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Industry 4.0 implications in logistics: an overview

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Abstract

During the last decade, the use and evolution of Information and Communication Technologies (ICT) in industry have become unavoidable. The emergence of the Industry Internet of Things (IIoT) promoted new challenges in logistic domain, which might require technological changes such as: high need for transparency (supply chain visibility); integrity control (right products, at the right time, place, quantity condition and at the right cost) in the supply chains. These evolvments introduce the concept of Logistics 4.0. In this paper, it is presented some reflections regarding the adequate requirements and issues enabling organizations to be efficient, and fully operational in Logistics 4.0 context.

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1. Introduction

As never seen before, technological innovation and customer demands for sophisticated technology and services promotes the emergence of new challenges, which is increasingly changing industry. This transformation will dramatically influence how organizations will be managed according to the new incentives, and environmental and context configuration. Although some sectors like automotive, technology and biology industry, through its

commitment to overall efficiency and innovation, took the lead on the platoon of industry changes, others will have to follow the technological evolution because this change is being done very quickly, allowing us to refer as the new Industrial revolution, commonly known as the fourth industrial revolution (Industry 4.0).

This revolution is causing profound changes, not only in industry but also in society, in the economic rhythm and outlook, in how work is planned and operationalized, in what way should be oriented the human-machine interactions, among other situations. Although, the ability to correctly interpret and perceive these changes will allow us to gain a higher level of awareness and a capacity to monitor and read the markets, which will promote the organizational alignment with this pattern of paradigm change. Therefore, the gained sensibility will potentiate the interpretation of the clients' behavior towards choosing products and services, purchase vs. rental, as well as the appearance of new paradigms such as: shared economy, collaborative innovation, additive manufacturing, social networks, digital platforms among others that are contributing and enhancing the pace of change.

During the last decade, the use and evolution of Information and Communication Technologies (ICT) in industry have become unavoidable, mainly by being vital for increasing the organizational efficiency and its level of competitiveness [1]. This has promoted the adoption of ICT in most of the industry activities, but especially in logistics and production operations. This technological evolution is evidenced by the well-known applications and highly used by most of organizations, such as Enterprise Resource Planning (ERP), Warehouse Management Systems (WMS), Transportation Management Systems (TMS), Intelligent Transportation Systems (ITS) [2]. Nevertheless, the information availability in real time and in-line, gathered through VANET Systems [3], sensor networks, drone points and business intelligence systems, will increase the decision-making efficiency of management and become more and more flexible and efficient into the near future.

In an Industry Internet of Things (IIoT) context the logistics challenges might require something like: high need for transparency (supply chain visibility); integrity control (right products, at the right time, place, quantity, condition and at the right cost) of the supply chain [4]; dynamic 'reconfigurability' of supply networks, specially by re-examining service-level agreements with upstream and contracted suppliers; supply network design, towards achieving lean, agile, resilient and green supply chains [5]. In this context, logistics will be addressed under the term of "Logistics 4.0". In a technological and in-line processes perspective it must be noticed, the Logistics 4.0 aim is not to replace humans in their works, but to avoid inaccuracies and to have faster processes where the information can be shared effortless and in real time. It will be always needed the involvement of people controlling the processes and taking control of any system failure.

In this paper, we intend to focus the discussion on some of the key challenges that will be needed to meet the requirements of the Logistics 4.0 era. This paper is organized as follows: In Section 2, we introduce an overview of Industry 4.0, its main features and its enabling technologies. In Section 3, we discuss the main implications and what are the basis of an efficient and strong Logistics 4.0, where Cyber-Physical System and technologies, are used to carry out activities, which are repetitive and automatic, with reduced human involvement. Lastly, Section 4 provides the conclusions and further developments.

2. Industry 4.0 overview

In general, Industry 4.0 encompasses the development and integration of innovative information and communication technologies into the industry. The main goal is to foster the intelligent networking of products and processes along the value chain, thus allowing it to use more efficiently the organizational processes, into the creation of goods and services to enhance customer benefit offering them novel products and services. These related changes in the industrial sector are seen as a comprehensive paradigm, currently named as the fourth industrial revolution: Industry 4.0 [6-8].

The first industrial revolution began with the development of the steam engine and the introduction of heavy mechanical manufacturing equipment. The second industrial revolution was characterized by the use of electricity, which allowed the use of the conveyor belt and the assembly line. The third industrial revolution brought the automation of production processes through the massive use of electronics and information and communication technologies. Lastly the evolution of the cyber technologies and their integration into digital ecosystems of all industry value chain contributed to the emergence of the fourth industrial revolution, named "Industry 4.0". The first reference to the Industry 4.0 was introduced at the Hannover Fair of Industrial Technologies, in 2011 [8]. Since then

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