

Oct 27th, 1:00 PM - 2:30 PM

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Recommended Citation

Azemi, Fatmir; Hajrizi, Edmond; and Maloku, Bekim, "Maturity Level of Kosovo Manufacturing Industry with regard to Industry 4.0" (2017). *UBT International Conference*. 279.

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Maturity Level of Kosovo Manufacturing Industry with regard to Industry 4.0

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Abstract. In this paper the concept of Maturity Level of Kosovo Industry will be presented according to the Industry 4.0. Digitalization of factory has impact the entire business environment and lead to Smart Enterprises. To create a model of Smart Factory, first we have analyzed the existing situation of Kosovo Manufacturing Industry with regard to revolution of Industry. In this paper we will describe the results of a recent research at the Kosovo manufacturing companies and are included metalworking and furniture industry, where is developed a Maturity Level for Kosovo Industry. To describe the Maturity Level of Kosovo Industry we have delivered questionnaire and have been done interviews with CEOs (Chief Executive Officer). The average score of Industrial Maturity Level for Kosovo Industry is 2.14 which represent 2nd Industrial Revolution, but some of enterprises belong to 3rd Industrial Revolution. Also, the main barriers of this low level of Maturity Level of Kosovo Industry are highlights based on questionnaire and interviews with CEOs, such as: lack of training programs, language barriers, high cost of purchasing/maintenance of technology, unskilled workers, and est.

Keywords: Industry 4.0, Smart Enterprises – Factory, Digitalization, Kosovo Industry

Introduction

We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society [1].

The First Industrial Revolution is characterized by the used water and steam power in England in the late 18th century. The Second Industrial Revolution, which began in the middle of 19th century (1850-1970), used electric power to create mass production. A next industrial era, which is described as the Third Industrial Revolution used electronics and information technology to automate production. Now a Fourth Industrial Revolution is building on the Third, it is characterized by Internet of Things, Cloud based Manufacturing, a convergence of physical and virtual world by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres.

To achieve a full Industry 4.0 implementation companies needed to be full digitalized, equipped with new technology available, to create and utilize a digitalized production. This is challenge not for developing countries but even for developed countries. So, Kosovo enterprises cannot just

wait until all the technology will be available, but it would get initiatives to starting the use of existing technology in process of digitalization factory, developing new ones to help industrial companies take advantage of the digitalization benefits of Industry 4.0. Several associations and initiatives around the world are focused on applied digitalization, like Industry 4.0 – Germany, Made in China 2025 – China, Industrial Internet Consortium (IIC) – US, Industrial Value Chain Initiative (IVI) – Japan, The project Innovative Smart Enterprises (HR-ISE model) – Croatia, est. The main objective of this paper is to get initiatives in creating and preparation environment in Kosovo enterprise for Industry 4.0. In this way, we have measured a Maturity Level for Kosovo Industry and the research has been done at the manufacturing companies respectively are included metalworking and furniture industry.

Literature Review

According to industry experts we are now experiencing the next industrial revolution, the 4th one. The term Industry 4.0 was first used by a group of expert at the Hannover Fair in April 2011 (Kagermann, Lukas und Wahlster 2011) and officially presented at the 2012 Hannover Fair in Germany as one of ten “Future Projects” that form Germany’s High-Tech Strategy 2020 [2],[3]. Industry 4.0 is characterized by digitalization of products and services, the application of internet of things, the technological integration of Cyber Physical Systems using the Technologies of Information and Communication in industrial processes of manufacturing and logistics, and things like that.

To achieve this Industrial Revolution enterprises should change in classical organization of industrial work methodologies and development of new business models, in productive system, manufacturing of goods, maintenance of services, also changing working relationship with human being. Several initiatives around the world are focused on those things and governments have already their strategy for the future competitiveness at the global market, such as the Industrial Internet Consortium (IIC), Japan’s e-Factory, Intelligent Manufacturing (China), as well as the German Industry 4.0 platform are each defining a reference architecture model for overall factory of the future infrastructures.

Method

To describe the current state of Kosovo manufacturing enterprises regard to the industry revolution, have been gathered data from enterprises at metalworking and furniture industry. Beside other questions, the question nine present the level of communication at the departments within enterprises. This model of question is based in the model survey that has been done in Croatia Industry, Ivica Veza, et al.[4].

Respondents have been answered in each departments for level of communication from score 1 to 5, and answers have been converted from 1 to 4 which representing one of the four of historical industrial revolution. Using that model, on average score has been calculated for each of 13 departments of manufacturing.

To gather data, we have delivered 219 questionnaires, some of them have sent via e-mail and some of them we have sent personally, but we have received 106 questionnaires from the enterprises, have been chosen two types of enterprises: furniture and metalworking industry. Also, a large number of interviews have been done with CEOs (Chief Executive Officer) of enterprises.

