The Impact of digitization and automation of production on the role of the workforce in companies in Slovakia

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Abstract. The aim of this article was to evaluate the current view of domestic and foreign authors on problems and trends of production logistics in the conditions of globalization and to explore possibilities of development of the concept of Industry 4.0 in Slovakia. We also focused on the digitalization of processes, which are one of the basic prerequisites for the company's operation in the Industry 4.0 concept. The current conditions in the Slovak Republic, resulting from the functioning of the market economy, create new opportunities and the need to apply business approaches in production management. It is a prerequisite for the success not only of manufacturing companies to find balance between modern trends and technologies and people with necessary knowledge and skills.

1 Introduction

Globalization affects every social area, including manufacturing. Traditional production processes are squeezed out by new, more innovative solutions, which customers expect to be more efficient. Along with intense and rapid changes, not only a technological, but mainly a social question resonates in the society: "How will a person's position change in the manufacturing process of the future?" The effects of robotization and digitization on jobs, which are characterized by monotony, low educational requirements and high frequency or injury risk, are evident already.

The advent of digitization has begun to show fundamental change in all areas of business. New global markets, business models, ICT advances and innovation in every business area are emerging.

The goal of the paper is to identify activities and aspects of the corporate environment, as well as the external environment of companies in Slovakia, which needs to be developed in order to implement and apply the principles of digitization and automation of production. The concept of Industry 4.0, its substance and the possibilities that exist for its implementation into industrial companies with a potential impact on employees, can also be considered as an object of research. Among several research methods, mainly theoretical methods and out of these, general (logical) methods, a method of abstraction, method of analysis and synthesis, method of generalization, comparative method and the method of induction and deduction have been applied.

2 Current state of the area under examination

First of all, it is necessary to define the concept of the manufacturing process so that we can address its automation and robotization in the next sub-chapters.

The core activity of the company is production. In the broadest concept, 'production' means the combination of production factors, such as labor, soil, capital, in order to obtain certain products. Production means a business process that ensures the conversion of inputs into the expected outputs. Therefore, the production process could be defined as a transformation process. In other words, it is the process of making products or providing services. The production process is not intended for any products, but only those that are viable on the market. The conversion of inputs into outputs must take place as efficiently as possible, i.e. with optimal consumption of production factors.

Several elements and components are involved in the production of specific products of a material nature and thus, in the working process. The basic components of the production process, which affect the level and, consequently, the results achieved, are considered to be labor, labor force and work equipment. The work items include raw materials, basic and auxiliary materials, energy, fuel, etc. Work equipment is machinery and

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appliances, the role of which in production processes is increasing with the development of mechanization and automation. The workforce is a social element. It can be said that it is a crucial element in production. The workforce affects all other elements of the production process. The three basic elements of production consist only of a potential production process, which is realistically only formed by interaction between all three key components.

2.1 Automation of production

The concept of automation began to be used from about 1947 in the automotive industry to describe the increased number of automatically functioning devices and controls in mechanized production. The origin of the word is attributed to D.S. Harder, who was an engineering manager at Ford Motors Company.

Automation, like many other concepts, does not have a completely precise definition, but the basis is the same. Automation, which is the successor to mechanization from the point of view of industrialization, means that people's control activities with technical equipment or vending machines are replaced. An automatic machine is a machine that itself performs predetermined tasks with minimal assistance of people, mostly with using artificial intelligence.

The Encyclopedia Britannica explains automation as using machines in tasks performed by humans, or more often, in tasks that would not be possible without them. Although the term mechanization is more often used to express the replacement of humans by machines, automation is generally used to express the integration of machines into autonomous systems. It also says that automation can be defined as technology for performing processes using programmed commands combined with automatic feedback management to ensure that instructions are executed correctly. The resulting system is able to operate without human intervention. Development of this technology is increasingly dependent on the use of computers and computer technologies.

The World Bank's report 2019 on the world development shows that economic effects of workers replaced by automation are outnumbered by new sectors and jobs in the technology sector.

The first references come from ancient Egypt, where, for example, automatic grain milling systems and field irrigation were adopted. It was also the automatic closing of the bronze gate in Alexandria, which was described by Herón in his work *Pneumatica*. The most famous vending machines from the Middle Ages are the clocks, wind chimes and others.

In 1905, an automatic machine for blowing glass bottles was introduced. The machine, operated by two workers, could produce 17,280 bottles in 24 hours, compared with 2,880 bottles produced by six men. The costs for making bottles by the machine was 10 to 12 cents, compared to $1.80 for man-made hand operations.

In December 1913, Ford Motor Company introduced an assembly line for car manufacturing, which is considered to be one of the pioneering types of automation in the manufacturing industry. The production time of one car dropped from more than 12 hours to just 93 minutes, the working time was reduced by one hour per day to make the three-change operation easier to implement.

In the twentieth century, significant developments in several areas occurred. Development of an electronic digital computer has made the control function more sophisticated and faster in automation. The current trend in automation is to connect individual control computers to local computer networks, in which they can communicate and coordinate with each other in order to streamline the entire production process and not just the individual parts of it.

