CHALLENGES FOR LOGISTICS IN THE CONCEPT OF INDUSTRY 4.0

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Abstract

The Industry 4.0 concept is becoming increasingly popular. It gives the possibility of gaining a competitive advantage for the countries of the European Union. The transport/forwarding/logistics sector can be regarded as a leader in the evolution of the Industry 4.0 platform, because the automation of logistics has been a trend for several years now. More and more new technologies are being used based on the rapid acquisition and processing of data for warehouse management, freight transport (such as autonomous vehicles) and radio identification. In this situation, there is a strong need to develop new solutions and tools under Logistics 4.0.

This article attempts to identify and describe the key challenges and future prospects for logistics that will need to be addressed to implement the Industry 4.0 platform.

Keywords: Industry 4.0, automation of logistics, Logistics 4.0, network

1. INTRODUCTION

The concept of the Industry 4.0 is becoming increasingly popular among European countries. Its goal is to create very modern fully automated future factories where machines and devices communicate with each other via the Internet and exchange information in real time. In such factories it is possible to become incomparable faster production of individualized products according to customer requirements. Data received from suppliers and customers should be used at every stage of the production process. According to the assumption, the use of the Industry 4.0 concept should reduce the time to introduce a product to the market by 50% and increase the efficiency of production processes by about 30% [1].

On the one hand, proposed solutions offer the possibility of rapid development and a significant competitive advantage on the market for enterprises from the European Union countries, because used manufacturing processes is much more flexible and the customer is involved from the beginning of the production process. On the other hand, the fourth industrial revolution has many fears and problems to be solved.

Logistics is the engine of the economy, so its importance in developing the concept of the Industry 4.0 is really significant. As a result of globalization, the potential of the global market has developed and opportunities for free movement of goods and capital have emerged. However, there was also global competition, which resulted in turbulences in the market of incomparably greater speed and power. Currently, logistics systems must be built in such a way that they allow for rapid adaptation to changing market conditions. Such adaptive logistics systems use new types of technology based on highly advanced IT systems to increase their adaptability to changing market conditions [2].

The TSL industry can be regarded as a leader in the evolution of the Industry 4.0 platform. An automation of logistics has been a trend for several years now. More and more new technologies are based on rapid acquisition and processing of data for warehouse management, freight transport (such as autonomous vehicles) and radio identification. In this situation there is a strong need to develop new solutions and tools under Logistics 4.0. This concept can be defined as autonomous, self-organizing systems that consist of independent subsystems.

This article attempts to identify and describe the key challenges and future prospects for logistics which should be solved to implement the 4.0 platform.

2. THE INDUSTRY 4.0 AS A CONNECTION OF DIFFERENT TECHNOLOGIES

Nowadays, the Fourth Industrial Revolution is gaining in popularity and interest in science and economy. Strong competition and growing customer expectations make it not only necessary to increase the efficiency of production, but also to find ways to personalize it. It is needed to manufacture short series of products designed to meet the needs of a specific customer. Their price should be not higher than the price of products manufactured in mass production. Such a flexibility should be a result of the Fourth Industrial Revolution [3].

To achieve this, a great digitization and computerization of processes is necessary. As a result, cyber-physical systems will be created and smart factories will be developed in which machines and devices communicate and make autonomous decisions. The effectiveness and efficiency of processes will be increased and the supply chain will be much more flexible.

The Industry 4.0 concept combines mobile technology with automation and implements communication between people, machines and devices. A control of devices and machines will be possible beyond the visual line of sight. Many different technologies is used in smart factories (see **Figure 1**).

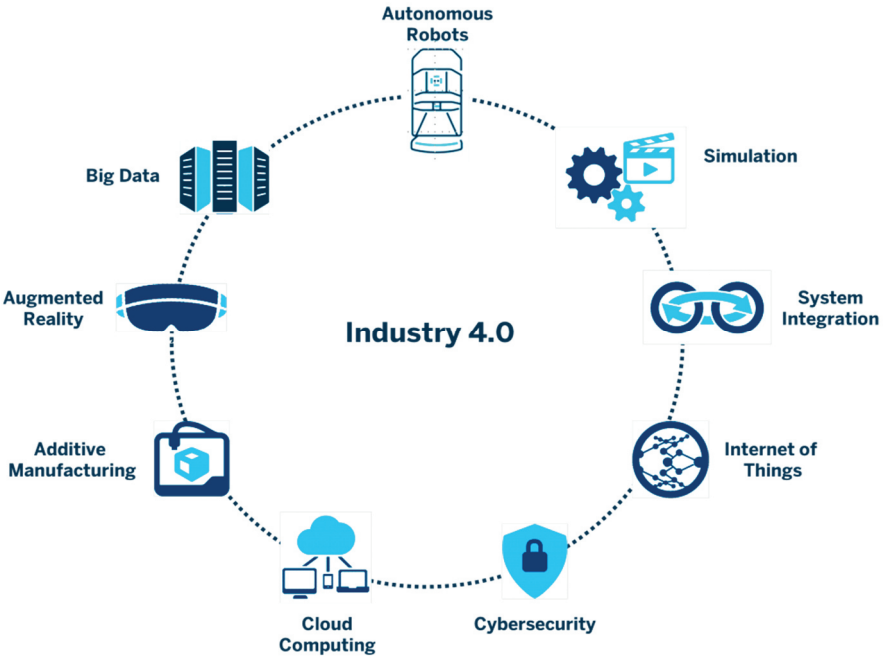

Figure 1 The most commonly used technologies in Industry 4.0 [4]

The Industry 4.0 concept adopts among other things the following: Cyber-Physical Systems (CPS) which integrated networking, computing and physical processes, Internet of Things (IoT), Internet of Services, Cyber security, Innovative methods of collecting and processing huge amounts of information and using Cloud Computing and Big Data, Additive Manufacturing, Mass Customization, etc.