The questionnaire was designed to provide a description of usage and impact of ICT in Kosovo industry, but question nine describes the level of communication through departments in the enterprises, which is our objective of presentation in this paper, also the main barriers to using computers and other information technologies facilities at the enterprises. Questionnaire administration offers a suitable method for posing an equivalent set of questions to a large number of people.

Results

Overall average represents industrial maturity level of Kosovo metalworking and furniture industry (Figure 1), and distribution of enterprises according to their industrial maturity level is presented in Figure 2.

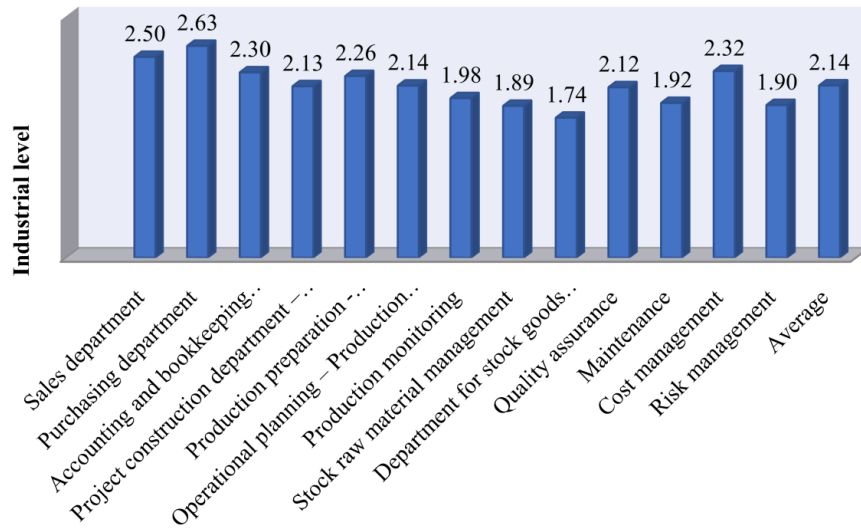


Fig. 1. Average level of industrial maturity for specific departments of production for Kosovo metalworking and furniture industry

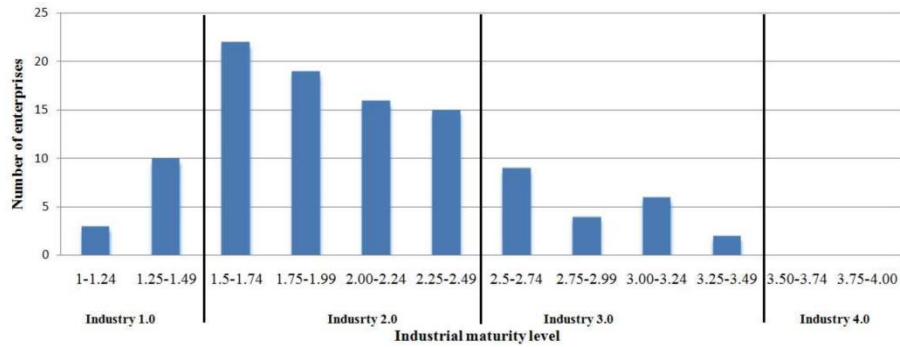


Fig. 2. Distribution of enterprises from Kosovo metalworking and furniture industry according to their industrial maturity level

Figure 1 shows that average score of Industrial Maturity Level for Kosovo metalworking and furniture industry is 2.14 which represent 2nd Industrial Revolution. Since most of the enterprises have score between 1.50 and 2.49 (figure 2), they belong also to 2nd Industrial Revolution. Some of enterprises belong to 3rd Industrial Revolution, and none of the enterprises are in 4th Industrial Revolution, i.e. Industry 4.0. So, current state of Kosovo manufacturing industry is not Industry 4.0, but Industry 2.14.

We have compared those results with results from Croatia Manufacturing Industry (figure 3), it seems that Kosovo Manufacturing Industry is approximately in same state as it was Croatia Manufacturing Industry in 2013 (Kosovo Manufacturing Industry is Industry 2.14, Croatia Manufacturing Industry is Industry 2.15 [4], but Kosovo Manufacturing Industry is a couple of years later than Croatia Manufacturing Industry. Figure 4 presents compared both Kosovo and Croatia manufacturing Industry, but distribution of enterprises according to their maturity level. Also, from this graph seems that Croatia Industry is a little forward from Kosovo Industry.

