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Industry 4.0 as a Challenge and Possibility in Small and Medium Size Enterprises

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Abstract:
This study has been carried out within the Industrial revolution trend in manufacturing industries. It has been aimed to investigate how a small and medium size company could implement the ideas behind 4th industrial revolution in their processes. The main idea and core concept of recent studies are trying to find question to the following question: 'Is it better to adapt and shift to digitalization in operation or it is better to operate familiar environment'. A blend of literature-based subtractions is used to show the consequences and potentials of Industry 4.0 in SMEs. In this paper, we will try to cover enhance and the eventual aspects of Industry 4.0 has on SMEs through in-depth literature review. The findings indicate that Industry 4.0 can be crucial for companies. Companies first must achieve maturity level of processes then implement Industry 4.0. Our research work contributes understanding of transformation into digitalization and advantages of Industry 4.0 and the results from this study can be used as a basis for further investigation on this topic.

Keywords: *Digitalization, Industry 4.0, Industrial Revolution, SMEs, Smart systems*

1. Introduction

Digital revolution is becoming widespread as a new vision of our age. Intelligent factories (smart factory), artificial intelligence, autonomous robots, cloud computing, Internet of Things with smart machines such as 3D scanner / printer and Big Data analysis tools are developed and introduced in the framework of fourth Industrial Revolution. Industry 4.0 is not only digitalization-oriented technology, but it is also a new way of organizing a business, interaction with different technological tools to create advanced environment in order to generate new flow of production. (Schmidt et al., 2015). Industry 4.0 well-known within Europe, as its origins comes from Germany. (Strozzi et al., 2017; Galati and Bigliardi, 2019; Frank et al., 2019; Sharp et al., 2019). The core idea behind Industry 4.0 was development in manufacturing in order support economic growth (Yin et al., 2018). New competitive advantage of Industry 4.0 is, it allows to control whole value chain, balance the production, and help to implement just-in-time production, autonomously with the intelligent network. Companies save energy, resources, money and get effective way of production. the best representative of new technological era is 3D printing, which discussed frequently and started to be involved in in some fields.

The power of Fourth Industrial Revolution merged digital and physical words, with in-built sensors in smart machines and equipment that are connected to each other and also, they have internet connectivity to the manufacturing shop floor. This is why this revolution has got the second name: 'Cyber-Physical Revolution'.

It is recommended to apply this initiative in SMEs, with the consideration of risks, obstacles and complications regarding it' implementation. Value creating processes can highly be affected by number of factors such as customers wish, or company's limits. Data security, standards improvements, employee training and issues will determine Industry 4.0's impact on SMEs. There is no big base of literature to describe full, complete and exact image of Industry 4.0 within SMEs. The way that Industry 4.0 may affect other industries is also needs to be investigated. This paper aims to give an understanding of possible Industry 4.0 implementation in SMEs, and differentiates its pros and cons. The findings of this research can be use in the future research on insight of how Industry 4.0 will conduct itself in the future, especially in the context of practical problem solving. That's why this research is important and pursuits clarify the possibilities and challenges through SMEs will go while implementing Industry 4.0.

2. Research Methodology

In order to achieve the goal of the researchers, a thorough literature review was carried out. We will introduce the term Industry 4.0 and try to formulate an appropriate definition. In this paper, literatures associated with Industry 4.0 are studied broadly through databases EBSCO, Emarald Insight, Google Scholar, Science Direct. Keywords like 'Industry 4.0', 'Cyber-Physical System', 'Internet of Things', and the founded articles were used for achieving the relevant literature sources and each article examined in details. In order to get a better understanding of the current position and condition of

SMEs we reviewed latest articles, book chapters, and conference proceeding. Theoretical literature analyzing of the challenges, opportunities, identifies potential implementation barriers and benefits they get in adoption process.
With regard to the structure of this paper, three main parts can be distinguished: First part will cover theoretical background of Industry 4.0 and its main concepts. Second part devoted introducing SMEs, and following that, third part will include potential capabilities and consequences Industry 4.0 in SMEs were reviewed.

