and firm performance, normally using statistical methods to find associations between the two, but with relative success given the difficulty in proving the cause-effect link. Yet another group of studies examined the alliance outcomes and impact on firm performance using direct interviews or questionnaires. This approach overcomes the causality issue but cannot avoid the problem of subjectivity because it is based essentially on perceptual measures.

A different way of analysing performance in the context of alliances is to look at the organisational learning and competence-acquisition from alliances. Alliances allow firms to implement strategies for learning and innovation more effectively (Ciborra, 1991). They may be an avenue for learning and internalising new skills, in particular those which are tacit, collective and embedded (Doz and Hamel, 1998). Alliances are considered an important mechanism to deal more effectively with technological and market uncertainty (Hagedoorn et al., 2000).

Yet another way of analysing performance is to assess the performance of alliances against alternative strategies (i.e., go-it-alone, merger, acquisition and licensing). This topic is absolutely relevant but was not addressed empirically here. These alternative strategies are not perfect substitutes of each other and not all of them are always available to target particular objectives. Further, there is no absolute advantage of one strategy over the others; each strategy is only relatively advantageous over the others. Several authors consider alliances to be a superior alternative in many situations.

The main findings of the empirical research are presented below by way of answering the questions formulated in this thesis.

a) Do (successful) technology alliances cause better firm performance?

The full answer to this question is divided into four parts. The first part focuses on the general results about the impact of technology alliances on firm performance. The first point to make is that there is no unique pattern in the results. The successful cases, though quite few, illustrate the potential performance benefits that SMEs can achieve with the CRAFT model of partnering, if the projects are technically successful and provided the firms can meet the necessary conditions to exploit the alliance outcomes. On the other hand, the data show that the real impact of alliance outcomes on the performance of firms fell far behind the initial expectations across the whole range of the performance indicators, and for more than 60% of all firms in the study the real impact is expected not to be significant. Should this be classified as failure? The answer is not straightforward. Indeed, these results do not necessarily imply alliance failure or dissatisfaction with the alliance performance, as we will see below. The variety of situations confirms the difficulties involved in assessing alliances discussed in Chapter 2. Of the executives reporting an overall impact on performance smaller than "Very important", only one of them was able to translate that impact into a percentage variation, suggesting that the effect on firm performance is hardly quantifiable below a certain level. The Beta (1993) study also could not quantify about one-third of all detected economic effects, essentially due to lack of information.

Second, one should understand whether the Portuguese firms entered the alliances aiming to achieve performance improvements or only to achieve other kinds of benefits. If the former is not the case, it is hardly useful to make any association between the alliance performance and firm performance. Although it is widely recognised in the literature that the firm's objectives may be different from those of the alliance in which it is involved, previous studies that addressed the alliance-performance link did not discuss that issue. In fact, two firms (5%) were not expecting a positive impact on performance when they entered the alliance[88] (see Figure 7.1 in Chapter 7), but one of them was expecting an extremely important impact on the indicator "Environmental damage". Both projects did

[88] Another firm could have been included in this group since the executive interviewed said there were no plans to exploit the alliance outcomes from the very beginning, although he also considered the project would have a slight impact on the firm performance. Essentially, the firm entered the alliance for other reasons.

not achieve their objectives, however the executives reported having had some direct and indirect benefits. These perceived benefits have no direct repercussion in terms of performance, though they can be useful in the future. Not expecting a positive impact on performance is not the same as to say that firms were not expecting anything from the alliance because they did (e.g. contacts with R&D institutions and other firms, experience in inter-firm cooperation). The low cost of participation in the alliances allowed some SMEs to pursue essentially particular objectives. Had the cost of participation been more substantial then probably the strategy of SMEs would be different.

The third part of the answer focuses on the technical success of alliances, here measured by the degree to which the objectives set out at the beginning were attained (C1.2). Table 9.1 shows how the executives classified the alliances' technical success. Contrary to what one would expect, and even taking into consideration the subjectivity of the assessment, it appears that the comparison between the alliance achievements and its objectives is not a straightforward assessment because some alliance partners expressed quite different opinions on that matter.[89] The aggregated answers of all groups exceed the number of alliances, which is 30. There are at least three reasons to explain this inconsistency:

- Information asymmetry among partners mainly due to their role in the alliance and interest in its outcomes - firms playing a smaller role or being less interested in the project appeared to be less accurate in their analysis;
- Prospect of obtaining economic benefits - firms with smaller prospect of obtaining economic benefits tended to assess less positively the outcomes;
- Different expectation about the benefits, which has chiefly to do with the different levels of initial knowledge about the technology to be developed and its potential use.

Therefore, it is difficult to say exactly how many alliances achieved technical success. The results indicate that just about 50% of the 30 R&D alliances achieved most or all of the objectives set out at the beginning. A large proportion of alliances could not attain success,

[89] The data presented in Table 9.1 has been reduced from five to three categories in order to clarify the explanation of the results and emphasise the most important divergences. However, in the categories "Disagree" and "Agree" there were also different opinions about the degree to which the objectives were attained.

thus impeding partner firms from achieving performance benefits.

Table 9.1 *Did the alliance achieve its objectives?*

		Disagree	Neutral	Agree	Missing	Total
C1.2 (No. of firms)		14	5	23	1	43
No. of alliances these firms are from		13	4	17	1	35 (≠ 30)
Divergent opinions	A (1,43)	✓		✓		
	B (4,11,17)		✓✓	✓		
	C (28,30,35)	✓		✓✓		
	D (13,29)	✓		✓		
	E (9,34)	✓	✓			

Notes: Disagree (1. Strongly disagree + 2. Disagree). Agree (4. Agree + 5. Strongly agree).
Source: Answers to question C1.2. See also Figure 6.6 in Chapter 6 and Table A2.5 in Appendix 2.

The fourth part of the answer focuses on the relationship between alliance success and firm performance. Table 9.2 compares the degree to which the objectives were attained (C1.2) with the real impact on firm performance (D1.18), as perceived by the executives.

Table 9.2 *Alliance success versus impact on firm performance*

Project number	1	6	11	15	12	19	31	18	2	35	27	7	8	41	13	14	24	32	33	39	30	37	38
C1.2 scores	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4
D1.9 scores (expected)	5	5	3	4	4	5	4	3	2	3	?	3	3	3	3	3	3	2	2	3	3	4	4
D1.18 scores (real)	5	5	5	5	4	4	4	3	2	2	?	4	4	4	3	2	2	2	2	2	1	1	1

Source: Answers to questions C1.2, D1.9 and D1.18.

The main conclusion that comes out from Table 9.2 is that alliance success does not necessarily cause better firm performance. The achievement of the alliance's objectives is a necessary but not sufficient condition for better firm performance. However, better firm performance normally requires at least the partial fulfilment of the alliance objectives. There are several firms agreeing with the success of the project who expect a "Slightly important" impact on firm performance (D1.1.8 = 2) or no impact at all (D1.18 = 1). As Table 7.3 and the discussion on the measurability of performance variation in Chapter 7 show, those executives expecting a "Slightly important" impact on firm performance were unable to quantify that impact in percentage terms, suggesting that such an impact is hardly quantifiable. Furthermore, as we will see below, there is a serious risk that some technically successful projects will not be exploited by the firms due to circumstances not under their control. Of those 23 firms who believe the alliance was successful (i.e. C1.2 = 4

or 5), perhaps no more than 50% will have a significant impact on performance. However, several firms were not expecting a significant impact on performance anyway (see D1.9 scores).

The evidence above does not corroborate the working hypothesis formulated in Chapter 4, which stated "Firms whose R&D alliance has achieved technical success are expected to exploit the alliance outcomes and have a positive impact on performance." Technical success is important but appears to be insufficient to assure any consequent impact on firm performance. Some firms may not want to exploit the alliance outcomes, the circumstances may have changed or they may not meet all the necessary conditions to do so. Part of the firms will not exploit the alliance outcomes and as so will not have performance improvements.

b) To what extent do the initial conditions and the alliance implementation process affect the alliance outcomes?

These two aspects had an important influence on the alliance outcomes. In some cases they essentially explain the poor results achieved. It is always risky to say that the results would be better if some of the circumstances were different, because this would imply new challenges and new problems. Even so, from the results of Chapters 5 and 6 one can identify several critical factors in the alliance process, which weakened the potential for achieving greater benefits, first jointly and then individually. These critical factors are presented below according to three dimensions: actors, alliance structures and programme. The critical factors concerning the programme are presented in the section on policy implications.

Actors. Most firms did not take full advantage of what was on offer, i.e. the possibility of having access to research resources at a low cost to set up a project to suit their interests. This is explained by the lack of experience in similar projects, lack of a portfolio of research projects and relative interest of projects to the firms. Most firms accepted participating in projects structured by others with little contribution on their part. They had access to structured projects they probably would not have enough competence to structure by themselves and avoided the transactions costs of forming a research alliance, but it also

impeded them from customising the research projects to entirely suit their needs and choose the partners to work with. As a result, for a great deal of Portuguese SMEs the alliances they were involved with were strategically neither important nor urgent. By setting up their own projects, the Portuguese firms would likely be much more committed and have more realistic expectations about the alliance outcomes. Firms would benefit from a more energetic participation, however the lack of resources (know-how, people, financial) and prior experience are possible explanations for them to accept smaller roles, and smaller influence on alliances as well. Since most partners were unknown to the firms and there were no preparatory meetings, the game was risky.

The RTD performers were an important part of the whole process of cooperation because the technical success of most projects chiefly relied on what they were capable of doing, i.e. their technological competence and commitment to the project. The poor commitment and professional attitude of some of them eventually jeopardised the alliance outcomes and the ability of firms to achieve better benefits. The commitment of partners is widely recognised in the literature as an important success factor in alliances and has been identified as a major negative factor of cooperation (see Table 6.2 in Chapter 6).

Alliance structure. Joining together firms and RTD performers is, in principle, advantageous for SMEs because they get access to RTD performers' technological resources. However, when there is a clear divide between technology users and technology producers, as often happened in the cases under analysis, the power within the alliance becomes very unbalanced and the interaction among partners quite poor. This is not immediately or necessarily a bad thing in itself if the project is implemented according to plan, but when the control over the alliance is too unbalanced the risk of misbehaviour is high. Poor interaction among alliance partners can hardly capture their potential contribution to the project and, as a result, the alliance outcomes tend not to reflect the joint capability. This affected an important part of the alliances. On average, the R&D alliances had a relatively high number of partners. This is justifiable if the contribution of each partner is important for the common undertaking, but a higher number of partners increases the transaction costs and the coordination problems. The executives did not consider the number of partners to be an important negative factor, but there are elements, such as the irrelevant contribution of some partners, suggesting the opposite.

c) Does satisfaction with the alliance imply better firm performance?

We have seen that attaining the alliance objectives is not sufficient to cause better firm performance. The satisfaction with the alliance, i.e. the individual assessment of alliance success, is more than the degree to which the alliance has achieved its objectives. It includes also the benefits achieved individually, planned or not. For some firms, however, only the latter appears to matter. Because a large majority of firms were expecting an effect on performance and about two-thirds of them were satisfied with the alliance (see, for instance, Figure 7.4), the above question is quite important. And even more since previous research has not addressed the question.

In Chapter 7, we concluded that the alliance success, measured by the degree of firm's satisfaction, does not imply necessarily better firm performance. One-third of the executives were satisfied with the alliance but were not expecting any significant impact on performance. Table 9.3 summarises the justifications provided by these executives to explain this apparent contradiction. It supports the argument that neither the technical success of alliances nor the individual satisfaction with the alliance appear to be sufficient conditions to cause a positive effect on firm performance.

Table 9.3 *Satisfaction with the alliance but no impact on performance: reasons*

Alliance objectives	Specific conditions impeding economic success	Individual aspects of satisfaction	Common aspects of satisfaction
Success	• Dependence on external factors (e.g. market conditions) • Dependence on internal factors (e.g. firm size) • Small scope of the project	• Technical progress	• Contacts • Experience in cooperation • External image • ...
Partial success	• Limited use of the results • Technology reached its limits	• Progress achieved and the new knowledge acquired • Unplanned benefits	
Unimportant	• Not interested in the common results	• Achievement of individual objectives	

Source: Author's elaboration.