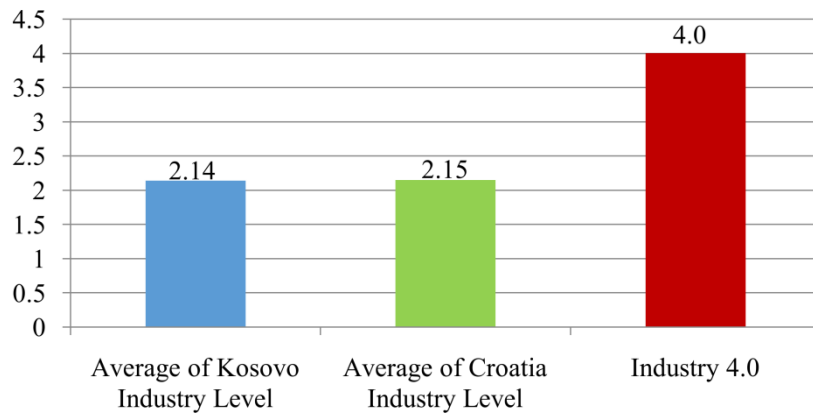


Fig. 3. Croatia and Kosovo manufacturing industry level with regard to Industry 4.0

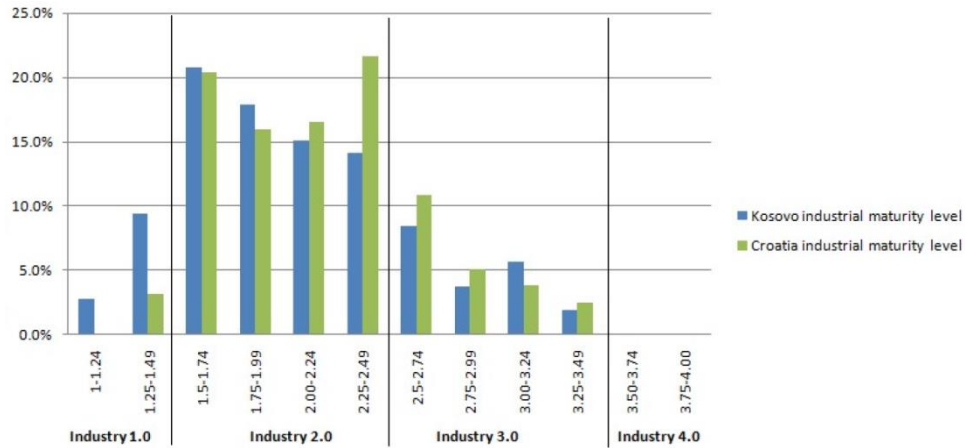


Fig. 4. Distribution of enterprises from both Croatia and Kosovo industry according to their maturity level

Barriers in the usage of computers and other information and communication technology facilities

Respondents were asked about the main factors that cause resistance to the use of ICT (ICT - Information and Communication Technology). Figure 5 presents a summary of the responses to ten different factors relating to perceived barriers to using computers and other information technologies facilities at the enterprises.

Six factors should be highlighted out as important barriers: lack of training programs 98.90 %, language barriers 92.30%, high cost of purchasing/maintenance of technology 84.60%, unskilled workers 81.30 %, and with 80.20 % inadequate education and lack of creative administrative leadership. Results of the survey also show that: limited size of firm's operations (27.50 %), fear of losing job (28.60 %), technophobia (25.30 %) and over-expectation of technology (25.30 %) are less important barriers.

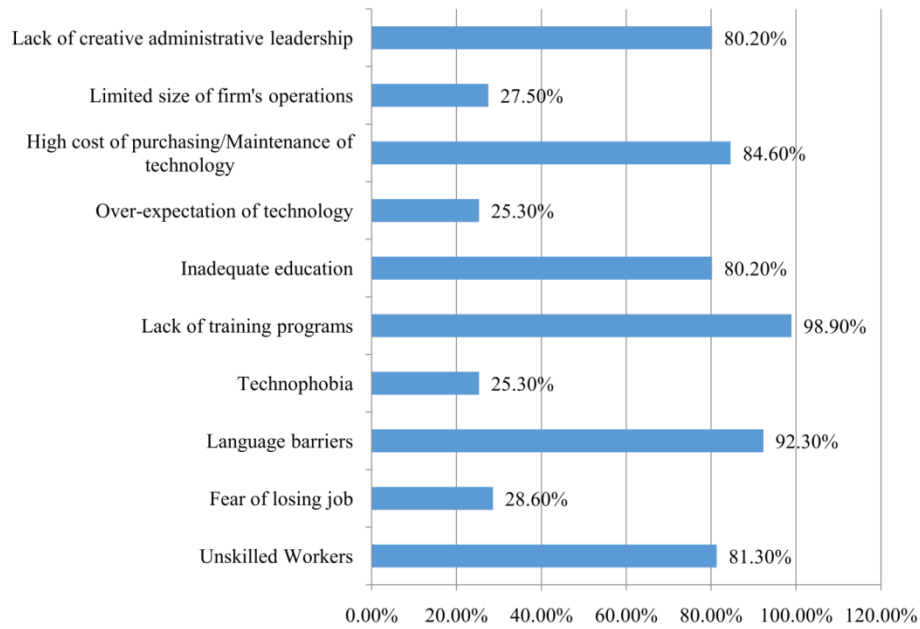


Fig. 5. Graphical presentation of barriers and obstacles in usage of computers and other information and communication technology facilities