2.1. Phase I: Industry 4.0

According to Lasi et al. (2014), Industry 4.0 stands for an advanced digitalization within industrial factories, in form of a combination of internet technologies with future-oriented technologies in the field of 'smart' machines and products. New enterprise created with intelligent network, Internet of Things (IoT) will combine digital and physical worlds in terms of information technology and operation technology. Advanced robots, autonomous production enhance development of products and processes. From the point of view of Schmidt, Industry 4.0 is the superposition of several technological developments that embraces both products and processes. It is related to the so-called cyber physical systems that describe the merger of digital with physical workflow (Schmidt et al., 2015). It will transfer all real time data to machines, equipment's sensors to make a smart decision regarding value chain, supply chain, and business. That allows companies to respond quickly and in no time to their customer's needs. As market conditions are changing rapidly it is better to take an advantage that intelligent technologies say. Cooperation makes flow of the information and physical processes flexible, smooth, take place without any delay and obstacles in the best possible way. Manufacturing supply chains, value chains, can use intelligent devices and machines that enables crucial decision making in production as a result of massive data analysis done by these machines in a short time period based on real-time data. Companies that will adapt to the development of the Industry 4.0 revolution await the competitive advantage they will gain in their current markets. Therefore, Industry 4.0 is seen as a period that should be evaluated for developed countries such as the USA. That is why research in developed countries have been carried with more importance and weight. (Wan et al., 2017; Wang et al., 2016). Learning activities are the core concept of important decision-making process. Because of this, update on every level of manufacturing comes from time to time to follow up changes happened in environment. Industry 4.0 is a completely new organization of business with intelligent network connecting value and supply chains, that is not limited to any technical capability of digitization in modern business. Industry 4.0 brought the competitive advantages of industry giants such as Germany, the USA and Japan and now slowly beginning to shift to emerging economies such as China, India and Brazil.

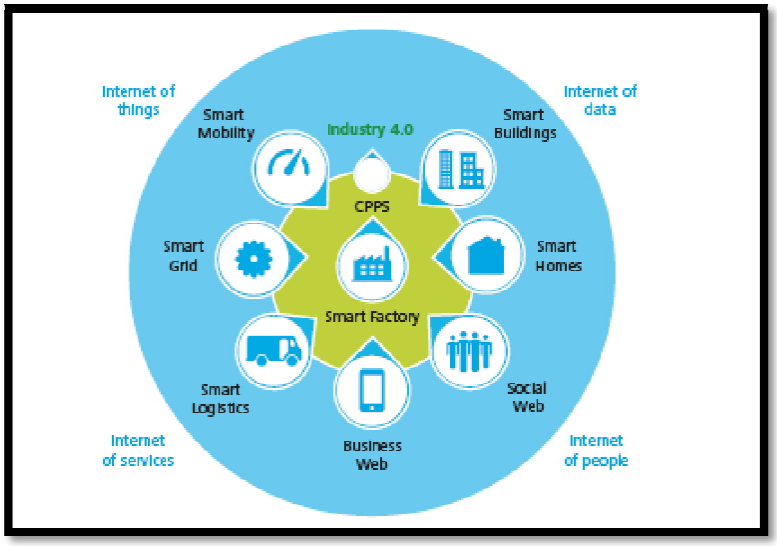

Figure 1: The Industry 4.0 Environment
Source: Deloitte (T.Y.). Industry 4.0 – Challenges and Solutions for the Digital Transformation and Use of Exponential Technologies, S. 4

Artificial intelligence – AI is the main feature Industry 4.0 provides to help minimizer humans involvement in processes. Manufacturers can rely on real-time data that AI presents and operate dependent on that without previously prepared production plan. AI also enables job scheduling, problem solving, arranging production plan, offer other internet-enabled services to users based on AI techniques.

IoT – Nowadays, defined as an evolutionary approach in internet usage. In IoT, mobile devices are able control whole production process, they also can provide interconnections with diverse functionalities between manufacturers. IoT adopted the latest and most developed technology, where devices with huge computing power can influence manufacturing system. It is a modern manufacturing concept that increases performance and effectiveness of manufacturing system through obtaining and sharing data, as well as high automation of device and staff.
Cyber-physical system – system contains of different physical input and output, embedded with large scope of information sensors. Interactions between them merges two completely different worlds, physical objects and software become closely

cooperate and enable different solutions to exchange information. Sensors are controlling algorithms and capacity on the system.