Some factors help to explain this apparent contradiction. On the one hand, the majority of Portuguese SMEs did not set up the joint research project they were in and only a few of

them provided a substantial contribution to it. As mentioned above, the research projects were not strategically important to most firms. On the other hand, the costs of participating in the alliances were admittedly small, which explain at least partially the first point. Additionally, technology-based cooperation with international firms and RTD performers was essentially new to most of the Portuguese SMEs and, therefore, an excellent opportunity to learn from partners and get experience in cooperation. These factors certainly help towards explaining why one-third of the executives were satisfied with the alliance but were expecting a marginal impact on performance. Further research is needed.

d) To what extent can firms turn technology alliances into firm performance? What are the factors behind the unsuccessful exploitation of alliance outcomes?

Achieving technical success is an important step in any R&D alliance. In most cases, however, the transformation of alliance outcomes into firm performance is not an automatic process and involves the risk of failure, i.e. the technical success of alliances does not imply that (all) firms will have the capability to materialise the potential benefits generated together into performance. Depending on the specific characteristics of each project, the post-alliance period may involve a great deal of collaboration between former partners. Some R&D projects end naturally at the end of the research period, others have further requirements, such as scaling up prototypes, building facilities or financial resources. Firms cannot always meet such requirements or guarantee factors not under their control.

Taking into consideration the situation of the firms who classified the alliance as technically successful, Figure 9.1 lists the internal and external factors which can explain the unsuccessful exploitation of alliance outcomes. As we have seen in Table 7.5 (Chapter 7), these factors can be classified according to the firm's prospect of attaining economic benefits and each firm can be affected by one or more factors. Each factor described in Figure 9.1 has the potential to increase the costs, diminish the advantages and, more importantly, cause failure (i.e. no exploitation of alliance outcomes), but its level of risk varies according to the firm's and project's characteristics. We are not able to compare the relative importance of each factor or quantify how many firms ended up not exploiting the

alliance outcomes, but we can say that at least four firms failed to exploit the alliance outcomes at this stage due to internal and/or external factors. Another three firms said explicitly that the exploitation of alliance outcomes was dependent upon the cost of the novel equipment, which has yet to be produced.

Figure 9.1 *Factors behind the unsuccessful exploitation of alliance outcomes*

Internal factors	External factors
• Firm's small size (when the new technology involves economies of scale); • Financial capability (to acquire the new technology, make changes in the production process, built a new plant or protect the knowledge); • Cost-effectiveness of the new technology (which is dependent on both the market size for this new technology and the relative advantages for the firm); • Firm's lack of interest in exploiting the alliance outcomes (either decided initially or in the course of the relationship); • Research outcomes smaller than expected.	• Unsuitable market conditions (to launch the new product); • Dependence on a third party, frequently a partner (to produce the novel equipment, system or industrial product); • Dependence on a third party to implement the new technology.

Source: Author's elaboration.

The results clearly indicate that the process of exploiting the alliance outcomes is not automatic and may involve a considerable risk of failure. This is particularly relevant in those cases which involve post-alliance activities requiring the participation of others (for instance, former partners), demand a considerable amount of resources, or depend on the market conditions.

9.3 POLICY IMPLICATIONS

The subject matter of this thesis is analysed primarily from the firm's viewpoint. However, the empirical study involves R&D alliances sponsored by the European Union and, therefore, the research findings have implications at the policy level. This section addresses the issue of government policy at two different levels. First, in line with the firm's perspective, it focuses on the structural aspects of the CRAFT programme that somewhat affected the achievement of better results. Second, it attempts to understand the effectiveness of EU policy on cooperation by assessing the extent to which the CRAFT programme's objectives were achieved.

9.3.1 Structural aspects of CRAFT alliances

The CRAFT programme allowed many SMEs to participate in R&D joint projects in which they would otherwise not have done (see Chapter 5). Generally, the size of projects demanded resources (financial, human, facilities) and competencies that firms alone were not capable to provide. Eventually, the EU funding turned many infeasible projects, if carried out autonomously by firms, into cost-effective alliances.

The characteristics of the EU-sponsored CRAFT alliances influenced the structure of the projects, implementation conditions and the ability of firms to exploit the outcomes. Some important aspects come out in the course of this research. First, the CRAFT programme has characteristics resembling the old linear model of development and diffusion of technology. That is not apparent in the structure and objectives of the programme, but the implicit model (i.e. the model in which the R&D alliances actually take place) provide evidence that points in the direction of the linear model, such as the divide between different types of partners, the stream of knowledge that is mainly (sometimes totally) unidirectional, from the technology producers to the technology users, and the lack of de facto (genuine) interaction between all the alliance partners. Such a divide between technology users and technology producers does not stimulate convincingly the interaction among all the partners and, as a consequence, tends not to take advantage of their joint potential.

Second, contrary to the general opinion of the executives, the number of alliance partners appears to be an important variable. From the EU perspective, larger alliances have the potential to be more effective in the sense that a larger number of firms have access to the new technology. It also reduces the bureaucratic costs of analysing the applications (fewer projects). However, unless essential to the project, a higher number of partners implies greater costs and coordination problems for alliance partners, with no apparent advantages for firms. For a large alliance under CRAFT, involving partners from several countries, to be manageable, partners need very defined roles, but to the detriment of stronger interaction among them. The fact that most firms had no experience in inter-firm cooperation, especially in R&D projects, created additional problems for SMEs.

Third, some RTD performers were not strongly and professionally committed to the project during its implementation, which naturally deteriorated the relationship between the alliance partners and affected negatively the alliance outcomes. Some firms felt powerless to deal with such situations.

Fourth, unlike the research investment, which is subsidised, the post-alliance investment necessary for firms to reap the benefits is important and often represents a significant constraint. The low cost of participation in an international joint research project attracts SMEs and often relaxes their demands, but it may also represent a pitfall because they may not have adequate financial capability to exploit the alliance outcomes.

9.3.2 Policy assessment

This study was not designed to understand to any extensive degree the extent to which the policy objectives have been met. That line of investigation would certainly complement this work, allowing a more detailed understanding of the outcomes of the CRAFT model of partnering. Despite the limitations of this study, its findings are nevertheless relevant and shed some light on the effectiveness of the EU policy on cooperation. However, any attempt to understand the effectiveness of EU policy on cooperation by analysing the extent to which its objectives have been met has the potential to be a rather subjective exercise, since the policy objectives are identified but not quantified, either in scope or in time.

The specific objectives of the CRAFT programme were three. First, “to promote the development of technologies adapted to the needs of SMEs.” Essentially, all the projects analysed satisfied this objective to a certain degree; all of them involved the development of technologies adapted to the needs of SMEs, although with varying degrees of novelty and complexity. Second, “to promote transnational networking and cooperation amongst SMEs, and between SMEs, research organisations and large companies.” This objective can be best assessed in the future, but one can identify two somewhat contradictory signs already. On the one hand, the low level of interaction between alliance partners and the fact that less than 30% of firms seem to have developed a network for exchanging technical information (most of these firms knew each other before this project) indicate a rather limited success in achieving this objective. On the other hand, a large proportion of firms

are interested in taking part in future alliances, with or without EU funding, and many of them believe they have found new ways of having access to technical information, suggesting a more positive effect on networking and cooperation. Only in the future will it be possible to assess how these networks evolved, in and out of the context of EU-sponsored RTD programmes.

Third, "to support SMEs in their efforts to strengthen their capability to absorb and to contribute to the development of the technologies they require." This is, perhaps, the most ambitious and important objective, but also the least likely to attain a satisfactory result. It implicitly assumes that SMEs have a given level of absorptive capacity (Cohen and Levinthal, 1989, 1990), that is, the ability to identify, assimilate and exploit knowledge from the environment. This assumption may not be adequate. Indeed, Rothwell and Dodgson (1991) and Rothwell (1991) argue that SMEs often lack important resources, such as qualified technical specialists, that influence their ability to assimilate and further develop externally acquired technology. Exposure to external sources of information and knowledge needs to be accompanied by the firm's internal ability to absorb such information and knowledge (Soo et al., 1999: 15). A large proportion of the firms analysed here do not perform formal in-house R&D and most of the technology they utilise is externally produced, thus affecting their absorptive capacity. Quintas and Guy (1995: 346) conclude, "Programmes which aim to improve competitive performance through technological innovation derived from investment in R&D need to tackle the organisational, social and economic and institutional issues which condition the wider innovation process." It would be an exaggeration to affirm that the firms' ability to assimilate and exploit knowledge has changed significantly due to their participation in the CRAFT alliances.

Taking into consideration both the financial and technological capability of firms to carry out the projects, only a very small number of them could have done them alone (see Chapter 5). About 55% of the executives affirmed that the expected benefits from the project would not justify its costs if accomplished autonomously, and many have admitted they would not participate in the joint project had the EU not financially supported it. From an economic point of view, it appears that more than 50% of the projects were not feasible and would be rejected even if implemented cooperatively. One can say, therefore, that the

EU funding turned many unfeasible projects into cost-effective ones. It allowed the implementation of joint projects that would be dropped otherwise.

How strategic were the projects to the Portuguese SMEs? Using the urgency and importance indicators as a proxy to assess the strategic nature of projects, projects were urgent and very important to less than 30% of the interviewees. Projects were important to 45% of the executives but not urgent to about 60% of them. A significant number of firms did not regard the project as strategic for the business, but it was worth participating because, with the EU financial support, the expected benefits would justify the investment. It is not possible to give an exact account of the benefits achieved by firms, for instance, how much have firms learned and how useful will such knowledge be. The findings show, however, that more than 60% of the firms do not expect a significant impact on the performance indicators.

The results are not spectacular but they are likely to reflect the consequences of inexperienced SMEs lacking appropriate in-house technological resources who decided to respond to the EU "inducement" to perform cooperative research with international partners. The evidence provided is insufficient to assess the extent to which the EU intervention in the innovation process is necessary, relevant or appropriate, partly because, ultimately, the decision is political.[90] It is, however, a small contribution to understanding the performance of EU policy on collaborative R&D.

9.4 GENERALISABILITY OF RESULTS

The findings of this thesis are important to understand the alliance-performance link and the difficulties firms may experience in exploiting the alliance outcomes. However, the unique characteristics of the sample raise the question of the generalisability of the conclusions. To what extent are the conclusions context-bounded? Several factors were identified in Chapter 4 which could affect the broad generalisation of the results. Concerning the alliance context, it is not possible to assess the extent to which the results were affected because these were "government-sponsored" alliances, but we can say that

[90] For further information on the assessment of the EU cooperative research policy see, for instance, the special issue of Research Policy (Vol. 27, No. 6, 1998) on EU Research Funding Policy.

not all projects were considered of marginal importance, as Sciberras (1987) suggested, and some of them will have a significant impact on performance. SMEs did not use the CRAFT programme to implement "second rate" research projects because, as seen in Chapter 6, the vast majority of them do not perform formal R&D and did not have a portfolio of projects to choose from. The fact that about 50% of the projects were economically unfeasible and would not be implemented if not financially supported by the EU suggests that the conclusions might not hold in the context of "market-driven" R&D alliances.

In relation to the characteristics of firms, although one cannot link the structural characteristics of the Portuguese industry with the impact on firm performance because only Portuguese firms were analysed, it was apparent that not having the appropriate research resources affected the absorptive capacity of firms and lacking adequate financial resources affected the exploitation of the alliance outcomes. As regards the alliance type, the findings are clearly insufficient for a broad generalisation to all types of inter-firm alliances and all types of partner firms, given the specific characteristics of the analysed sample.

The findings of the thesis are primarily relevant to joint research projects structured in similar settings, but this assertion might be excessively prudent. Further research is needed to ascertain if they have a broader generalisation.

