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IMPACT OF INDUSTRY'S 4.0 TECHNOLOGIES IN THE PORTUGUESE FOOTWEAR INDUSTRY

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Extended Abstract

Abstract

The main purpose of this paper is to explore the Industry 4.0 impacts in the Portuguese footwear industry. A qualitative investigation was carried-out based on in-depth interviews with various relevant actors and experts of the Portuguese footwear cluster. The study reveals that this industry is generally well equipped and informed regarding the related technology trends. Successful examples of Industry 4.0 technologies and application were identified. Nonetheless, a lack of a skilled workforce was identified as the main constraint for effective Industry 4.0 implementation, as well as the urge for less complex technologies with increasingly less human intervention. It was also found out that investments on advanced technology are being constrained by the lack of knowledge concerning the manufacturing-specific needs and what would be the return of such investments. These findings have implications that may promote further investigation and the adoption of new Industry 4.0 related technologies in the footwear sector.

Keywords: Industry 4.0, Portuguese Footwear Industry, Portuguese footwear cluster, Industry s 4.0 technologies, Smart production.

1 Introduction

Industry 4.0 is a term often used to refer the digital transformation of industrial markets based on new management and manufacturing paradigms.

It is commonly accepted that Industry 4.0 is a collective term for the broad range of current digital technologies related to the value chain organization. This concept aims to introduce technical advances such as wireless network systems, cyber-physical systems, the Industrial Internet of Things, and cloud computing in industry (Satoglu et al, 2018).

Lu (2017) also claims that “Industry 4.0 can be summarized as an integrated, adapted, optimized, service-oriented and interoperable manufacturing process which is correlated with algorithms, big data, and high technologies” (Ślusarczyk, 2019).

1.1 The 4th Industrial Revolution

It has been widely accepted that the Industry 4.0 paradigm has had its epicentre in Germany and that it is currently recognized as the 4th Industrial Revolution. The three previous industrial revolutions of the past were all triggered by technical innovations: the introduction of water and steam-powered mechanical manufacturing at the end of the 18th century, the division of labour at the beginning of the 20th century and introduction of programmable logic controllers (PLC) for automation purposes in manufacturing in the 1970s (Schuh et al., 2015).

Since the first industrial revolution, subsequent revolutions have resulted in radical changes in manufacturing. Manufacturing processes have become increasingly complicated, automatic and sustainable, which means people can operate machines simply, efficiently and persistently. Nowadays modern manufacturing plays an essential role in the world, especially in European countries. With the technological development, the new Industry 4.0 concept was recently introduced in Germany which symbolizes the beginning of the 4th industrial revolution (Qin et al., 2016). This new industrial paradigm relates to the creation of smart factories based on Cyber-Physical Systems (CPS), which allow the creation of digital replicas of existing physical world systems, thus facilitating decentralized decision-making processes, based on the large volume of data that they can collect and treat in real time (Plinta, 2016).

Since it was first mentioned in the Hannover fair event in 2011, the Industry 4.0 term is currently one of the most popular manufacturing topics among industry and academia in the world and has also been considered as the new industrial revolution with extreme impacts on manufacturing in the future (Rojko, 2017). With the rise of this 4th industrial revolution, the paradigm of the companies has shifted and will continuously change throughout the upcoming years. These changes will affect companies and the way they produce, manage and process the different activities in the value chain (Nagy et al., 2018).

1.2 Industry's 4.0 Smart Factories

Industry 4.0 is to set up intelligent manufacturing and intelligent factory based on CPS. CPS or cyber-physical systems, are integrations of computation and physical processes, with smart manufacturing currently on the forefront.

Embedded computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa (Lee, 2008).

In the manufacturing context, this means that information related to the physical shop floor and the virtual computational space are highly synchronized. In a smart factory, products find their way independently through production processes and are easily identifiable and locatable at any time, pursuing the idea of a cost-efficient, yet highly flexible and individualized mass production (Henning et al., 2013).

Jain et al., (2001) defined the Virtual Factory, which is another name for Smart Factory, as “An integrated simulation model of major subsystems in a factory that considers the factory as a whole and provides an advanced decision support capability” (Sacco et al., 2011).