2.2 Robotics and robotization

Automation technology has matured to the point in which it has developed a number of other technologies that have achieved their own recognition and status. Robotics is one of those technologies. It is a specialized automation industry. That is why the concept of robotics needs to be clarified in order to understand the difference between robotics and robotization.

Robotics is an automation technology that has been developed since about 1960. It is a science dealing with robots. In robotization, it is nothing more than the introduction of robots into industrial tasks or production processes.

In both cases, however, these are the robots that form the essence of the entire robotization. The word *robot* comes from the Czech word *robot*. The first reference of the word robot was used in 1920 in a game by Karl Capek R.U.R. (Rossum’s Universal Robots). The robot is known either as a machine, a device performing complex operations according to a specified program, or as an artificial human, a human-like machine.

The most typical human characteristics of a modern industrial robot is powered by a mechanical arm. The robot arm can be programmed to move a sequence of movements to perform necessary tasks. Industrial robots are usually used as a substitute for human workers in factories.

According to the Oxford Dictionary, a robot is a machine that is programmable by a computer, capable to automatically perform complicated series of operations. A more complicated but more precise definition is

provided by the ISO standard 8373:2012, according to which the robot-controlled mechanism is programmable on two or more axes, with a certain degree of autonomy, moving in a space to perform specified tasks.

Thus, robotization means using robots to perform tasks for which they have been pre-programmed. In this paper, we also consider as necessary to compare the robot and the human, so that we could have a better idea of how robots can influence the manufacturing process and the position of the workforce in it.

The advantage of robots is that they can perform repetitive tasks evenly, which are often monotonous and difficult for humans to stay focused on. Thus, we are getting to their next advantage, which is a constant full concentration. The big advantage is also that robots, as they are not living organisms, can work in a dangerous, hazardous environment, and also, their strength and load capacity can be much higher than in humans. Last but not least, robots have essentially unlimited capacity to store the amount of information which they can recover at any time. Unlike robots, a human have empathy, they can solve abstract problems, they can better cope with changes. As opposed to that, robot would have to be re-programmed. In addition, humans are able to deal with unexpected situations and they are flexible.

Cost-effectiveness means reducing production costs by eliminating, for example, the cost of workers' wages. It is also an advantage that robots can operate in a repetitive cycle, ensuring increased productivity. In addition, thanks to this ability, the quality of products is also improved. This means that workers who produce a given product by repetitive activities often make production errors, which also triggers increasing costs. Among other things, we know that there are also injuries in workplaces, especially in dangerous environment, which is not the case with robots.

In regard to disadvantages, it is important to note in particular how robotization affects or could adversely affect the society.

Usually, the biggest hurdle that decides whether or not a company will invest in robotic automation is the high initial investment. In some countries, longer return of investment may also be discouraging. Then we see the downside of increasing skilled staff, which is an advantage on the one hand, as this can provide new jobs. On the other hand, it is difficult to find a skilled workforce which entails the cost of additional training. One of the biggest problems in implementing robotic automation is the impact of jobs on workers. If a robot can work faster and more consistently, then there is a risk that humans may not be needed at all. While these concerns are understandable, they are not really accurate. During the early years of the revolution, people were also worried about job losses, but as history has shown us, these fears did not come true and so people continue to play a critical role in manufacturing.

2.3 Impact of automation and robotization on society

Technological change always raises fears of imminent mass unemployment, when innovation will be able to replace human labor at an ever-increasing pace. In addition to traditional industrial automation and advanced robots, new generations of more capable autonomous systems are emerging, from autonomous vehicles on the road to automated controls in grocery stores (self-service cash registers).

In this section, we will focus in particular on how automation and robotization affect society today and how it can affect it in the future, as it is still in the process of development. On the one hand, Slovakia is one of the world leaders in terms of automation and robotization. In terms of main barriers that make this situation difficult, the following aspects have been included:

- inefficient lifelong learning system which involves less than 3% of adults in Slovakia, while the EU average is 10.8%,
- imbalance between acquired knowledge during formal study and labor market needs.
- lack of knowledge of the labor market needs by the education system and the unpreparedness of universities and secondary schools, but also of primary schools for changes in labor market requirements,
- lack of skilled labor in key sectors of the national economy,
- inflexible labor market, lack of support for flexible forms of work.

In Slovakia, a third of people work in the industry, which ranks the country second in the most industrialized countries in the European Union. It is said that it is the industry that is one of the most automated sectors, which gives us a negative position. The survey shows that in Slovakia, up to 70% of jobs can succumb to automation and robotization, and a further 32% will face a significant change in the way the work will be done. The probability that one job will be automated and cancelled is at 62%, which is in 14 percentage points higher than the OECD average.

Automation is concentrated mainly in the automotive industry in Slovakia. 4 car makers are based in Slovakia, namely Volkswagen Slovakia in Bratislava, PSA Groupe in Zavar, Kia Motors Slovakia in Teplička nad Váhom and Jaguar Land Rover in Nitra. In total, they produced more than 1.25-million vehicles last year, in 2019. The automotive industry employs directly and indirectly approximately 275 thousand people. It is the

structure of the Slovak industry, where assembly activity prevails over research and development, marketing, and services, that is one of the reasons why our country is at the forefront.