9.5 FURTHER RESEARCH

The thesis addressed an issue eminently relevant in the present competitive context of firms, particularly small and medium-sized firms. We are now better informed about the performance consequences that firms can achieve by participating in EU-sponsored technology-based alliances. The specificities and limitations of the study delimited the strength of its conclusions but stimulated the discussion and created excellent research opportunities. It is important to examine the alliance-performance link in other contexts, both government-sponsored and "market-driven" research alliances, and improve the methodological approach to collect the detailed data necessary to analyse the issue in greater detail. It is also important to understanding better the role of SMEs in international R&D alliances, particularly when they lack adequate research resources for the research

activities and to assimilate the alliance outcomes.

REFERENCES

ABRAVANEL, Roger and David ERNST (1993), Alliances versus acquisitions: strategic choices for European "National Champions", *in* Joel Bleeke and David Ernst (ed.), *Collaborating to compete: using strategic alliances and acquisitions in the global marketplace*, pp. 229-248. New York: Wiley.

ANDERSON, Erin (1990), Two firms, one frontier: on assessing joint venture performance, *Sloan Management Review*, Winter, Vol. 31, No. 2, pp. 19-30.

ARNOLD, Eric, Ken GUY and Mark DODGSON (1992), *Linking for success: making the most of collaborative R&D*. London: IEE - The Institution of Electrical Engineers.

ASSIS, José A. B. (1996), *External linkages, innovation and the small and medium sized enterprise: the role and effectiveness of public technology policy in Portugal*, Unpublished doctoral thesis, SPRU, University of Sussex, UK.

BADARACCO, J. (1991), *The knowledge link: competitive advantage through strategic alliances*. Boston, MA: Harvard Business School Press.

BARLOW, James, Michael COHEN, Ashok JASHAPARA and Yvonne SIMPSON (1997), *Towards positive partnering - revealing the realities in the construction industry*. Bristol: The Policy Press, University of Bristol.

BEAMISH, Paul W. and Andrew C. INKPEN (1995), Keeping international joint ventures stable and profitable, *Long Range Planning*, Vol. 28, No. 3, pp. 26-36.

BEECHAM, M. A. and M. CORDEY-HAYES (1998), Partnering and knowledge transfer in the U.K. motor industry, *Technovation*, Vol. 18, No 3, pp. 191 – 205.

BEESLEY, M. N. and Roy ROTHWELL (1987), Small firm linkages in the United Kingdom, Paper presented for the ISPIM Conference on Innovation, Adaptation and Growth, Brighton, 24-26 August.

BENFRATELLO, Luigi and Alessandro SEMBENELLI (2000), *Research joint ventures and firm performance*. Nota di laboro 13.2000. Milano: Fondazione Eni Enrico Mattei.

BERG, S. V., J. DUNCAN and P. FRIEDMAN (1982), *Joint venture strategies and corporate innovation*. Cambridge, MA: Oelgeschlager, Gunn & Hain.

BETA (Bureau d'Economie Theorique et Appliquée) (1993), *Economic evaluation of the effects of the Brite-Euram programmes on the European industry*, Final report for the Commission of the European Community DG XII. Strasbourg: Université Louis Pasteur.

BIE (Bureau of Industry Economics) (1995), *Beyond the Firm: an assessment of business linkages and networks in Australia*, Research Report 67. Canberra: AGPS. (http://www.pc.gov.au/icpubs/biepubs/research/rr67/)

BIRCHALL, D. W., J. J. CHANARON and K. SODERQUIST (1996), Managing innovation in SMEs: a comparison of companies in the UK, France and Portugal, *International Journal of Technology Management*, Vol. 12, No. 2, pp. 291-305.

BLEEKE, Joel and David ERNST (eds.) (1993a), *Collaborating to compete: using strategic alliances and acquisitions in the global marketplace*. New York: Wiley.

BLEEKE, Joel and David ERNST (1993b), The way to win in cross-border alliances, *in* Joel Bleeke and David Ernst (eds.) (1993), *Collaborating to compete: using strategic alliances and acquisitions in the global marketplace*, New York: Wiley, pp. 17-34. (*Reprint from the March-April 1989 issue of the Harvard Business Review*)

BLEEKE, Joel and David ERNST (1995), Is your strategic alliance really a sale?, *Harvard Business Review*, January-February, pp. 97-105.

BROCKHOFF, Klaus, Ashokk GUPTA and Christian ROTERING (1991), Inter-firm R&D co-operations in Germany, *Technovation*, Vol. 11, No. 4, pp. 219-229.

BROCKHOFF, Klaus and Thorsten TEICHERT (1995), Cooperative R&D and partners' measures of success, *International Journal of Technology Management* – Special issue on The Management of Technological Flows Across Industrial Boundaries, Vol. 10, No. 1, pp. 111-123.

CALLAHAN, John and Scott MACKENZIE (1999), Metrics for strategic alliance control, *R&D Management*, Vol. 29, No. 4, pp. 365-377.

CAMERON, Kim S. (1986), Effectiveness as paradox: consensus and conflict in conception of organizational effectiveness, *Management Science*, Vol. 32, No. 5, pp. 539-553.

CARAÇA, J. M. G., F. GONÇALVES, J. M. B. BRITO, A. MATEUS, J. M. F. RIBEIRO, A FAÍSCA and C. MORENO (1993), *Study of the impact of Community RTD programmes on the Portuguese S&T potential. A report to the Commission of the European Communities*. Lisboa: JNICT.

CARVALHO, Adão (1996), *Cooperação tecnológica entre empresas: motivações e factores de sucesso. Estudo de casos*., Unpublished Master's Thesis. Lisboa: ISEG-UTL.

CERVANTES, Mario (1999), Public/private partnerships in science and technology: an overview, *STI Review*, Special issue on Public/private partnerships in science and technology, No. 23, pp. 7-21. Paris: OECD.

CHESNAIS, François (1988), Technical co-operation agreements between firms, *STI Review*, OECD, No. 4, pp. 51-119.

CHIESA, Vittorio and Raffaella MANZINI (1998), Organizing for technological collaborations: a managerial perspective, *R&D Management*, Vol. 28, No. 3, pp. 199-212.

CHOWDHURY, Jafor (1992), Performance of international joint ventures and wholly owned foreign subsidiaries: a comparative perspective, *Management International Review*, Vol. 32, No. 2, pp. 115-133.

CIBORRA, Claudio (1991), Alliances as learning experiments: cooperation, competition and change in hightech industries, *in* Lynn K. Mytelka (ed.) *Strategic partnerships and the world economy*, pp. 51-77. London: Pinter.

COHEN, Wesley M. and Daniel A. LEVINTHAL (1989), Innovation and learning: the two faces of R&D, *The Economic Journal*, Vol. 99, pp. 569-596.

COHEN, Wesley M. and Daniel A. LEVINTHAL (1990), Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly*, Vol. 35, pp. 128-152.

COUNCIL ON COMPETITIVENESS (1996), *Endless frontier, limited resources: U.S R&D policy for competitiveness*. Washington: Council on Competitiveness.

DAVIS, Howard (1977), Technology transfer through commercial transactions, *Journal of Industrial Economics*, Vol. XXVI, No. 2, pp. 161-175.

DELAPIERRE, Michel, Jean-François LEMETTRE, Lynn MYTELKA, Jean-Benoit ZIMMERMANN and Blanka VAVAKOVA (1988), *Cooperation between firms and research institutes: the French case*. No imprint.

De MEYER, Arnold (1999), Using strategic partnerships to create a sustainable competitive position for hi-tech start-up firms, *R&D Management*, Vol. 29, No. 4, pp. 323-328.

DEVLIN, Godfrey and Mark BLEACKLEY (1988), Strategic alliances: guidelines for success, *Long Range Planning*, Vol. 21, No. 5, pp. 18-23.

DODGSON, Mark (1992a), The future for technological collaboration, *Futures*, June, pp. 459-470.

DODGSON, Mark (1992b), The strategic management of R&D collaboration, *Technology Analysis & Strategic Management*, Vol. 4, No. 3, pp. 227-244.

DODGSON, Mark (1993a), Organizational learning: a review of some literatures, *Organizational Studies*, Vol. 14, No. 3, pp. 375-394.

DODGSON, Mark (1993b), *Technological collaboration in industry: strategy, policy and internationalization in innovation*. London: Routledge.

DOZ, Yves L. (1988), Technology partnerships between larger and smaller firms: some critical issues, *in* Farok J. Contractor and Peter Lorange (eds.) (1988), *Cooperative strategies in international business*, pp. 317-338. NY: Lexington Books.

DOZ, Yves L. and Gary HAMEL (1998), *Alliance Advantage: the art of creating value through partnering*. Boston, MA: Harvard Business School Press.

DUSSAUGE, Pierre and Bernard GARRETTE (1995), Determinants of success in international strategic alliances: evidence from the global aerospace industry, *Journal of International Business Studies*, Vol. 26, No. 3, pp. 505-530.

DUSSAUGE, Pierre and Bernard GARRETTE (1997), Anteciper les conséquences des alliances stratégiques, *Revue Française de Gestion*, Dossier Alliances et partenariats: les fruits de l'experience, No. 114, Juin-Juillet-Août, pp. 106-117.

DUSSAUGE, Pierre and Bernard GARRETTE (1999), *Cooperative strategies: competing successfully through strategic alliances*. Chichester: John Wiley.

DUYSTERS, Geert, Gerard KOK and Maaike VAANDRAGER (1999), Crafting successful strategic technology partnerships, *R&D Management*, Vol. 29, No. 4, pp. 343-351.

DYMSZA, William A. (1988), Successes and failures of joint ventures in developing countries: lessons from experience, *in* Farok J. Contractor and Peter Lorange (eds.) (1988), *Cooperative strategies in international business*, pp. 403-424. New York: Lexington Books.

ECCLES, Robert G. (1991), The performance manifesto, *Harvard Business Review*, Jan-Feb, pp. 131-137.

EUROPEAN COMMISSION (1994), *Technology stimulation measures for SMEs. Part II: cooperative research - CRAFT. Information Package*. Luxembourg: Office for Official Publications of the European Communities.

EUROPEAN COMMISSION (1995), *Panorama of EU industry 95/96*. Luxembourg: Office for Official Publications of the European Communities.

EUROPEAN COMMISSION (1998), *Technology stimulation measures for SMEs 1994-96 - project synopses*. Luxembourg: Office for Official Publications of the European Communities.

EUROSTAT (1999), *Research and development: annual statistics 1988-1998*. Luxembourg: Office for Official Publications of the European Communities.

FORREST, Janet E. (1992), Management aspects of strategic partnering, *Journal of General Management*, Vol. 17, No. 4, pp. 25-40.

FRANKO, L. G. (1971), *Joint venture survival in multinational corporations*. New York: Praeger.

FREEMAN, C. (1991), Networks of innovators: a synthesis of research issues, *Research Policy*, Vol. 20, pp. 499-514.

FUKASAKU, Yukiko (1999), Public/private partnerships for developing environmental technology, *STI Review*, Special issue on Public/private partnerships in science and technology, No. 23, pp. 105-130. Paris: OECD.

GEORGE, Varghese P. and George FARRIS (1999), Performance of alliances: formative stages and changing organizational and environmental influences, *R&D Management*, Vol. 29, No. 4, pp. 379-389.

GERINGER, J. Michael (1989), Control and performance of international joint ventures, *Journal of International Business Studies*, Vol. 20, No. 2, pp. 235-254.

GERINGER, J. Michael and Louis HEBERT (1991), Measuring performance of international joint ventures, *Journal of International Business Studies*, Vol. 22, No. 2, pp. 249-263.

GHEMAWAT, Pankaj, Michael E. PORTER and Richard A. RAWLINSON (1986), Patterns of international coalition activity, *in* Porter, Michael E. (ed.), *Competition in global industries*, pp. 345-365. Boston: Harvard Business School Press.

GLAISTER, Keith W. and Peter J. BUCKLEY (1998), Measures of performance in UK international alliances, *Organization Studies*, Vol. 19, No. 1, pp. 89-118.