In addition, Francisco & Almeida (2005), proposed the Virtual Factory Framework as a virtual advanced software environment that aims assisting the design and management of all physical factory entities including all products, manufacturing resources, and even the network of companies during all phases of the factory life-cycle. Hence, the potentials that might come along with smart factories are expected to be significant. It is important to understand that not only production processes but also the roles of employees are expected to change dramatically.

1.3 Industry 4.0 and the shift in the workforce

In today's global environment, sustainability and competitive advantage of companies depend mostly on their capability of adaptation to changing business requirements. The Fourth Industrial Revolution, has been profoundly changing dynamics of most industries. Automation of business processes together with emergence of novel business models impose new digital skill requirements for workforce.

In order to meet these new requirements, companies will have to focus their strengths, not only in attracting and developing new talent, but also re-skilling current employees through training programs as well as re-designing work processes for reducing the skill mismatch between jobs and employees (Karacay, 2018). As automation and digitalization of work processes increase, workers will be required to take charge of less automatable and more complex tasks, whose completion necessitate solid literacy, numeracy, problem-solving, and ICT skills together with soft skills of autonomy, co-ordination and collaboration.

Overall, there will be higher demand placed on all members of the workforce in terms of managing complexity, problem-solving and higher levels of abstraction for obtaining simplified representation of the bigger wholes (Satoglu et al., 2018). Having these changes in consideration, producers must set priorities and upgrade the workforce, which means, analyze the long-term impact on the workforce and conduct strategic workforce planning. Additionally, they have to adapt roles, recruiting, and vocational training to prepare the workforce with the additional IT skills that will be required (Rüßmann et al., 2015).

2 The Footwear Industry

One of the most profitable markets in the world is the fashion and lifestyle industry and it is defined to be a billion-dollar industry employing millions of professionals all around the world.

Fashion industries are one of the most dynamic supply chains in the world and due to this nature, there are new challenges and many opportunities presented. Moreover, the footwear industry is part of the fashion industry and will be the focus of this study.

2.1 Challenges and opportunities for the Portuguese Footwear Industry

Based on the collected data, is possible to realize that the current situation in Europe is not favorable and that the market demands are more difficult to deal with and also more heterogeneous, which puts the Portuguese manufacturers in an unfavorable position (APICCAPS, 2013). In order to respond to the new demands of the clients and also, be able to compete with emerging producers based in Asia and Africa, Portuguese manufacturers will have to invest in new technologies and innovation in order to become more flexible, more efficient and have a quicker response capacity.

In the last few decades, the Portuguese footwear industry has undergone rapid and intensive transformation. Footwear companies braced the challenge to modernize their facilities and production methods, also investing in the less tangible aspects that gave them a competitive edge. Nowadays, Portuguese companies are known worldwide not only for the quality of their work, but also for the excellence of their service, the ability to deliver small series, always based on a quick response to the market needs and requirements.

Having this in mind, the Portuguese shoe industry is already taking the steps in order to become more competitive in this new technological era. Some examples of this new wave of startup companies, that are taking advantage of the new technologies that are embedded in the Industry 4.0, are the ones that use the App and photos in order to build a 3D model of the person's feet in order to better advise the customer in which shoe fits better; other example is a Portuguese company that is making custom shoes for brides. It is possible to find companies that use the online store to sell totally customized shoes, where the client is able to choose every aspect of the shoe, from the material, color and shape.

2.2 Understanding the impacts of Industry 4.0 in the Portuguese Footwear industry

It has been realized that Industry 4.0 is an extremely broad topic, that encompasses different departments and activities in a company. In this study, the focus is to analyse the effect that this revolution is having in the Portuguese footwear cluster and also at the factory level. Thus, the main goal is to understand what are the impacts of Industry's 4.0 technologies in the Portuguese footwear industry.

In order to answer to the above research question, it was imperative to design the objectives that would lead the research. The first objective was to evaluate the degree of knowledge that the Portuguese manufacturers have in regards to Industry 4.0, in order to have a clearer notion of the dissemination of this topic among the Portuguese manufacturers. The following objective was to analyse the degree of digitization of the Portuguese footwear industry according to the inputs given by the producers interviewed.