Based on barriers and obstacles withdraw from survey (interview and questionnaire) the four different topics at organisation are needed to develop and investigated: The Culture (People), Processes, Technology and Environment. Figure 6 describes the current state of Kosovo industry and the way to transform their industry in direction to industry 4.0.

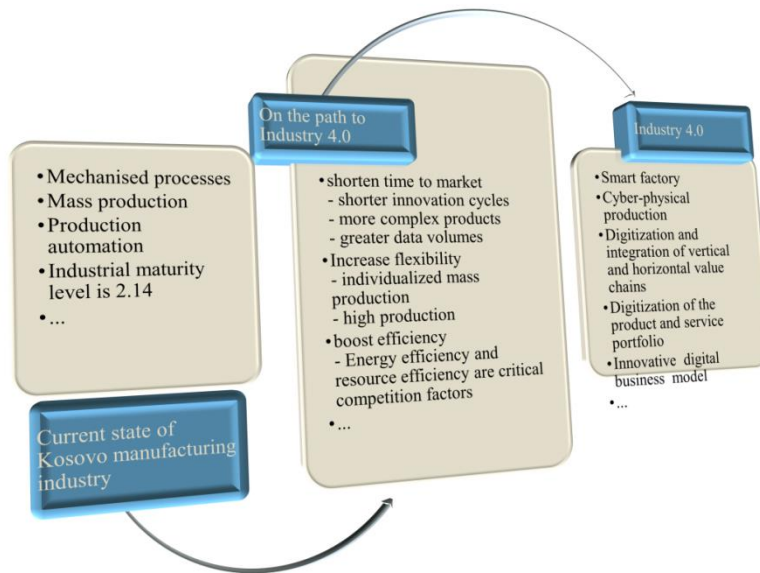


Fig. 6. Current state of Kosovo manufacturing industry and the path to Industry 4.0

Discussion

Technological developments have forced enterprises to take important steps towards changing in classical organization of industrial work methodologies and development of new business models. Several initiatives around the world are focused on creating of their model and strategy for the future factory regarding to Industry 4.0. Based on results from this paper Kosovo Manufacturing Industry is far away from Industry 4.0 with Industrial Maturity Level 2.14 which represents the Second Industrial Revolution. The main goal of this work was to measured Industrial Maturity Level of Kosovo Manufacturing Industry as well as barriers and obstacles in usage of ICT at the enterprises. Also, we compared those results with results from Croatia Manufacturing Industry, it seems that Kosovo Manufacturing Industry is approximately in same state as it is Croatia Manufacturing Industry, but Kosovo Manufacturing Industry is a couple of years later than Croatia Manufacturing Industry. Meanwhile, Croatia has already taken some steps in the develop model of Innovative Smart Enterprise, project INSENT [4], Kosovo officially not yet.

Conclusions and future work

Customized products with quality, low cost and shorten time to market will be the demands of costumers for the future enterprises. New manufacturing processes should be addressed those challenges. Information and communication technologies, such as Internet of Things, Big Data,

Cyber-Physical-System and things like this should be implemented in the manufacturing enterprises to achieve Smart Factory of Industry 4.0 [5]. Industrie 4.0 (English translation: Industry 4.0) stands for functional integration, dynamic reorganization, and resource efficiency [6].

We have measured industrial maturity level for Kosovo Industry and we have drawn a conclusion that industrial maturity level for Kosovo Industry is 2.14, which represent the Second Industrial Revolution. But, some of enterprises belong to the Third Industrial Revolution; they are scored between 2.5-3.49. We can conclude that current state of Kosovo manufacturing industry is not Industry 4.0, but Industry 2.14 with some of potential of enterprises of Industry 3.0. Therefore, Kosovo manufacturing industry is far away from Industry 4.0 and required cooperation between Government, Businesses, People and Standard Bodies. The main obstacles and barriers of this low level of maturity level of Kosovo Industry based on questionnaire and interviews with CEO are: lack of training programs, language barriers, high cost of purchasing/maintenance of technology, unskilled workers, and inadequate education and lack of creative administrative leadership. This paper work is done in process of our initiatives to create a model of smart factory for Kosovo enterprises, and the future work will be done in this direction. Therefore, in the future, our focus is to develop and investigate personnel, processes, technology and environment regarding to Industry 4.0.

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