GOMES-CASSERES, Benjamin (1996), *The alliance revolution: the new shape of business rivalry*. Cambridge, MA: Harvard University Press.

GUGLER, Philippe (1992), Building transnational alliances to create competitive advantage, *Long Range Planning*, Vol. 25, No. 1, pp. 90-99.

GUGLER, Philippe and John H. DUNNING (1993), Technology-based cross-border alliances, *in* Culpan, R. (ed.), *Multinational strategic alliances*, pp. 123-165. Binghanston, NY: Haworth Press.

GULATI, Ranjay (1998), Alliances and networks, *Strategic Management Journal*, Vol. 19, pp. 293-317.

GUY, Ken, John CLARK and James STROYAN (1999), Characterising participation in European advanced technology programmes, *STI Review*, Special issue on Public/private partnerships in science and technology, No. 23, pp. 131-159. Paris: OECD.

HAGEDOORN, John (1990), Organizational modes of inter-firm co-operation and technology transfer, *Technovation*, Vol. 10, No. 1 pp. 17-30.

HAGEDOORN, John (1993), Understanding the rationale of strategic technology partnering: interorganizational modes of cooperation and sectoral differences, *Strategic Management Journal*, Vol. 14, pp. 371-385.

HAGEDOORN, John (1995), Strategic technology partnering during the 1980s: trends, networks and corporate patterns in non-core technologies, *Research Policy*, Vol. 24, pp. 207-231.

HAGEDOORN, John, Albert N. LINK and Nicholas S. VONORTAS (2000), Research partnerships, *Research Policy*, Vol. 29, pp. 567-586.

HAGEDOORN, John and Jos SCHAKENRAAD (1994), The effect of strategic technology alliances on company performance, *Strategic Management Journal*, Vol. 15, pp. 291-309.

HAIR, Joseph F., Ralph E. ANDERSON, Ronald L. TATHAM and William BLACK (1998), *Multivariate data analysis*. Prentice Hall.

HÅKANSSON, Per, Hans KJELLBERG and Anders LUNDGREN (1993), Strategic alliances in global biotechnology – a network approach, *International Business Review*, Vol. 2, No. 1, pp. 65-82.

HAMEL, Gary (1991), Competition for competence and interpartner learning within international strategic alliances, *Strategic Management Journal*, Vol. 12, pp. 83-103.

HAMEL, G., Yves L. DOZ and C. K. PRAHALAD (1989), Collaborate with your competitors and win, *Harvard Business Review*, Jan-Feb., pp. 133-139.

HARRIGAN, Kathryn R. (1986), *Managing for joint venture success*. Lexington, MA: Lexington Books.

HARRIGAN, Kathryn R. (1988), Strategic alliances and partner asymmetries, *in* Farok J. Contractor and Peter Lorange (eds.) (1988), *Cooperative strategies in international business*, pp. 205-226. New York: Lexington Books.

HAYES, R. H., S. C. WHEELWRIGHT and K. B. CLARK (1995), Measuring manufacturing performance, *in* Holloway, J., J. Lewis and Geoff Mallory (eds.), *Performance measurement and evaluation*, pp. 153-176. London: Sage. (First published in *Dynamic manufacturing: creating the learning organization* (1988), pp. 130-166. NY: The Free Press.)

HENART, Jean-Francois (1988), A transaction costs theory of equity joint ventures, *Strategic Management Journal*, Vol. 9, No. 4, pp. 361-374.

HIDALGO, Carlos Otero (1997), *Science and technology in southern Europe: Spain, Portugal, Greece, Italy*. London: Cartermill.

HORTON, Veronica (1998), An exploration of strategic collaboration in the Triad, *European Business Review*, Vol. 98, No. 1, pp. 4-12.

HUMAN, Sherrie E. and Keith G. PROVAN (1997), An emergent theory of structure and outcomes in small-firm strategic manufacturing networks, *Academy of Management Journal*, Vol. 40, No. 2, pp. 368-403.

INKPEN, Andrew C. (1996), Creating knowledge through collaboration, *California Management Review*, Vol. 39, No. 1, pp. 123-140.

INKPEN, Andrew C. and Paul W. BEAMISH (1997), Knowledge, bargaining power, and the instability of international joint ventures, *Academy of Management Review*, Vol. 22, No. 1, pp. 177-202.

INKPEN, Andrew C. and Mary M. CROSSAN (1995), Believing is seeing: joint ventures and organization learning, *Journal of Management Studies*, Vol. 32, No. 5, pp. 595-618.

ITAMI, Hiroyuki (1987), *Mobilizing invisible assets*. Cambridge, MA: Harvard University Press.

JACQUEMIN, Alexis (1988), Market structure, competition and industrial policy: cooperative agreements in R&D and European antitrust policy, *European Economic Review*, Vol. 32, pp. 551-560.

JARILLO, J. Carlos (1988), On strategic networks, *Strategic Management Journal*, Vol. 9, pp. 31-41.

JONES, Kevin and Walter E. SHILL (1993), Japan: allying for advantage, *in* Joel Bleeke and David Ernst (eds.), *Collaborating to compete: using strategic alliances and acquisitions in the global marketplace*, pp. 115-134. New York: Wiley.

JORDE, Thomas J. and David J. TEECE (1989), Competition and cooperation: striking the right balance, Working paper No. BPP-39. Berkeley, CA: University of California.

KILLING, J. Peter (1983), *Strategies for joint venture success*. New York: Praeger.

KILLING, J. Peter (1988), Understanding alliances: the role of task and organizational complexity, *in* Farok J. Contractor and Peter Lorange (eds.) (1988), *Cooperative strategies in international business*, pp. 55-67. New York: Lexington Books.

KOGUT, Bruce (1988a), A study of the life cycle of joint ventures, *in* Farok J. Contractor and Peter Lorange (eds.) (1988), *Cooperative strategies in international business*, pp. 169-185. New York: Lexington Books.

KOGUT, Bruce (1988b), Joint ventures: theoretical and empirical perspectives, *Strategic Management Journal*, Vol. 9, pp. 319-332.

KOGUT, Bruce (1989), The stability of joint ventures: reciprocity and competitive rivalry, *Journal of Industrial Economics*, Vol. XXXVIII, pp. 183-198.

KOH, H. and N. VENKATRAMAN (1991), Joint-venture formation and stock market reaction: an assessment in the information technology sector, *Academy of Management Journal*, Vol. 34, No. 4, pp. 869-892.

KOTABE, Masaaki and K. Scott SWAN (1995), The role of strategic alliances in high-technology new product development, *Strategic Management Journal*, Vol. 34, No. 4, pp. 869-892.

LARANJA, Manuel and Margarida FONTES (1998), Creative adaptation: the role of new technology based firms in Portugal, *Research Policy*, Vol. 26, pp. 1023-1036.

LARÉDO, Philippe (1998), The networks promoted by the framework programme and the questions they raise about its formulation and implementation, *Research Policy*, Vol. 27, pp. 589-598.

LEI, David T. (1997), Competence-building, technology fusion and competitive advantage: the key roles of organizational learning and strategic alliances, *International Journal of technology Management*, Vol. 14, Nos. 2/3/4, pp. 208-237.

LEVEQUE, François, Christophe BONAZZI and Christian QUENTAL (1996), Dynamics of cooperation and industrial R&D: first insights into the black box II, *in* Rod Coombs, Albert Richards, Pier P. Saviotti and Vivien Walsh (eds.) (1996), *Technological collaboration: the dynamics of cooperation in industrial innovation*, pp. 180-200. London: Edward Elgar.

LEWIN, Arie Y. and John W. MINTON (1986), Determining organizational effectiveness: another look, and an agenda for research, *Management Research*, Vol. 32, No. 5, pp. 514-538.

LEWIS, Jordan D. (1990), *Partnerships for profit: structuring and managing strategic alliances*. New York: The Free Press.

LINK, Albert (1999), Public/private partnerships in the United States, *Industry and Innovation*, Vol. 6, No. 2, pp. 191-217.

LINK, A. N. and L. L. BAUER (1989), *Cooperative research in U.S. manufacturing: assessing policy initiatives and corporate strategies*. Lexington, MA: Lexington books.

LORANGE, Peter and Johan ROOS (1992), *Strategic alliances: formation, implementation and evolution*. Cambridge, MA: Blackwell.

LUUKKONEN, Terttu (1998), The difficulties in assessing the impact of EU framework programmes, *Research Policy*, Vol. 27, No. 6, pp. 599-610.

LUUKKONEN, Terttu and Sasu HÄLIKKÄ (2000), *Knowledge creation and knowledge diffusion networks: impacts in Finland of the EU's fourth framework programme for research and development*, Tekes, Publications of the Finish Secretariat for EU R&D 1/2000. Helsinki: Finish Secretariat for EU R&D.

MACDONALD, Stuart (1992), Formal collaboration and informal information flow, *International Journal of Technology Management* – Special issue on Strengthening Corporate and National Competitiveness through Technology, Vol. 7, No. 1/2/3, pp. 49-60.

MARITI, P. and R. H. SMILEY (1983), Co-operative agreements and the organization of industry, *The Journal of Industrial Economics*, Vol. XXXI, pp. 437-451.

McCONNELL, John J. and Timothy J. NANTELL (1985), Corporate combinations and common stock returns: the case of joint ventures, *Journal of Finance*, Vol. XL, No. 2, pp. 519-536.

METCALFE, J. S., L. GEORGHIOU, P. CUNNINGHAM and H. M. CAMERON (1992), *Evaluation of the impact of European Community research programmes upon the competitiveness of European industry - concepts and approaches*. Luxembourg: Office for Official Publications of the European Communities.

MILES, Matthew B. and A. Michael HUBERMAN (1994), *Qualitative data analysis: an expanded sourcebook*, Second edition. Thousand Oaks, CA: Sage.

MOTHE, Caroline and Bertrand V. QUELIN (1999), Creating new resources through European R&D partnerships, *Technology Analysis & Strategic Management*, Vol. 11, No. 1, pp. 31-43.

MOWERY, David C. (1989), Collaborative ventures between U.S. and foreign manufacturing firms, *Research Policy*, Vol. 18, pp. 19-32.

MOWERY, David C., Joanne E. OXLEY and Brian S. SILVERMAN (1996), Strategic alliances and interfirm knowledge transfer, *Strategic Management Journal*, Vol. 17 (Special issue), pp. 77-91.

MURRAY, Edwin A. and John F. MAHON (1993), Strategic alliances: gateway to the new Europe?, *Long Range Planning*, Vol. 26, No. 4, pp. 102-111.

MYTELKA, Lynn K. (ed.) (1991), *Strategic partnerships and the world economy*. London: Pinter.

NIOSI, Jorge (1996), Strategic technological collaboration in Canadian industry: towards a theory of flexible or collective innovation, *in* Rod Coombs, Albert Richards, Pier P. Saviotti and Vivien Walsh (eds.) (1996), *Technological collaboration: the dynamics of cooperation in industrial innovation*, pp. 98-118. London: Edward Elgar.

NOOTEBOOM, Bart (1999), *Inter-firm alliances: analysis and design*. London: Routledge.

NUENO, Pedro (1999), Alliances and other things, *R&D Management*, Vol. 29, No. 4, pp. 319-322.

OECD (1991), *OECD Economic survey - Portugal*. Paris: OECD.

OECD (1993), *Reviews of national science and technology policy: Portugal*. Paris: OECD.

OECD (1995), Science and technology indicators. *Meeting of the committee for scientific and technological policy at ministerial level*. Paris: OECD.

OECD Secretariat (1999a), OECD science, technology and industry scoreboard 1999: benchmarking knowledge-based economies. Paris: OECD.

OECD Secretariat (1999b), Trends in university-industry research partnerships, *STI Review*, No. 23, Special issue on Public/private partnerships in science and technology, pp. 39-65. Paris: OECD.

OECD (2000), *OECD small and medium enterprise outlook*. Paris: OECD.

PARK, Seung Ho and Michael V. RUSSO (1996), When competition eclipses cooperation: an event history analysis of joint venture failure, *Management Science*, Vol. 42, No. 6, pp. 875-890.