3. CURRENT STATE OF LOGISTICS AUTOMATION AND FUTURE PROSPECTS

It can be concluded that the automation in logistics started quite early. The main goal of automation is to integrate the work of machines and devices with human work and IT systems. Mostly in companies nowadays

is used automation of warehouse and production processes, supervision of implementation of warehouse and RFID automation and also inventory automation.

Many companies now use self-propelled forklifts. Another example of warehouse automation are the shelves having satellite-controlled platforms that transport pallets to specific locations. Also, traditional bar codes are often replaced by automated identification methods.

The Industry 4.0 concept opens up great opportunities for transport and logistics. Transport according to the concept 4.0 is expected as intelligent transport items that are based on sensor intelligence and optimize the route themselves based on information collected from different types of sensors about what is happening on the route, and transmitted via the Internet to road users. In addition, they send the arrival time information to the place of unloading and send the necessary documents via digital. Optimization also applies to the carriage of loads. Communication with the fleet manager or transport exchanges via digital and forwarding information about the availability of transport capacity can provide unmatched capacity utilization and real-time loading planning, which will dramatically shorten time and reduce transportation costs, thus increasing efficiency and effectiveness. The biggest challenge is the use of modern technology to minimize downtime in transport [5].

Intelligent transport items according to the Industry 4.0 concept can also energy harvested. In this process energy is derived from external sources such as: kinetic energy, solar power, wind energy, etc. which is captured and stored for small, wireless autonomous devices. Energy harvesters provide a very small amount of power for low-energy electronic.

Cost-effective small batch manufacturing of high numbers of variants is expected in 4.0 factories. Industry 4.0 concept assumes that machines, equipment, warehousing systems and products are connected and exchange information and they can realize autonomous actions and are able to control one another's. A digital supply chain shaped by Logistics 4.0. will be created. Benefits of the digital supply chain are as follows [6]:

- complete transparency along the entire supply chain in real time,
- reduce the complexity of management through decentralization,
- availability of all supply chain-relevant information in the cloud,
- autonomous decision-making,
- clear optimization potential through Big Data applications,
- increased automation through human-machine interaction,
- minimization of errors in complex processes through augmented reality solutions,
- universal optimization with Big Data,
- flexible material flow patterns,
- increased automation through interaction with people in real time.

The significant element of a development of Logistics 4.0 will be innovative IT technologies which are based on [7]:

- e-commerce,
- 3D printing,
- Internet of Things,
- Internet of Services,
- City Logistics,
- Mass Configuration,
- API Economy which enables both information flow and cash flow in real time.

The need to accelerate the implementation of logistics systems led to the introduction of Automatic Data Capture (ADC) systems. They allow data directly into IT system without using the keyboard to be entered. Optical tools (bar codes), magnetic (magnetic tapes), biometric (voice recognition) and electromagnetic (radio

waves) are used for automatic identification [8]. Frequently is used RFID (Radio Frequency Identification) technology that uses radio bar codes or EPC (Electronic Product Code), which is a combination of RFID technology with Internet capabilities. Many Polish warehouses use RFID systems to locate forklifts and stored goods. Information is read through special sensors. RFID is also used to generate information about revising goods in a warehouse or the space used on shelves.

Another example of logistics automation is research and development work on autonomous vehicles. New intelligent communication technologies such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) create completely new possibilities. Their use can significantly accelerate the development of autonomous vehicles. They allow the exchange of information between moving vehicles and the surroundings of the motorway. Researchers and designers see significant potential of these technologies in the development of autonomous cars.

The main barrier to the development of the concept of the Industry 4.0 is limited investment opportunities what means a lack of capital needed to develop a technical infrastructure, automation and communication of machinery and equipment. In addition, a significant barrier especially in Poland is low labor costs, which do not mobilize to implement fully automated production and services [9].

In Poland and the European Union countries, small and medium enterprises (SME's) are dominated in the TSL industry. Hence, a lack of capital is the most important limitation of the development of Industry 4.0. For this reason, the concept of Industry 4.0 is expected to grow mainly through enterprise networks that will jointly build up modern 4.0 platforms. Each of the companies belonging to the network will only specialize in a narrow range of logistics services. Together they will create very modern, automated supply chains that will be able to compete with large modern smart factories or will provide services to them. So, another important challenge in implementing the 4.0 concept is to work with other companies that will build together a complex networks [10], [11].

4. CONCLUSIONS

A critical literature analysis show, that there are many modern technologies and solutions that can completely automate logistics processes and extremely increase their efficiency and effectiveness. We are faced with the enormous challenges that will surely revolutionize the hitherto approach to logistics.

However, the automation, improvement and modernization of logistics processes is bound to overcome a number of barriers. The most important of these are the lack of capital, which is essential for automating and introducing very modern solutions.

Summarize, the Industry 4.0 is a big challenge for enterprises as well as it gives them a significant opportunity to develop. However, requirements are very high, too. Companies must change their strategy completely and overcome many barriers. The preliminary research indicates that the most important needed changes to implement Industry 4.0 assumptions are as follows:

- technical infrastructure,
- automation of device operation and communication between them,
- employee competences - the skills of employees needed to control an automated systems,
- collaboration with other companies - building relationships and competencies with other companies that will allow joint a network of companies to be created.

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