After analysing the previous topics, it was important to evaluate the implementation of Industry's 4.0 technologies in the Portuguese footwear industry. The fourth and fifth objectives were focused on the benefits and challenges that come with this revolution in order to have a more accurate idea of the major pros and cons that the producers deal with in their day-to-day operations.

The two final research objectives of this study were to identify the main drivers for the implementation of these technologies in the footwear sector and finally evaluate the impacts that the implementation of Industry's 4.0 technologies might bring to the company's workforce.

3 Methodology

In order to lay the foundations for the study, a dedicated literature review was carried-out, followed by a qualitative investigation of exploratory nature. Twelve in-depth interviews with various relevant actors of the Portuguese footwear scene were performed and analyzed. The fundamental basis of this study is based on personal opinions which are constructed having in consideration the academic and scientific state of the art and the application of the different study tools. These interviews were conducted with internal and external informants. Internal informants included top and middle managers that were listened to with the aim of getting acquainted with the firms' history, culture, strategy and the way they perceive and react to environmental changes. These interviews were complemented with extensive talks with external informants such as industry experts. The role of these experts was critical in two key stages of the research: the design of the questionnaire and the interpretation of some results.

Interviews administered to the top managers of the firms, together with those that were conducted in the Footwear Technological Center (CTCP) and to two directors of APPICAPS (Portuguese Footwear, Components, Leather Goods Manufacturers' Association), allowed the understanding of the circumstances under which innovations are being adopted and the main types of innovations introduced over the period of analysis. Additionally, the interaction with the experts facilitated the contact with the firms.

Direct observation took place throughout the visits to a sample of firms. These visits, which had an average duration of one hour, allowed the observation of behaviors displayed by managers, designers and production workers in the shop floor. In some cases, some participant observation was conducted while working alongside the production workers and gaining in-depth understanding of the activities involved in the production process. All interviews were conducted face-to-face, with the exception of one, that was carried-out over the phone.

4 Results and Discussion

When analyzing the degree of knowledge that Portuguese manufacturers have in regards to Industry 4.0, it is possible to conclude that the producers are well informed regarding new technologies that are already being used in the industry and also new technologies that are being released. Concerning the degree of digitization of the footwear industry, these manufacturers believe that the industry has already some tools that allow for the automation of some processes. Nonetheless, all interviewees refer that the Footwear Industry is a sector that is still very dependent on human labor and that nowadays the related technologies have not evolved enough in order to allow full process automation scenarios. The interviewees also stated that currently it is not easy to effectively implement the Industry 4.0 paradigm in current work scenarios as, according to Zhou et al. (2016), it is likely to take ten or more years to realize it. Concerning such implementation of Industry's 4.0 technologies in the Portuguese footwear industry, it is possible to notice that the technologies with the highest degree of implementation are the automatic cutting machines.

Regarding the benefits that arise from the implementation of Industry's 4.0 technologies, it is important to conclude that the most recurrently mentioned was the fact that the automation of processes allows a lower degree of dependency on human labor. Also, improvements regarding flexibility of processes, especially due to the automatic cutting machines, faster production and more efficiency were also very common topics in the answers of the interviewees. On the other hand, observing the present overall setting, the main challenges identified were the lack of skilled human labor to work with these new technologies and machines. As for the main drivers for the implementation of industry's 4.0 technologies, it is important to conclude that the main ones are the training of the employees in order for them to keep up with the technological advances and also government support through the applied fiscal policy, enabling a lighter tax burden.

Concerning the implications in the workforce, it is possible to conclude that most of the interviewees do not believe that the implementation of these technologies will cause drastic job losses. The common belief is that, there are some more routine tasks that are already automatized, with the tendency of more tasks to following this route.

Finally, when asked about the intention of investing in new industry 4.0 related technologies in the future, seven out of ten of the manufacturers claim that they have the intention to invest either in machinery, improving their management system or selecting technologies that allow for better communications and interactions with their customers, increasingly less human intervention.

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