PARKHE, Arvind (1993), Strategic alliances structuring: a game theoretic and transaction cost examination of interfirm cooperation, *Academy of Management Journal*, Vol. 36, pp. 794-829.

PAVITT, Keith (1998), The inevitable limits of EU R&D funding, *Research Policy*, Vol. 27, No. 6, pp. 559-568.

PERLMUTTER, Howard V. and David A. HEENAN (1986), Cooperate to compete globally, *Harvard Business Review*, March-April, pp. 136-152.

PETERSON, John (1993), Assessing the performance of European collaborative R&D policy: the case of Eureka, *Research Policy*, Vol. 22, pp. 243-264.

PETERSON, John and Margaret SHARP (1998), *Technology policy in the European Union*. London: Macmillan.

PLUNKET, Anne (1999), *Evolution de la coopération: contribution à l'étude des déterminants des processus d'évolution et de sélection de la coopération technologique*, Doctoral Thesis. Paris: Université Paris Sud XI, Faculté Jean Monnet.

PORTER, Michael E. and Mark B. FULLER (1986), Coalitions and global strategy, *in* Porter, Michael E. (ed.), *Competition in global industries*, Boston: Harvard Business School Press, pp. 315-343.

QUINTAS, Paul and Ken GUY (1995), Collaborative, pre-competitive R&D and the firm, *Research Policy*, Vol. 24, pp. 325-348.

REUER, Jeffrey J. (1997), *The dynamics and effectiveness of international joint ventures*, Working paper (97/108/SM). Fontainebleau: INSEAD.

RICHARDSON, Stephen A., Barbara S. DOHRENWEND and David KLEIN (1965), *Interviewing. Its forms and functions*. London: Basic Books.

ROSENFELD, Stuart A. (1996), Does cooperation enhance competitiveness? Assessing the impacts of inter-firm collaboration, *Research Policy*, Vol. 25, pp. 247-263.

ROTHWELL, Roy (1991), External networking and innovation in small and medium-sized manufacturing firms in Europe, *Technovation*, Vol. 11, No. 2, pp. 93-112.

ROTHWELL, Roy and Mark DODGSON (1991), External linkages and innovation in small and medium-sized enterprises, *R&D Management*, Vol. 21, No. 2, pp. 125-137.

SAXTON, Todd (1997), The effects of partner and relationship characteristics on alliance outcomes, *Academy of Management Journal*, Special issue on Special Research Forum on Alliances and Networks, Vol. 40, No. 2, pp. 443-461.

SCHMITZ, Herbert (1998), *Responding to global competitive pressure: local co-operation and upgrading in the Sinos Valley, Brazil*, Institute of Development Studies, Working Paper No. 82, University of Sussex, UK.

SCIBERRAS, E. (1987), Government sponsored programmes for international technological exchanges and applied collective research, *R&D Management*, Vol. 17, No. 1, pp. 15-23.

SCOTT, John T. (1999), Financing and leveraging public/private partnerships: the hurdle-lowering auction, *STI Review*, Special issue on Public/private partnerships in science and technology, No. 23, pp. 67-84. Paris: OECD.

SHARP, Margaret (1998), Competitiveness and cohesion - are the two compatible?, *Research Policy*, Vol. 27, No. 6, pp. 569-588.

SINGH, Kulwant (1997), The impact of technological complexity and interfirm cooperation on business survival, *Academy of Management Journal*, Special issue on Special Research Forum on Alliances and Networks, Vol. 40, No. 2, pp. 339-367.

SINGH, Kulwant and Will MITCHELL (1996), Precarious collaboration: business survival after partners shut down or form new partnerships, *Strategic Management Journal*, Vol. 17, pp. 99-115.

SMITH, Ken G., Stephen J. CARROLL and Susan J. ASHFORD (1995), Intra- and interorganizational cooperation: toward a research agenda, *Academy of Management Journal*, Vol. 38, pp. 7-23.

SOO, Christine W., David F. MIDGLEY and Timothy DEVINNEY (1999), The process of knowledge creation in organizations, Paper for the EGOS Colloquium - *Knowledge, Knowing and Organization Track*, University of Warwick, 4-6 July.

STAINER, Alan (1999), Productivity and performance - prologue and prescription, *International Journal of Technology Management*, Vol. 17, Nos. 7/8, pp. 725-727.

STUART, Toby E. (2000), Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry, *Strategic Management Journal*, Vol. 21, pp. 791-811.

TEECE, David (1986), Profiting from technological innovation: implications for integration, collaboration, licensing and public policy, *Research Policy*, Vol. 15, No. 6, pp. 285-305.

TEECE, David and Gary PISANO (1994), The dynamic capabilities of firms: an introduction, *Industrial and Corporate Change*, Vol. 3, No. 3, pp. 537-556.

TEECE, David, Gary PISANO and Amy SHUEN (1997), Dynamic capabilities and strategic management, *Strategic Management Journal*, Vol. 18, No. 7, pp. 509-533.

TIDD, Joe, John BESSANT and Keith PAVITT (1997), *Managing Innovation: integrating technological, market and organizational change*, Ch. 8; pp. 37-40; 362-363. Chichester: John Wiley.

TIJSSEN, Robert J. W. and Joke C. KOREVAAR (1997), Unravelling the cognitive and interorganisational structure of public/private R&D networks: a case study of catalysis research in the Netherlands, *Research Policy*, Vol. 25, pp. 1277-1293.

TOMLINSON, James W. C. (1970), *The joint venture process in international business: India and Pakistan*, Cambridge, Ma: The M.I.T. Press.

TRIPSAS, Mary (1997), Surviving radical technological change through dynamic capability: evidence from the typesetter industry, *Industrial and Corporate Change*, Vol. 6, No. 2, pp. 341-377.

VERTICA (1998), *SME participation in the 4 th European Union Framework programme for research and technological development*, Final Report for the European Commission, DGXII, SME Coordination Unit, 23 June.

von TUNZELMANN, G. N. (1995), *Technology and industrial progress: the foundations of economic growth*. Cheltenham: Edward Elgar.

von TUNZELMANN, G. and Q. WANG (1997), *The dimensions of complexity in production and management*, Working paper, Science Policy Research Unit, University of Sussex, October.

VONORTAS, Nicolas S. and Stratos P. SAFIOLEAS (1997), Strategic alliances in information technology and developing country firms: recent evidence, *World Development*, Vol. 25, No. 5, pp. 657-680.

WATKINS, Todd A. (1991), A technological communication cost model of R&D consortia as public policy, *Research Policy*, Vol. 20, pp. 87-107.

WOICESHYN, Jaana and Diana HARTEL (1996), Strategies and performance of Canadian biotechnology firms: an empirical evidence, *Technovation*, Vol. 16, No. 5, pp. 231-243.

WOOLRIDGE, J. Randall and Charles C. SNOW (1990), Stock market reaction to strategic investment decisions, *Strategic Management Journal*, Vol. 11, pp. 353-363.

YUAN, Benjamin and Ming-Yeu WANG (1995), The influential factors for the effectiveness of international strategic alliances of high-tech industry in Taiwan, *International Journal of Technology Management*, Vol. 10, Nos. 7/8, pp. 777-787.

Appendix 1 QUESTIONNAIRE

A INITIAL IMPORTANCE OF THE PROJECT

A1 Which of the following statements best describes the initial strategic importance of the project?

[Please tick (✓) the appropriate alternative]

- ☐ **A1.1** The project was mainly seen as a way of getting experience in interfirm cooperation
- ☐ **A1.2** The project aimed at launching a major new line of business
- ☐ **A1.3** The project aimed at launching a subsidiary line of business (e.g. reusing a by-product)
- ☐ **A1.4** The project was to strengthen the firm's existing core products/services
- ☐ **A1.5** The project aimed at preventing/diminishing environmental damages
- ☐ **A1.6** Other (please specify): _____

A2 At the beginning, how important was the project for your firm?

[Please tick (✓) the appropriate alternative]

- ☐ **A2.1** Marginal importance
- ☐ **A2.2** Moderately important
- ☐ **A2.3** Very important
- ☐ **A2.4** Fundamental for the firm survival
- ☐ **A2.5** Other (please specify): _____

A3 How strong was the sense of urgency of this project? Was it an one-off project or was it part of a long-term strategy?

A4 How do you classify the project's main goal?

[Please tick (✓) the appropriate alternative]

- ☐ **A4.1** To develop a new marketable product/service
- ☐ **A4.2** To improve the features of an existing product/service
- ☐ **A4.3** To develop a new production technology
- ☐ **A4.4** To improve an existing production technology
- ☐ **A4.5** To adapt an existing production technology from other sector(s)
- ☐ **A4.6** Other (please specify): _____

A5 Did this project intend to place your firm in a position ahead of competition?

A6 Which of the following alternative strategies could have been used instead of cooperation?

[Please tick (✓) the appropriate alternatives]

☐ **A6.1** Go it alone (solely using internal resources)

☐ **A6.2** Go it alone (in cooperation with R&D performers)

☐ **A6.3** Market transaction (e.g. licensing agreement)

☐ **A6.4** Merging with other firm

☐ **A6.5** Acquiring other firm

☐ **A6.6** Other (please specify): _____

A7 How far do you agree with the following statements concerning the option to cooperate instead of using an alternative strategy?

[1- Strongly disagree; 2- Disagree; 3- Neutral; 4- Agree; 5- Strongly agree]

A7.1 The costs of the project were too high for the firm to carry it out alone.....	1	2	3	4	5
A7.2 Lack of in-house expertise to carry out the project alone	1	2	3	4	5
A7.3 We were expecting to get benefits that go beyond the scope of the project	1	2	3	4	5
A7.4 The expected benefits would not justify the costs if carrying out the project alone	1	2	3	4	5
A7.5 The kind of technological solution we were looking for was not available in the marketplace	1	2	3	4	5
A7.6 The risk of failure was too high if carrying out the project alone	1	2	3	4	5
A7.7 We were seeking to learn from our partner firms and R&D performer(s)	1	2	3	4	5
A7.8 An independent strategy would have taken too much time.....	1	2	3	4	5
A7.9 The scale of the project would not justify a merger or acquisition strategy.....	1	2	3	4	5

B STRUCTURAL FACTORS

B1 At the beginning of the project what was the firm's experience on interfirm cooperation?

[Please tick (✓) the appropriate alternative]

☐ **B1.1** This was the very first time we entered a research cooperative project

☐ **B1.2** We do not have much experience (less than three times)

☐ **B1.3** We have experience (three or more times)

B2 Did you know some/all of your partners prior to this project?

[Please tick (✓) the appropriate alternative]

☐ **B2.1** No, we did not know any of them

☐ **B2.2** Yes, all of us worked together in a similar cooperative project before

☐ **B2.3** Yes, some of us worked together in a similar cooperative project before

☐ **B2.4** Yes, we already had commercial relationships with some/all of them

☐ **B2.5** Yes, we knew some/all of them but had no commercial relationships before

☐ **B2.6** Other (please specify): _____

B3 What kind of participation did your firm have during the preparation and negotiation of the project?

B4 Did the partner firms sign a formal contract prior to the relationship? How important was it in the whole process of cooperation?

B5 Did the partner firms agree on intellectual property rights before the beginning of the project?

B6 Please describe the type and frequency of interactions (e.g. meetings, visits) between partner firms and between them and R&D performers?

B7 How important were the following factors in negatively influencing or in limiting the expected outcomes of the alliance?