Cloud computing – Companies applying Cloud computing may achieve significant benefits through delivering visualized and scalable information on available resources. In term of scarcity of resources and lack of information, this approach allows organizations to start small business and invest more in resources. With minimum budget, infrastructure and personnel it enables all size and types of organizations increase their capacity (Saxena and Pushkar, 2016).

3D modelling - One of the biggest advantages of 3D printers is flexible production. If we keep it together with mass production, we can obtain products that are independent and unique from each other with each product we produce. Additive manufacturing, or 3D manufacturing, is a process in which digital 3D design data is used to create a component in layers with additives / materials. The term '3D printing' is increasingly used synonymously with additive manufacturing. (Chong vd., 2018, s. 1)

2.2. Phase II: SMEs - Importance and Role in Global Economy

Companies with fewer employees that 250 are consider as Small-Medium sized Enterprises. There are other division inside this group of enterprises such as micro, small, and medium sized enterprises, with the number of employees of fewer than 10, 50-249 employees and 50.249 employees respectively. ME includes companies with fewer than 250 employees. Usually in micro enterprises we consider people working for themselves, most of the time without hired employees. SME play great role in structure of economy and modern world as they are the driven engine of economic development, stability, and creates jobs. There is a tendency of developing private SMEs faster, dynamically rather than state owned ones. In comparison of these two, we must mention possibilities, support, subsidies that governmental SMEs get as well as less problems with financing to deal with. Private SMEs faces lots of challenges and obstacles but, still they are quite compatible. It means that types of ownership also have great role in definition of role of SMEs. Studies carried out, show young firms has access to more reliant information and communication technologies rather than older and conservative firms. SMEs have very substantial impact in economic growth: they create jobs, economic growth and ensure social stability (Knight, 2000; Wallsten, 2000).The results of the survey run by Yao Wangin (2016) his research in term of biggest obstacles to growth in SMEs in developing countries between 2006-2014 is shown in Figure 2.

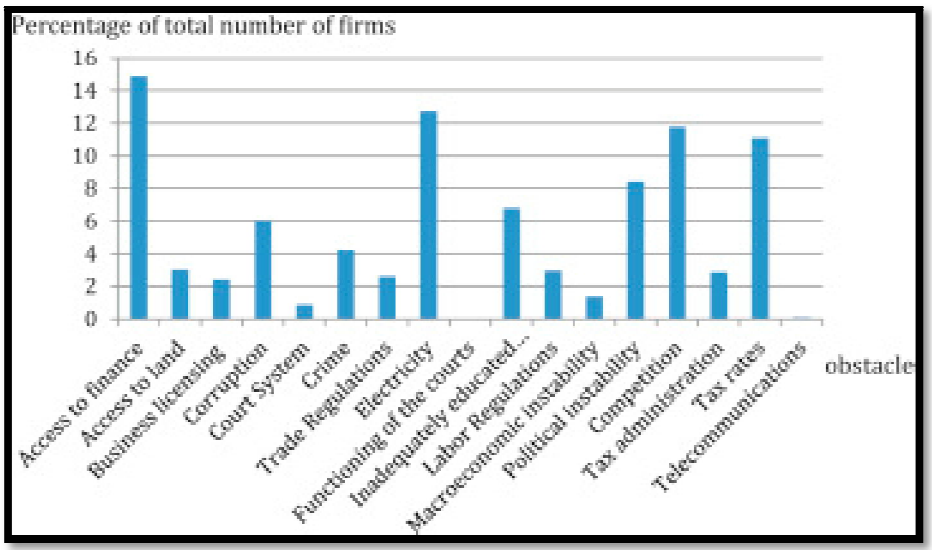

Figure 2: The Main Barriers to Growth as Perceived by SMEs
Source: Yao Wangin, 2016

From the Figure 1 it's clear that 5 significant obstacles to growth in 2016 are: Access to finance, Electricity, Political instability, Competition and Tax rate. It was revealed that ownership of the company plays great role in financing rather than size and age of companies which do not have huge impact on their financing sources. This causes several problems for SMEs as limits their power and makes them incompatible towards Industry 4.0 (Müller and Voigt, 2016; Kaartinen et al., 2017; Moeuf et al., 2018; Mittal, Khan, et al., 2018; Vrchota et al., 2019). The main advantages that SMEs have are flexibility to adapt to market condition, quick response to customer needs, competitiveness, adjustment to economic situation, effectiveness. Along with the advantages there some serious disadvantages that SMEs must deal with such as: problems in administration, lack of experience in management, motivation in small companies, problems with financing, weak coordination between production and sale and many others

