A Novel Framework for Intelligent Automation

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Abstract: As the industry continues to pursue the reduction of downtimes and increases in the efficiency of resource usage, data appears as a valuable business asset, empowering intelligent automation solutions. In order to deal with current challenges in acquisition and management of data in industrial settings, this paper proposes a framework for intelligent automation. The traditional automation pyramid does not cope with today's application requirements, as intelligent automation needs to exchange, in real-time, information with all layers of the pyramid, simultaneously. The middleware for intelligent automation provides interoperability through integration software along with cloud functionalities and big data warehousing. The middleware also provides decentralization by connecting to remote decision support systems. This paper presents two real implementation examples of the framework in the wood and the chemical industry. The framework successfully addresses the requirements of key intelligent automation features and data characteristics, supporting the development of support decision systems into automation modules.

Keywords: Intelligent Automation, SCADA, Manufacturing Execution Systems, Industry 4.0.

1. INTRODUCTION

Taiichi Ohno, in Toyota Production System (Ohno 1988) used the concept of *autonomation* or "automation with a human touch" to describe machine intelligence and how machines would operate autonomously in the years to come. Today, Intelligent Automation arrived with Industry 4.0 as a combination of artificial intelligence and automation (Accenture 2016; Deloitte 2014). The Industry 4.0 initiative, digital manufacturing, smart factories or fourth industrial revolution, have all in common the organizational changes introduced by the adoption of technologies and devices, capable of autonomously interact with one another, and with people, along the value of chain (Kagermann, Wahlster, and Helbig 2013; European Parliment 2016).

1.1 Towards a data-driven industry

The change in the paradigm does not change what is generically pursued by the industry, which is to reduce downtimes and optimize the usage of the resources. Nowadays, mass customization is the result of market pressure to combine low costs of mass production with the flexibility of custom production (Liu et al. 2018). Companies are forced to produce smaller and more diverse batches, making the level of organization, integration and communication more complex and both real-time, and decentralized-decision dependent (Mcfarlane et al. 2012). The ability to grow is linked to the efficiency offered and the flexibility with which new systems plug-and-work with previous, whilst taking advantage of global standards.

Data is a valuable business asset. The continuous data flow generated by such environments can be addressed by integrated analysis to optimize the control of production processes in the form of data-based decision support systems. The acquisition, manipulation and use of data has become a core value behind the investment in new technologies by the industry. Areas behind this transformation include:

- Intelligent Automation, such as cyber-physical systems, collaborative robotics and predictive analytics (Faller and Höftmann 2018);
- Internet of Things (IoT), where all devices are expected to be connected and communicate with each other, referred by the International Telecommunications Union as "the infrastructure of the information society";
- Cloud-based solutions and edge computing supporting big data platforms, while ensuring peripheral decentralization through the use of the resources of the devices (Shi et al. 2016);
- Digital twins, for simulation models (Liu et al. 2018) and augmented reality. Virtualization is achieved through digitalization efforts.

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