[1- Irrelevant; 2- Slightly import.; 3- Moderately import.; 4- Very import.; 5- Extremely important]

B7.1 Language/communication problems	1	2	3	4	5
B7.2 Number of interactions between the partner firms and R&D performers (☐ too many?, ☐ too few?)	1	2	3	4	5
B7.3 Quality of interactions between the partner firms and R&D performers	1	2	3	4	5
B7.4 Cultural differences among the partner firms	1	2	3	4	5
B7.5 Difference in size between the partner firms	1	2	3	4	5
B7.6 Lack of willingness of partner firms to share know-how	1	2	3	4	5
B7.7 Number of alliance partners (☐ too many?, ☐ too few?)	1	2	3	4	5
B7.8 Written contract among the partner firms (☐ existence?, ☐ non-existence?)	1	2	3	4	5
B7.9 Prior agreement on intellectual property rights (☐ existence?, ☐ too weak/ non-existence?)	1	2	3	4	5
B7.10 Technological complexity of the project	1	2	3	4	5
B7.11 Lack of in-house technological expertise to exploit the project outcomes	1	2	3	4	5
B7.12 Lack of or scarce financial resources to exploit the project outcomes	1	2	3	4	5
B7.13 Lack of or scarce management time	1	2	3	4	5
B7.14 Lack of experience in similar projects	1	2	3	4	5
B7.15 Different expectations/conflicts of interest amongst the partner firms (and/or R&D performers)	1	2	3	4	5
B7.16 Lack of commitment or delay in accomplishing tasks by partner firms (and/or R&D performers)	1	2	3	4	5
B7.17 Miscalculation of the risk involved in the project	1	2	3	4	5
B7.18 Inflexibility of the objectives of the research project	1	2	3	4	5
B7.19 Lack of expertise of the R&D performer(s) to carry out the research project	1	2	3	4	5
B7.20 Too much optimism at the beginning	1	2	3	4	5
B7.21 Dependence on the European Union (e.g. funding, regulations)	1	2	3	4	5
B7.22 Other (please specify): _____	1	2	3	4	5

C DETERMINANTS OF PERFORMANCE

C1 In assessing the performance of the alliance, how far do you agree with the following statements?

[1- Strongly disagree; 2- Disagree; 3- Neutral; 4- Agree; 5- Strongly agree]

C1.1 Overall we are satisfied with the performance of this alliance	1	2	3	4	5

C1.2 The alliance has realised the goals we set out to achieve 1 2 3 4 5

C1.3 Now we have a competitive advantage over our direct competitors..... 1 2 3 4 5

C1.4 This project has/will have a positive impact on the firm performance 1 2 3 4 5

The firm will certainly use interfirm cooperation on a more regular basis:

- **C1.5** if European Union funding is available..... 1 2 3 4 5
- **C1.6** even without European Union funding..... 1 2 3 4 5

C2 Which of the following possible benefits has your firm achieved as a result of alliance participation and how important do you believe they are to the firm's (future) performance?

[0- Tick this option if it does not apply to your firm; 1- Irrelevant; 2- Slightly important; 3- Moderately important; 4- Very important; 5- Extremely important]

DIRECT BENEFITS FOR THE FIRM (Those benefits that are directly related to the project goals)

0 **C2.1** Developed or improved a product/service (or a prototype) 1 2 3 4 5

0 **C2.2** Developed or improved a production process..... 1 2 3 4 5

0 **C2.3** Learned about/had access to the partner firms' technology..... 1 2 3 4 5

0 **C2.4** Learned about/had access to the R&D performers' technology..... 1 2 3 4 5

0 **C2.5** A patent was granted to the partner firms (or an application for a patent has been submitted) 1 2 3 4 5

0 **C2.6** Specific technical training was (has been) given to employees..... 1 2 3 4 5

0 **C2.7** Hired qualified personnel..... 1 2 3 4 5

0 **C2.8** Gained experience in interfirm cooperation..... 1 2 3 4 5

0 **C2.9** Benefited from temporary personnel exchanges between partner firms..... 1 2 3 4 5

0 **C2.10** Acquired new machinery that incorporate new technology..... 1 2 3 4 5

0 **C2.11** Acquired other equipment that incorporate new technology..... 1 2 3 4 5

0 **C2.12** Improved /built a new plant/facilities..... 1 2 3 4 5

0 **C2.13** Created or improved the R&D department (e.g. new equipment, more staff)..... 1 2 3 4 5

0 **C2.14** Other (please specify): _____ 1 2 3 4 5

INDIRECT BENEFITS FOR THE FIRM (Those benefits that go beyond the project goals)

0 **C2.15** Obtained new ideas from partner firms to improve existing products/production processes..... 1 2 3 4 5

0 **C2.16** Obtained new ideas from R&D performers to improve existing products/production processes..... 1 2 3 4 5

0 **C2.17** Had access to new techniques and skills (other than those related to the project) 1 2 3 4 5

0 **C2.18** Became a supplier of partner firms 1 2 3 4 5

0 **C2.19** Became a customer of partner firms..... 1 2 3 4 5

0 **C2.20** The firm is applying the knowledge acquired in other products/services..... 1 2 3 4 5

0 **C2.21** Improved firm's image/reputation/credibility..... 1 2 3 4 5

0 **C2.22** Improved firm's visibility/exposure (e.g. publicity) 1 2 3 4 5

0 **C2.23** Got experience on how to prepare and implement a (joint) research project..... 1 2 3 4 5

0 **C2.24** The firm is using the knowledge/experience gained to develop other research projects..... 1 2 3 4 5

0 **C2.25** Improved management skills/practices 1 2 3 4 5

0	**C2.26** Received proposals for new joint projects from national firms	1	2	3	4	5
0	**C2.27** Received proposals for new joint projects from foreign firms	1	2	3	4	5
0	**C2.28** Learned about an unfamiliar market/customer needs	1	2	3	4	5
0	**C2.29** Developed a formal/informal network to exchange technical information	1	2	3	4	5
0	**C2.30** Found new ways of having access to technical information	1	2	3	4	5
0	**C2.31** Improved the knowledge about competitors	1	2	3	4	5
0	**C2.32** Other (please specify): _____	1	2	3	4	5

C3 How far can one say the benefits your firm achieved exceeded initial expectations? Did your firm implement any specific measures to reap the available benefits and learn from partners?

C4 In your opinion, which direct or indirect benefits would you consider as the most important to your firm? Why?

C5 Considering the whole investment in this project - preparation and negotiation, implementation and exploitation of results -, how important to your firm were the following categories of costs directly arising out of the project?

[1- Irrelevant; 2- Slightly import.; 3- Moderately import.; 4- Very import.; 5- Extremely important]

C5.1 Personnel costs	1	2	3	4	5
C5.2 Training costs	1	2	3	4	5
C5.3 Travel and subsistence costs	1	2	3	4	5
C5.4 Subcontracting costs (e.g. consultancy)	1	2	3	4	5
C5.5 Acquisition of durable equipment	1	2	3	4	5
C5.6 Acquisition of consumables	1	2	3	4	5
C5.7 Computing costs	1	2	3	4	5
C5.8 Costs of protecting knowledge (e.g. patenting)	1	2	3	4	5
C5.9 Administration/management costs	1	2	3	4	5
C5.10 Other specific project costs	1	2	3	4	5

C6 What type(s) of costs was/were the most difficult for your firm to cope with? Why?

C7 Did your firm implement any specific procedures for measuring the project's costs and benefits?

C8 To what extent did the resources (financial, personnel and technological) devoted to this project impede or postpone the implementation of other projects? Did it affect in any way the normal functioning of your firm?

C9 Did the difference in size, the nationality or the role of each partner in the partnership (e.g. being a prime proposer or not) influence the partners' ability to capture the benefits from the alliance?

D INDICATORS OF PERFORMANCE

D1 At the beginning of the project, how important was its expected impact on each of the following performance indicators? And, what is the real impact the firm has experienced?

[1- Irrelevant; 2- Slightly important; 3- Moderately important; 4- Very important; 5- Extremely important]

	Expected impact						Real impact					
D1.1 Productivity (increase)	1	2	3	4	5		**D1.10**	1	2	3	4	5
D1.2 Production costs (decrease)	1	2	3	4	5		**D1.11**	1	2	3	4	5
D1.3 Sales (increase)	1	2	3	4	5		**D1.12**	1	2	3	4	5
D1.4 Profit (increase)	1	2	3	4	5		**D1.13**	1	2	3	4	5
D1.5 Product/Service quality (improve)	1	2	3	4	5		**D1.14**	1	2	3	4	5
D1.6 Customer satisfaction (improve)	1	2	3	4	5		**D1.15**	1	2	3	4	5
D1.7 Market share (increase)	1	2	3	4	5		**D1.16**	1	2	3	4	5
D1.8 Environmental damages (reduction)	1	2	3	4	5		**D1.17**	1	2	3	4	5
D1.9 Overall impact	1	2	3	4	5		**D1.18**	1	2	3	4	5

D2 How do you explain the difference between the expected results and the real impact on performance indicators?

D3 If possible, would you please provide an approximate figure for the real impact on some or all of those indicators?

D3.1 Productivity ..... _____ % of increase
D3.2 Production costs ..... _____ % of decrease
D3.3 Sales ..... _____ % of increase
D3.4 Profit ..... _____ % of increase
D3.5 Product/Service quality ..... _____ % of improvement
D3.6 Customer satisfaction ..... _____ % of improvement
D3.7 Market share ..... _____ % of increase
D3.8 Environmental damages ..... _____ % of reduction
D3.9 Overall impact ..... _____ % of improvement

E OTHER INFORMATION

E1 Firm's CAE (sector of activity): _____

E2 Firm's turnover: 1998: _____ PTE or 1999: _____ PTE

E3 Firm's number of employees: 1999: _____

E4 Interviewee's name: _____ Position: _____

E5 Number of partner firms: _____

Appendix

2 TABLES AND FIGURES

Table A2.1 *Previous studies on alliance performance - research methods and technical data*

Reference	Alliance type/ Sample size/Period	Sector/ Firm size/ Country (Region)	Indicators	Data collection method
Tomlinson (1970)	- Joint Venture - n = 71	- Oil, chemicals, engineering, electrical, vehicles, metals, tobacco and food; - Mainly large firms; - UK, India, Pakistan;	- Profitability; - Performance against scheduled objectives (market, cost, international integration, other)	- Archival data; - Interviews;
Franko (1971)	- Joint venture - n = 1100; - 1961-67;	- Manufacturing firms; - Large firms	- JV instability (instability of its ownership); - Duration; - Survival;	- 1967 Fortune 500 list; - Questionnaire; - Interviews;
Killing (1983)	- Joint venture - n = 37	- North American, Western Europe, developing countries (2);	- Performance: JV manager's own assessment; - Failure: JV liquidation or reorganisation;	- Interviews;
Harrigan (1988)*	- Strategic alliance - n = 895; - 1974-85;	- 23 industries;	- Venture performance: venture survival, duration; - Sponsor-indicated assessments of success	- Archival data; - Interviews, - Questionnaire;
Bleeke &Ernst (1989)**	- Cross-border alliances - n = 49;	- Some industries; - Large firms;	- Success and failure: the achievement of partner's objectives and partners recovering their financial costs of capital;	- Unpublished financial results; - Interviews;
Kogut (1989)	- Joint venture - n = 92; - 1975-83;	- Manufacturing; - US-based;	- JV instability; - Termination rates: ventures dissolved or acquired;	- Information published on the Mergers and Acquisitions - 3 Questionnaires;
Geringer & Hebert (1991)	- International joint venture - n = 69 + 48 (US, Canada); - 1979-85 (US), 1981-88 (Canada);	- Manufacturing; - Large firms; - US, Canada, other OECD countries;	- Subjective performance measures: parents' satisfaction; - Objective performance measures: IJV survival, stability and duration	- Secondary sources; - Questionnaires; - Interviews;
Chowdhury (1992)	- International joint venture - n = 8741 units; - 1951-75;	- Manufacturing subsidiaries; - Mainly large firms;	- Dependent variable: mode of entry - Indep. variable: performance criteria (exit rate, longevity, stability of ownership status, retention of parental control, export sales, factor usage)	- Harvard Multinational Enterprise project;
Parkhe (1993)	- Strategic alliance (dyadic) - n = 111 partners; - 1983-88;	- Chemicals, machinery, electric and electronic equipment, transport equipment; - At least with one US partner;	- Performance assessed through a number of objective and subjective measures;	- Funk and Scott's Index of corporate change; - Questionnaire;
Dussauge & Garrette (1995)	- Strategic alliance - n = 30; - 1950-90;	- Aerospace and defence industry; - Large firms; - Many developed countries;	- Subjective judgement: industry analysts + company executives; - Success: technical quality, economic success (commercial success + financial results)	- Archival data; - Questionnaire;

Table A2.1 (Cont.)

