

# PROBLEMS CONCERNING OPERATIONS SYSTEM OF THE ENTERPRISE IN THE CONTEXT OF INDUSTRY 4.0

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**Abstract.** Undoubtedly, industrial production is the backbone of the national economy. The manufacturing enterprise, besides a source of profit for its owners, is also a generator of a national gross product and hence of economic prosperity. Industrial enterprises are one of the largest employers and importers of taxes in the state budget.

When talking about industry, however, we must not forget that its development depends directly on scientific and technological progress and in particular on the achievements in automation, mechanization and robotics.

The innovation in enterprises is a continuous process. Industrial production today takes maximum advantage of the scientific and technological achievements of the 1980s and 1990s – Internet, mechanization, advanced production lines, computational power, maximum flexibility and production systems integrity. It is the accelerated automation and robotization that makes experts believe that we are on the verge of a fourth industrial revolution, and according to others – it has already occurred.

The importance of new technologies to society and the economy is determined by the definition of the term "Fourth Industrial Revolution (Industry 4.0)".

**Keywords:** Industry 4.0, Manufacturing, Automation, Production, Flexibility, Cybersecurity, Digitalization, Cyber-Physical Systems.

## 1. Introduction

During 2011, the term Industry 4.0 was defined for the first time in Germany as the "logo" of an initiative to adopt a high-tech strategy for the development of the country's economy. Two years later, the German National Academy of Science and Engineering presented the so-called "Manifesto for Industry 4.0" [1]. Leading European countries such as France, Austria, the UK, the Netherlands, Spain etc. also publish strategies for their industries [2]. In the US, Industry 4.0 concepts gain recognition through the Industrial Internet Consortium (ICC) in 2013 [3].

Initially, key technologies in industrial strategies have been identified: Industrial IoT, Simulations, Virtual / Added Reality (VR/AR), Autonomous Robots, Cloud Computing, Cybersecurity, 3D printing, horizontal and vertical system integration, Big

Data analyzes, and more. The list is supplemented by new solutions such as artificial intelligence and cognitive systems, machine learning, block technologies, digital platforms, etc. In practice, this list is expanding due to the strong dynamics of technological innovation.

In the **Bulgarian concept** for Industry 4.0, the latter is defined as „*a set of connected digital technology solutions that support the development of automation, integration and real-time data exchange in manufacturing processes*“ [4].

The vision outlined in the concept is that Bulgaria should be recognized up to 2030 as a regional center of the digital economy. At this stage, as the priority areas laid down in it, are put the following ones: (1) strengthening the link between science and industry and (2) accelerated the integration of Bulgaria into the European and international programs, initiatives and networks related to the Industry 4.0.

Technological upgrading of the Bulgarian economy is the second priority direction. Here the State has marked the introduction of standards, the establishment of systems and business models, building a broadband infrastructure for the industry, the introduction of incentives for the development and market introduction of new products, services and production processes.

The third strand is building human, scientific, organizational and institutional capacity.

Industry 4.0 strategy should not contradict, but build on already existing ones like the Convergence Program, the Innovation Strategy for Intelligent Specialization and so on.

Bulgaria has three big pluses on the way to the Industry 4.0. The first developed industrial sectors that are leaders in digitalization, as "electrical and Electronics" and "Machine", which together make up almost 20% of the Bulgarian export. The second plus is the potential of the ICT sector, and the third one – the high speed Internet connection in the country.

## **2. Current State Overview**

### **2.1. The Status**

For the vast majority of business organizations the digitalization is still just a prospect. Small and medium-sized companies (SMEs) are still far from these innovations. The companies, where new technologies are entering, are mostly large ones and are owned by international corporations – less than 25% of SMEs use automation to manage their supply chains. Among the biggest ones (with over 250 employees) barely 34% perform business processes automatically bound to those of their suppliers and customers, while 60.8% of large businesses are using ERP (Enterprise Resource Planning) systems [5]. That is why, according to the BASSEL [6] the foreign ownership in Bulgarian industry should be used as a channel for the acquisition of these technologies. In the Electric and Electronics Sector, 60 out of 400 businesses are foreign-owned, as they account for 40% of production [7].

The effect is a radical transformation of the traditional industries, which change their approach to work – meaning use of new production technologies, new machinery,

new materials etc. In this context, this is becoming an essential knowledge (intangible asset). Furthermore, there is a full integration between physical and cyber dimensions.

## 2.2. Brief History

The First Industrial Revolution occurs during eighteenth century with the mechanization of manufacturing processes, using the energy of water and steam. This fosters developing increasingly complex and diverse machines, as well as improving their efficiency (Fig. 1).