However, especially in developing countries SMEs are becoming popular and important, as they are an engine of economic development and creates new jobs. current economic condition enables SME gain importance, especially in developing countries, due to SME's contribution on growth and poverty reduction. SMEs contribution to development is hard to underestimate. However, governmental support programs in terms of opportunities of investment environment improvements, innovation, know-how

2.3. Phase III: SMEs and Industry 4.0

2.3.1. Possibilities

Until 2014, a smaller number of researches was done on the topic of Industry 4.0 and its impact on SMEs and this field was not developed at all. (Brettel et al., 2014; Lee et al., 2014; Schuh et al., 2014). After 2016 the number of researches in this field started to grow and even some developed tool, framework and strategies for implementation. (Wang et al., 2016; Wank et al., 2016; Jordan et al., 2017; Mittal et al., 2018; Orzes et al., 2019; Türkeş et al., 2019). SMEs have great opportunity to link their machines to IT systems. As we mentioned above, they are very flexible in term of responding to customer demand, so with the help of IT technologies and Industry 4.0 tools they will be able to complete the transformation into CPS. Cloud computing is the platform that is going to link customers and companies for better interaction and understanding of current happenings. This will increase importance and performance of SMEs drastically, empowering waste free flexible production with lower costs. In terms of embed system, CPS will obtain its data from encompass environment and provide information to the machine through wireless connection. Real production processes can operate without fixed plan, relying on real data and mapped virtually. Wide range of tools Industry 4.0 provides to SMEs includes: augmented reality, 3D modelling and simulation, in order to eliminate errors in production and reduce operational costs. Integration of systems will make communication faster, clear and effective due to improved structure of cross-domain and functional combination. Robots can perform huge amount of data and do complex tasks thus the output quality of the data will be improved. Some manufacturing companies have already used 3D models, simulations in their production and benefitted from Industry 4.0 created opportunities.

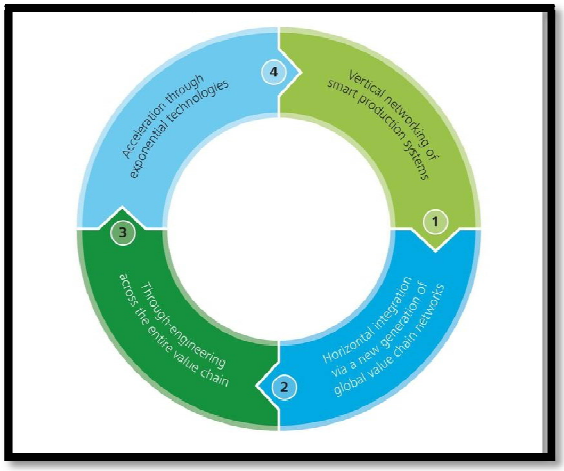

Figure 3: The 4 Characteristics of Industry 4.0
Source: Deloitte. Industry 4.0 – Challenges and Solutions for the Digital Transformation and Use of Exponential Technologies, P.8

These characteristics includes a range of solutions for manufacturing companies to adapt Industry 4.0 environment.

- Vertical networking solutions involve – IT integration – currently manufacturing companies poor integration creates, poor networking and therefore, new combined IT network should be developed, covering scopes from supplier relations ending with customer satisfaction.
- Data analysis – huge amount of brand-new information is always hard to process. But Industry 4.0 creates a massive competitive advantage for companies that can gather, manage and analyze big data. Thus, companies must focus on developing new skills such as handling big data.
- Cloud computing, - is the prove of being able to measure and manage big data. Cloud based smart production offers unique opportunities to only to the companies, but for the whole supply chain.
- In horizontal integration solution we can highlight – optimization of business model – trainings must be provided to employees and managerial staff to obtain cutting edge approach to traditional business model.
- Smart supply chains – the warranty of successful operation of a company. Involving suppliers and customers in one value creating activities to ensure individual needs of every customer.
- IT security – with the growing interest to big data and intelligent network, the security questions are also becoming important. existing companies should be equipped with center where data, new products, information will be stored and protected.
- Also, creating new taxation model, due to the implementation of 3D printers, new IT logistics are significant for new business model.
- Solutions for engineering – includes innovation activities of companies focused on customer's engagement. Digitalization makes learning easier, efficient, also providers monitoring and tracking services for innovation activities.
- Technology perspective – Exponential technologies and innovation can be the main source of effectiveness and create a new business area if applied in time. Missing opportunity means less chances to operate in efficient way.