Reference	Alliance type/ Sample size/Period	Sector/ Firm size/ Country (Region)	Indicators	Data collection method
Yuan & Wang (1995)	- International strategic alliance - n = 27 firms	- High-technology firms; - Located in the Hsinchu Industrial Park - Taiwan	- Effectiveness: firm's subjective judgement of the achievement of the objectives. - Influential factors: company's basic attributes, operational environment, alliance attributes, bilateral interaction; company's attitude; relative capability;	- Questionnaire;
Park & Russo (1996)	- Joint venture - n = 204; - 1979-88;	- Electronics industry; - At least one US-based firm;	- Duration; - Failure;	- Archival data; - Telephone enquiries;
Dussauge & Garrette (1997)	- Strategic alliance - n = 197 (between competitors)	- Manufacturing - Large firms	- Outcomes of alliances - three dimensions: its evolution over time, the strategic consequences for each partner; its impact on the intensity of competition	- Secondary sources; - Firm contacts;
Reuer (1997)	- International joint venture - n = 272; - 1985-95;	- Large firms; - Dyadic IJV with at least one US partner;	- IJVs instability: termination rates;	- Announcements in the Lexis-Nexis or Predicast's Funk and Scott Index databases;
Saxton (1997)	- Alliance (dyadic) - n = 98 partner contacts	- Chemicals and allied products; - Canada, US, UK, Germany, France, Japan, Malaysia, India;	- Dependent variable: alliance outcomes; - Indep. variables: reputation; similarity between the partners; prior relationships	- Questionnaire;
Glaister & Buckley (1998)	- International alliances - n = 75 UK partners; - 1980-89;	- Manufacturing; Tertiary sector; - Large firms; - Western Europe, US, Japan;	- Measures of performance: subjective level of satisfaction, Objective measures (survival, stability, duration);	- Announcements in the Financial Times; - Questionnaire;

Notes: (*) This study is based on Harrigan's previous works. (**) See Bleeke and Ernst (1993a).
Source: Author's elaboration.

Table A2.2 *Previous studies on firm performance through alliances - research methods and technical data*

Reference	Alliance type/ Sample size/Period	Sector/ Firm size/ Country (Region)	Indicators	Data collection method
Berg et al. (1982)	- Joint venture	- Chemical industry	- After-tax rate of return on investment;	
McConnell & Nantell (1985)	- Joint venture - n = 136; - 1972-79;	- Several companies; - Large firms; - US companies;	- Common stock returns; - JV announcements;	- Firms listed on the American or New York Stock Exchange; - Announcements in the Wall Street Journal Index;
Woolridge & Snow (1990)	- Joint venture - n = 197; - 07/72-12/87;	- 102 industries;	- Investment announcements; - Stock prices;	- Announcements in the Wall Street Journal;
Koh & Venkatraman (1991)	- Joint venture - n = 175; - 1972-86;	- Manufacturing, non-manufacturing; - Large and small firms;	- JV Announcements; - Stock market reactions;	- Announcements in the Wall Street Journal Index;
Beta (1993)	- Consortium; - n = 50 (176 firms);	- Large and small firms; - Western European countries;	- Direct and indirect economic effects (mainly expressed in terms of sales and cost reductions);	- Interviews;
Hagedoorn & Schakenraad (1994)	- Strategic technology partnering - n = 397; - 1980-87;	- Manuf. firms: Inf. technologies & electronics, mechanical engineering, processing industries; - Large firms; - Europe, US, Japan;	Economic performance (avg. share of net income): sectoral features, national circumstances, size of firm (avg. worldwide employment and turnover), innovative-ness (patent intensity), intensity of strategic partnering.	- CATI database – "literature-based alliance counting";
BIE (1995)	- Cooperative Business Arrangements; - (1286 firms);	- Clothing and footwear, engineering, IT&F, scientific and medical, food and beverages;	- Performance measures (employment levels, turnover, profits, productivity, exports); - Competitiveness measures (technology, quality, price, customer service);	- Survey; - Some interviews;
Mowery, Oxley & Silverman (1996)	- Alliance - n = 792; - 1985-86;	- Dyadic alliances at least with one US partner; - Large firms;	- Citation patterns in a firm's patent portfolio: cross-citation rate - Technological capabilities;	- CATI database; - The 1985 edition of Who Owns Whom; - Micropatent database;
Rosenfeld (1996)	- Networks;	- Several sectors; - Small firms; - US;	- Benefits;	- Interviews; - Questionnaires; - Archival data;
Singh & Mitchell (1996)	- Interfirm agreement (no JVs) - n = 693; - 1961-91;	- Hospital software systems industry; - Large and small firms; - US;	- Performance measure: business survival (i.e., a firm's participation in the industry)	- Archival data; - Interviews; - Questionnaire;

Table A2.2 (Cont.)

Reference	Alliance type/ Sample size/Period	Sector/ Firm size/ Country (Region)	Indicators	Data collection method
Barlow et al. (1997)	- Partnering - n = 5;	- Construction industry; - Large and small firms; - UK;	- Benefits and problems;	- Interviews;
Human & Provan (1997)	- Network - n = 2 (60+77 firms)	- Wood products industry; - US;	- Transactional outcomes; - Transformational outcomes;	- Interviews; - Questionnaires;
Singh (1997)	- Alliance - n = 693 (248 firms); - 1961-91;	- Hospital software systems industry; - Large and small firms; - US;	- Performance measure: business survival (i.e., a firm's participation in the industry)	- Archival data; - Interviews; - Questionnaire;
Tripsas (1997)	- Informal know-how trading, strategic alliances, long-term supplier relationships - n = 3 firms; - 1886-1990;	- Typesetter industry;	- Firm survival;	- Secondary sources; - Company archives; - Multiple interviews;
Schmitz (1998)	- Vertical and horizontal co-operation; - n = 65;	- Cluster – footwear industry; - Small firms; - Sinos Valley – Brazil;	- Performance index; - Co-operation index - both indexes constructed based on several variables (qualitative information);	- Archival data; - Questionnaire; - Interviews;
Benfratello & Sembenelli (2000)	- Research joint ventures; - (411 firms); - 1992-96;	- 21 manufacturing sectors; - European Union;	- Labour productivity; - Total factor productivity; - Price cost margin;	- EU data-sets; - Amadeus database (release 44, May 1998);
Stuart (2000)	- Alliances (5 types); - 1600 dyadic alliances; - 1985-1991;	- Semiconductor industry; - Small and large firms; - US, Europe, Japan and other Southeast Asian countries;	- Ex post performance, measured either as a rate of innovation or as a rate of sales growth;	- Dataquest consultancy firm;

Source: Author's elaboration.

Table A2.3 *How far do you agree with the following statements concerning the option to cooperate instead of using an alternative strategy?*

Variable	1-Strongly disagree	2-Disagree	3-Neutral	4-Agree	5-Strongly agree	Missing	Total
A7.1	2	6	3	6	23	3	43
A7.2	2	2	4	14	19	2	43
A7.3	1	14	8	15	2	3	43
A7.4	2	10	5	11	13	2	43
A7.5	1	3	9	15	12	3	43
A7.6	2	6	3	15	15	2	43
A7.7	1	1	7	17	15	2	43
A7.8	2	3	2	14	19	3	43
A7.9	0	3	1	9	28	2	43

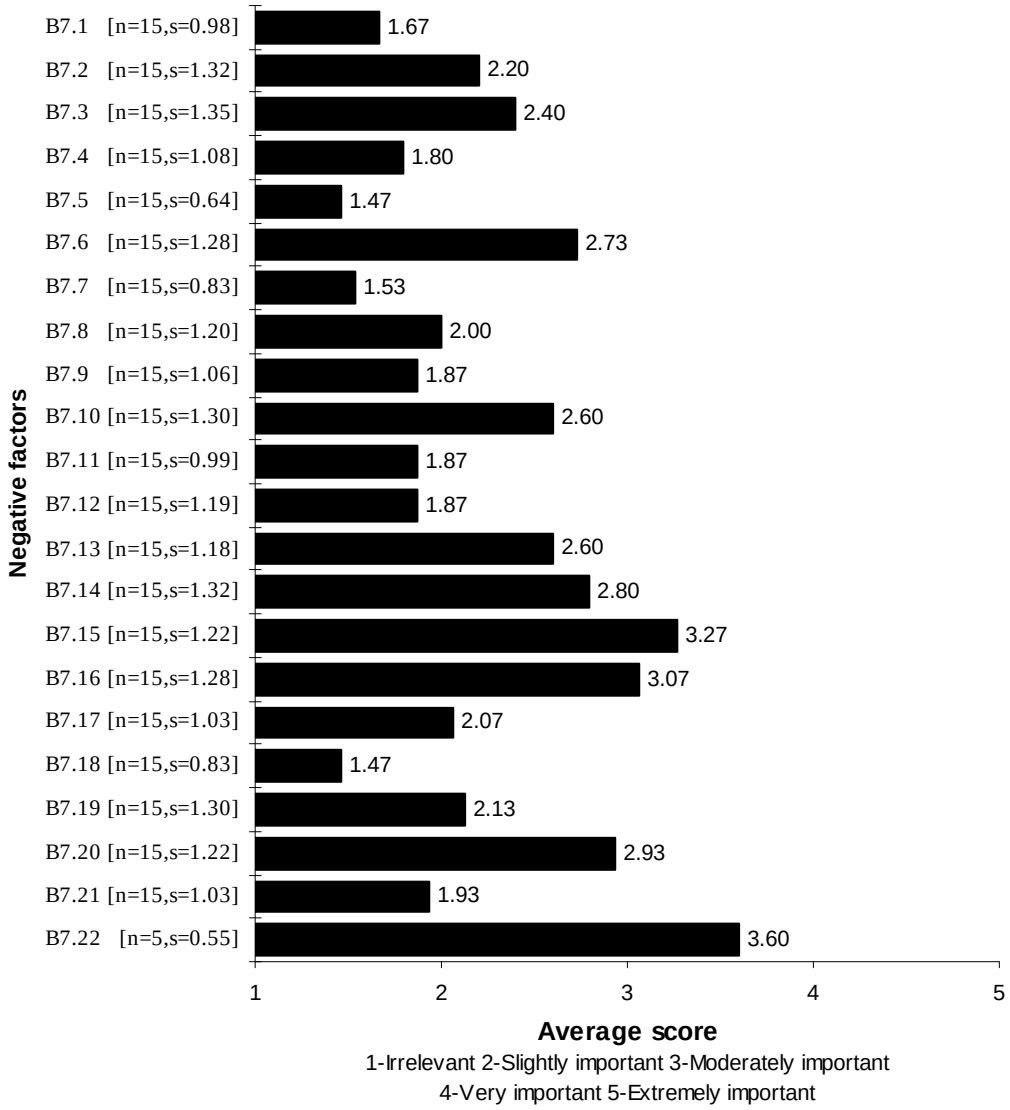
Key: See the questionnaire in Appendix 1.
Source: Interviews (question A7).