The Second Industrial Revolution is unfolding with the widespread introduction of electricity and mass production, leading to the so-called Economies of Scale and further improving manufacturing effectiveness and efficiency.

The Third Industrial Revolution is characterized by the introduction of automation in production processes using electronics and information technology (IT).

The Fourth Industrial Revolution (Industry 4.0) is integrating IT systems with the physical ones, in order to obtain the so-called Cyber-Physical Systems that actually combine the real world with the virtual one. However, there are also opposing views. Some authors [8] believe that Industry 4.0 is just an evolution of the third one.

Industry 4.0 is characterized by the cooperation between intelligent machines, information storage systems and production systems into intelligent networks, bringing together the real and the virtual world in cyber-physical systems (CPS). These innovative technologies allow companies to become "Smart", which helps to a great extent making customized products/services on a large scale, while providing opportunities to improve the flexibility and efficiency of enterprise operations system.

Some Japanese authors [3] already begin talking about emerging of the Fifth Industrial Revolution that is going to be based on the co-operation and interaction between human and machine.

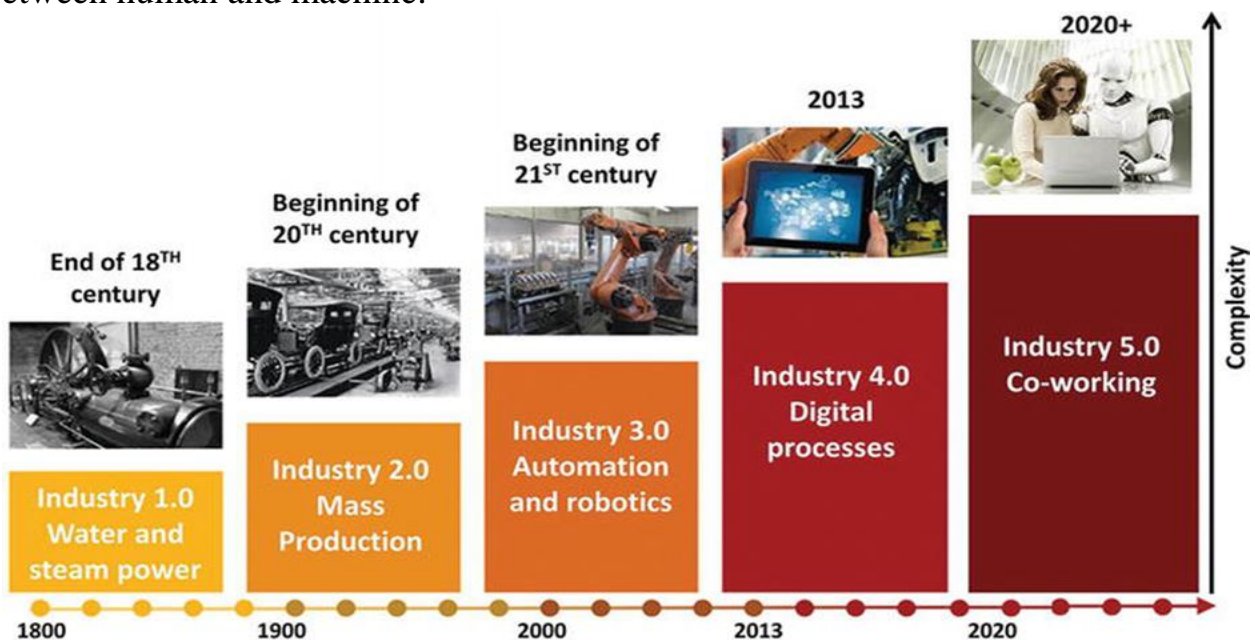


Fig. 1. Historical Flashback [7]

### **2.3. Main Characteristics of Industry 4.0**

- *Optimization in decision-making*

This is becoming a key factor in terms of the global competition. The opportunities for different kinds of analysis and real-time processing of large data enables a real time decision-making process. In the field of manufacturing and services this means flexible, adequate and timely deliveries. It is quite easy now to optimize the entire value chain during planning and scheduling;

- *Resource productivity and resource efficiency*

Industry 4.0 retains the existing strategic objectives set in the first place by industrial production: producing as much as possible given the available resources (resource productivity) in the most cost-efficient manner of resources for available products (resource efficiency). Moreover, in order to optimize resources utilization, reduce energy and emissions, certain systems can be optimized and adapted continuously in course of their work;

- *Individual approach to the customer*

Industry 4.0 allows taking into account the specific customer criteria in terms of product design, configuration, ordering, planning, manufacturing, and delivery, including changes made during communications with customer. That is why, applying its principles reflects to more cost effective production of customized products;

- *Flexibility*

Cyber-physical systems enable dynamic network organizing of business processes in different dimensions: time, quality, risk, sustainability, cost, environmental impact etc., in a way that the logistics chains could be kept in an optimal balance. At the same time, operations are designed to be able to quickly change substantially production volume and offset market demand fluctuations;

- *The potential to create value by offering new services*

Industry 4.0 enables the emergence of new forms of value creation and employment, for example by offering certain services in the supply chain. Big Data processing could be used by intelligent algorithms for the provision of innovative services. Within the Industry 4.0 there is a large development potential of B2B (Business-to-Business) services namely in the SMEs and Start-ups.