In order to use these advantages, companies need to improve their learning culture to successfully process with brand-new ideas and later establish them.

2.4. Benefits of Industry 4.0

- *Smarter supply chain*–In new age supply chains suppliers will be integrated to customers through intelligent value chain. Shop floors of the companies will get real time-based information and will be able to produce maximum mass customized products to fulfills its customers demand. This allows companies quickly respond to the changing environment and customers demand. This opens new opportunities and collaboration models through entire supply chain, and ensure sharing real data within chain.
- *Smarter production* - Smart factories can produce faster with less waste. Manufacturing industries in the edge of IoT will be able to control processes much better. Focus of production in Industry 4.0 is mass customized products, which are produced use data analysis and new production technologies.
- *Smarter products* – Based on customer demand, preferences, feedback and innovation technologies that Industry 4.0 maintains, products will become more customized. Main attention will be paid to the lifecycle of the products; thus, it is becoming shorter than in the past and more products will be selling as a service.

2.5. Challenges of Industry 4.0

Modrak states, introduction of I4.0 technologies in production, logistics are lagging far behind and challenging due to current organizational and managerial structure in SMEs. (Modrak et al. 2019) Management of SMEs lack of methodological approach and general standards, that's why they do not have comprehensive program to implement Industry 4.0. Challenges regarding formation of organizational structure that enables, implementation and functioning of Industry 4.0 in their environment very serious. In the framework of current SME employees existing skills and qualifications are not enough to apply and develop new business model such as CPS. Industry 4.0 requires well-educated, trained employees to support its implementation. SME must organize trainings and knowledge transferring programs to their employees to follow up with the Industry 4.0 trend. But to do so, they are lacking finances. In the equipment side SMEs also have drawbacks as they do not have fibro optic cables, resources, assets and technologies to provide and secure large data streams. Lack of these items makes difficult for SME join new generation value creation networks. According to Forstner and Dümmler the particular set of IT systems, machinery and processes at a given small or medium-sized enterprise tends to have been acquired over time; machines and equipment come from various manufacturers and are of different vintages. As a result, it is expensive to retrofit automation software to achieve compatibility (Forstner and Dümmler, 2014). For SMEs this challenge is particularly great because they have less resources and know-how than large companies (Wischmann, et al., 2015). In a structured literature review conducted by Modrak, he differentiates following obstacles for SMEs: (Modrak et al. (2019)

- Problems related production – introducing IoT to production, machines that are not capable to manage huge data, outdated technologies in production.
- Logistics – implementation smart supply chain, execution of smart value transfer networks, intelligent networks application
- Managerial and organizational challenges – new approach to production from managerial point of view for mass customized goods.
- There is a research gap in terms of empirical studies, but conducted wide literature reviews suggests, financial barriers are critical for SMEs and clearly application of Industry 4.0 concept is a step to change.

3. Conclusions

Performed literature review on current state of knowledge, connected with the introduction of Industry 4.0 on SMEs allows to identify following directions:

- There is an increasing interest and concern related to the Industry 4.0 and SMEs, which indicates that this filed of research is not developed so far and it needs further investigations.
- Technology, workforce and other assets of SME should be developed in order to be able to implement and support Industry 4.0 concept.
- Governmental support is the main to enable developments towards Fourth Industrial Revolution.
- Research and investigation on impact of Industry 4.0 on SMEs needs to be expanded, case studies and real examples of SMEs in Industry 4.0 should be executed.

First, the readiness level of SMEs should be measured and subsequently they may be involved in standardization process first. Secondly, they should involve employees to the training programs to get theoretical knowledge and upgrade their qualifications on Industry 4.0 concept and influence level.

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