Table A2.4 *How important were the following factors in negatively influencing or in limiting the expected outcomes of the alliance?*

Variable	1-Irrelevant	2-Slightly important	3-Moderately important	4-Very important	5-Extremely important	Missing	Total
B7.1	25	10	4	2	1	1	43
B7.2	19	11	6	4	2	1	43
B7.3	22	8	5	6	1	1	43
B7.4	27	13	1	0	1	1	43
B7.5	27	14	1	0	0	1	43
B7.6	21	10	6	3	2	1	43
B7.7	27	8	5	2	0	1	43
B7.8	29	7	4	1	1	1	43
B7.9	26	9	5	1	1	1	43
B7.10	16	10	8	7	1	1	43
B7.11	26	9	5	2	0	1	43
B7.12	26	7	4	5	0	1	43
B7.13	20	11	5	6	0	1	43
B7.14	19	11	6	4	2	1	43
B7.15	17	12	6	4	3	1	43
B7.16	13	12	9	4	4	1	43
B7.17	26	9	6	1	0	1	43
B7.18	31	9	1	1	0	1	43
B7.19	26	11	2	1	2	1	43
B7.20	19	7	11	3	2	1	43
B7.21	26	11	3	2	0	1	43
B7.22	0	1	2	5	3	32	43

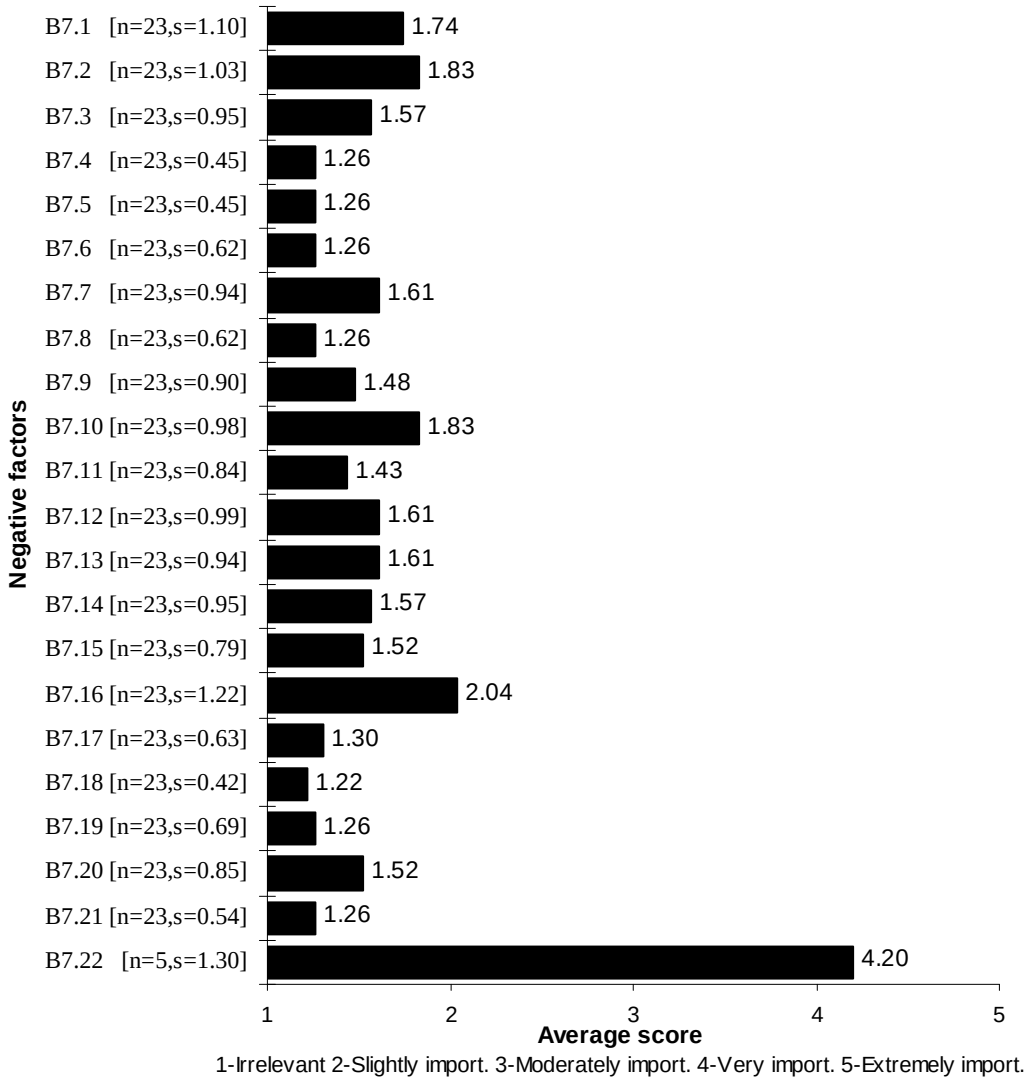
Key: See the questionnaire in Appendix 1.
Source: Interviews (question B7).

Figure A2.1 *Importance of the negative factors - for firms not satisfied with the alliance performance (C1.1 ≤3)*



Key: See the questionnaire in Appendix 1.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.4 and Table A2.5, both in Appendix 2.

Figure A2.2 *Importance of the negative factors - alliances that achieved the objectives (C1.2 > 3)*



Key: See the questionnaire in Appendix 1.
Notes: (n) Number of observations. (s) Sample standard deviation.
Source: Table A2.4 and Table A2.5, both in Appendix 2.

Table A2.5 *In assessing the performance of the alliance, how far do you agree with the following statements?*

Variable	1-Strongly disagree	2-Disagree	3-Neutral	4-Agree	5-Strongly agree	Missing	Total
C1.1	0	7	8	19	8	1	43
C1.2	3	11	5	12	11	1	43
C1.3	8	10	6	15	2	2	43
C1.4	8	7	9	14	4	1	43
C1.5	1	2	5	28	6	1	43
C1.6	1	2	10	24	5	1	43

Key: See the questionnaire in Appendix 1.
Source: Interviews (question C1).

Table A2.6 *Which of the following possible benefits has your firm achieved as a result of alliance participation and how important do you believe they are to the firm's (future) performance?*

Variable		0-Did not achieve it	1-Irre-levant	2-Slightly important	3-Moderately important	4-Very important	5-Extremely important	Missing	Total
Direct benefits	C2.1	21	5	2	6	5	2	2	43
	C2.2	17	3	4	4	9	4	2	43
	C2.3	10	3	8	15	4	1	2	43
	C2.4	11	5	1	15	9	0	2	43
	C2.5	30	0	1	4	4	2	2	43
	C2.6	33	0	1	2	4	1	2	43
	C2.7	40	1	0	0	0	0	2	43
	C2.8	7	3	1	16	12	2	2	43
	C2.9	38	0	0	2	1	0	2	43
	C2.10	30	0	0	1	8	2	2	43
	C2.11	35	0	0	2	4	0	2	43
	C2.12	33	0	0	3	4	1	2	43
	C2.13	32	0	0	4	5	0	2	43
	C2.14	37	0	0	0	3	1	2	43
	C2.15	18	5	4	6	7	1	2	43
Indirect benefits	C2.16	27	2	3	5	4	0	2	43
	C2.17	16	1	6	10	6	2	2	43
	C2.18	38	1	1	0	1	0	2	43
	C2.19	38	1	1	1	0	0	2	43
	C2.20	31	3	3	1	3	0	2	43
	C2.21	14	2	4	10	9	2	2	43
	C2.22	22	3	2	8	6	0	2	43
	C2.23	13	5	7	11	5	0	2	43
	C2.24	27	1	3	6	4	0	2	43
	C2.25	31	2	2	4	2	0	2	43
	C2.26	34	2	1	3	1	0	2	43
	C2.27	28	2	1	7	3	0	2	43
	C2.28	26	1	2	7	4	1	2	43
	C2.29	29	1	2	5	4	0	2	43
	C2.30	21	1	1	13	5	0	2	43
	C2.31	29	2	5	3	1	1	2	43
	C2.32	35	0	1	2	3	0	2	43

Key: See the questionnaire in Appendix 1.
Source: Interviews (question C2).

Table A2.7 *At the beginning of the project, how important was its expected impact on each of the following performance indicators? And, what is the real impact the firm has experienced?*

Variable		1-Irrelevant	2-Slightly important	3-Moderately important	4-Very important	5-Extremely important	Missing	Total
Expected impact	D1.1	19	5	7	6	3	3	43
	D1.2	13	9	7	9	2	3	43
	D1.3	17	5	7	7	5	2	43
	D1.4	10	8	8	9	5	3	43
	D1.5	15	4	10	8	4	2	43
	D1.6	16	2	7	12	4	2	43
	D1.7	19	3	6	10	3	2	43
	D1.8	16	6	10	4	5	2	43
	D1.9	2	8	16	11	4	2	43
Real impact	D1.10	23	6	5	3	2	4	43
	D1.11	21	7	6	4	1	4	43
	D1.12	25	6	3	2	4	3	43
	D1.13	19	7	5	4	4	4	43
	D1.14	22	6	7	3	2	3	43
	D1.15	23	5	4	5	3	3	43
	D1.16	26	5	3	4	2	3	43
	D1.17	25	5	6	2	2	3	43
	D1.18	12	15	3	6	4	3	43

Key: See the questionnaire in Appendix 1.
Source: Interviews (question D1).

Appendix 3

STATISTICAL OUTPUTS

RESULTS OF FACTOR ANALYSIS - SPSS 9.0 OUTPUTS

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
B7.1	1.6667	1.00406	42
B7.2	2.0238	1.19935	42
B7.3	1.9524	1.20876	42
B7.4	1.4524	.77152	42
B7.5	1.3810	.53885	42
B7.6	1.9286	1.17687	42
B7.7	1.5714	.88739	42
B7.8	1.5238	.94322	42
B7.9	1.6190	.96151	42
B7.10	2.2143	1.20032	42
B7.11	1.5952	.88509	42
B7.12	1.7143	1.06578	42
B7.13	1.9286	1.09082	42
B7.14	2.0238	1.19935	42
B7.15	2.1429	1.26050	42
B7.16	2.3810	1.28694	42
B7.17	1.5714	.83060	42
B7.18	1.3333	.65020	42
B7.19	1.6190	1.03482	42
B7.20	2.0952	1.20587	42
B7.21	1.5476	.83235	42

Communalities

	Initial	Extraction
B7.1	1.000	.870
B7.2	1.000	.800
B7.3	1.000	.511
B7.4	1.000	.741
B7.5	1.000	.737
B7.6	1.000	.621
B7.7	1.000	.817
B7.8	1.000	.783
B7.9	1.000	.828
B7.10	1.000	.793
B7.11	1.000	.779
B7.12	1.000	.761
B7.13	1.000	.774
B7.14	1.000	.795
B7.15	1.000	.871
B7.16	1.000	.565
B7.17	1.000	.750
B7.18	1.000	.721
B7.19	1.000	.691
B7.20	1.000	.737
B7.21	1.000	.675

Extraction Method: Principal Component Analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.575
Bartlett's Test of Sphericity	Approx. Chi-Square	554.489
	df	210
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.463	30.774	30.774	6.463	30.774	30.774	4.014	19.115	19.115
2	2.871	13.670	44.444	2.871	13.670	44.444	3.373	16.063	35.178
3	2.166	10.313	54.757	2.166	10.313	54.757	2.649	12.613	47.791
4	1.513	7.203	61.960	1.513	7.203	61.960	2.103	10.014	57.805
5	1.403	6.680	68.640	1.403	6.680	68.640	1.777	8.460	66.265
6	1.206	5.741	74.381	1.206	5.741	74.381	1.704	8.116	74.381
7	.914	4.354	78.735						
8	.902	4.296	83.030						
9	.739	3.519	86.550						
10	.531	2.528	89.077						
11	.454	2.160	91.237						
12	.370	1.763	93.000						
13	.320	1.523	94.523						
14	.294	1.401	95.923						
15	.247	1.176	97.100						
16	.203	.966	98.066						
17	.145	.689	98.755						
18	9.791E-02	.466	99.221						
19	7.489E-02	.357	99.578						
20	4.552E-02	.217	99.794						
21	4.316E-02	.206	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
B7.15	.839					
B7.20	.760					
B7.6	.721					
B7.16	.719					
B7.14	.586					
B7.3	.558					
B7.19	.532				.521	
B7.8		.838				
B7.9		.830				
B7.4		.799				
B7.21		.608				
B7.11			.807			
B7.5			.708			
B7.12			.692			
B7.13			.683			
B7.10				.741		
B7.17				.722		
B7.2		.523		.657		
B7.1					.902	
B7.7						.810
B7.18						.630

Extraction Method: Principal Component Analysis.
Rotation Method: Quartimax with Kaiser Normalization.

a. Rotation converged in 11 iterations.