In summary, the impact of new technologies and Industry 4.0 on business processes can be presented in the following way:

1. Creation of new products and services with built-in intelligence, innovative business models and opportunities for customization and adaptation to the needs of clients;
2. Digitization of the complete production cycle, accelerating development through digital prototyping and virtual production, flexible organization of production process;
3. Miniaturization trend in product design and development.

### **3. Issues Arising During Implementation of Industry 4.0**

In order to achieve adequate flexibility and efficiency, companies have to decide a number of issues, the most important of which, according to a study carried out by Morgan Stanley [9] are:

- 1) Cyber-Security and management of artificial intelligence

Cyber-Security and privacy of personal data is the first and most urgent challenge, given the growing number of attacks and data breaches due to increased connectivity;

2) Interoperability between existing systems

A functional digital environment requires a seamless sharing of data between machines, production units – enterprise and between enterprises. The same problem exists with the integration of the data due to the diversity of the types of data sources;

3) High business risk

The uncertain return on investment, as well as their high amount is mainly an obstacle that deters so far companies to deploy new technologies more quickly;

4) Still a low degree of maturity of new technologies;

5) Insufficient digital culture developed and competence as a whole

The forecasts of the experts are that machines will initially take the work related with the monotonous and repetitive movements so typical in the Assembly lines. This does not mean that the work done by the humans will surely be unnecessary. People are still better at creating unique and innovative products.

Industry 4.0 will benefit the most of the achievements in the field of software programming of resources. This means more and better programs, better predictive algorithms that will draw more and more qualitative analyses. This will allow the manufacturing process to be even more effective, optimal, cost effective and easy to manage, control and maintenance. In this way, the losses as a technological marriage, defects in the operational process will be kept to a minimum. The companies of the future will increasingly focus on operations management, while the machines perform monotonous and repetitive tasks. As a consequence, the management science will gain new meaning and even greater importance. Business management and business models of governance will have to be adapted to the new technological realities. Interaction between various units in the industrial enterprise will be subject to radical changes due to the increasingly shrinking role of man in favor of machinery.

In terms of human resources, the Fourth Industrial Revolution brings many unknowns about losing traditional jobs. Once automation and robotics are at its core, the most vulnerable groups will of course be low-skilled workers. According to some forecasts from the beginning of 2016, 47% of the current occupations in the US occupied by people are at risk of disappearing as a direct result of automated labor [10]. Another report by the World Economic Forum envisages losing 5 million jobs in the next five years [11]. On the issue of "What will these people work for?" it is obvious that a problem with a future "technological" unemployment is growing. What can be done is training and retraining programs for workers who lose their traditional work so that they can continue in other direction(s). However, the retraining does not mean a complete solution to the problem, because many employees will still be out of work and will not be able to be recruited back into the company.

The prediction of the effects of Industry 4.0 is characterized by a high degree of uncertainty. One cannot predict precisely what will happen in the next 10 to 15 years, especially when the human factor is involved, with all its complexity and dynamics. However, it is certain that the role of education, in-house training and national re-training programs for people of so-called "risk groups" is of paramount importance.

The efforts of both the business and the state, which need to increase their investment in science – practical applications, strategies, industrial innovation, etc. are needed.

#### 4. Conclusion

The Fourth Industrial Revolution has the potential to fundamentally change the structure of the economy as a whole. The production process will rely on automation, with high-tech robotic machines taking the lead. A basic requirement for the employees in the enterprise will be the Digital Competence.

Industry 4.0 will bring the need for new skills and abilities. Change will not be easy, but if we take a look at the past, we will see that there have always been professions that have vanished precisely because of technological advances.

From the present point of view, we cannot accurately predict how the problems caused by the coming of Industry 4.0 will be answered. In addition, as every root change, the industry of the future comes with its benefits and negatives. Humans have to adapt as much as possible and realize their place in the new world, which in any case must remain a leader. It can be summed up that Industry 4.0 will be more technological, more optimized, more research-intensive.

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