One of the benefits of automation is also reducing the costs. We demonstrate this by an example. In Fontan in Dolný Kubín, they have a melting furnace that cannot be shut down. Therefore, there is a non-stop operation running. In May last year, higher wages for weekends, nights and public holidays were approved. Personal costs would increase by 60 thousand euros, so they decided to robotize their production more intensively. This decision has helped them increase productivity without having to look for new employees. They needed six employees at milling, but now they only need three. However, this does not automatically mean a reduction in the number of employees. An example is the car factory Volkswagen, which has about 1,500 robots, but the number of employees is growing year-on-year.

Robotization in Slovakia is more visible from year to year. In terms of the number of robots, there were 165 industrial robots per 10,000 employees in 2018. The world average is 99 robots per 10,000 employees, which ranks Slovakia at the 16th place. In the following chart (Fig. 1.) the evolution of the number of robots in Slovakia over 4 years can be observed.

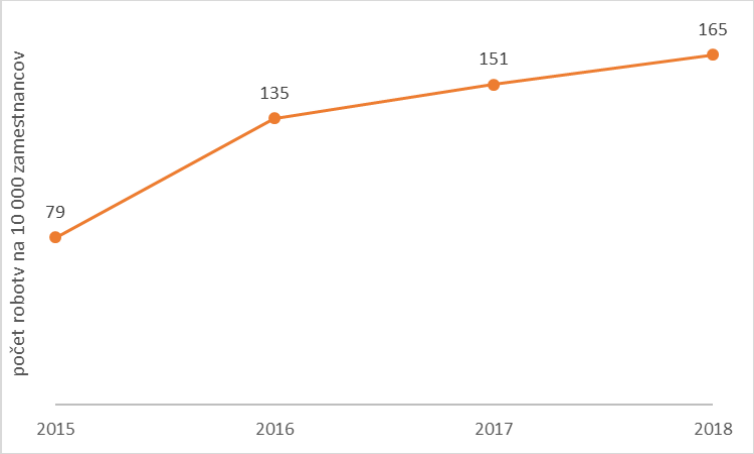

Chart 1. Development of the number of robots in Slovakia

2.4 Possible threats to the labor force due to automated production

Although automation and robotization are not the latest phenomena, there are still a few questions and, in particular, concerns about them. The most worrying impact is unemployment, i.e. the loss of a job due to automation or replacement of human labor by a robot.

Theoretically, around 50% of current jobs around the world could be automated. In case of around 60 % of professions, at least 30 % of the core activities could be automated. More than 5 million jobs in 15 developed and emerging economies could be lost in 2020. Some 45-60% of Europe's employees are at risk of being relocated to another job due to automation.

In their study 2013, Frey and Osbourne hypothesized that automation tends to focus on automating certain tasks rather than on the entire professions. Professions usually consist of performing a set of tasks, some of which are not easy to be automated. Therefore, the potential for automation of coherent occupations and workplaces could be much lower than indicated. Furthermore, it is important to understand that the technological possibility of using machines to provide certain tasks does not always mean losing a job. Replacing people with a machine may not happen at all, or people will still be needed to operate it. The paradox of automation is that the more efficient the automated system, the more important is the human contribution of operators. People are involved less, but their involvement is becoming more critical.

Most of the changes during automation occurred mainly in positions that employed young or uneducated workers. They were the ones who often performed simple, monotonous, and physically or mentally demanding work that is handled by a machine or a robot much better. Then, people can focus more on other work that requires more concentration. Therefore, it is likely that low-skilled workers will be burdened with adaptation costs since the automation of their work is higher than those of highly qualified workers. The most probable challenge for the future is to manage the growing inequality in education and ensure sufficient re-training, especially for low-skilled workers.

However, re-trainings and trainings mean spending money for employers. The best solution is to start developing scientific and technical literacy in schools. It is also important to create a flexible social system to help those

whose jobs disappear and thus, they will have nothing to do. This system should help them prepare for another position or to work in a completely different segment.

2.5 Expected implications in production

In its study, the European Parliament's Research Service published the following expected implications in production:

- a higher flexibility through automation, data management, integration of multifunctional robots enables the production of a wider portfolio of products in the existing production hall,
- mass customization (customization of the product exactly according to the requirements of the customer) will ensure economically efficient production of small numbers of products, even individual pieces, owing to a rapid reconfiguration of machines and an additive production. The company's director of Siemens Industry Automation explains the mass customization by the fact that customers' demands for individual customization are increasing (vehicle production is an example), which makes an effort to create factories that do not produce only in mass, but at the same time on a customized level,
- the speed of production will increase because of digital models and simulations, data-driven supply chains will speed up the production process by 120 % by shortening the time from the purchase order to the start of production,
- a high potential has been identified in the increase of quality by reducing the error-rate due to integrated sensors and machines that acquire intelligence through access to large data. The Siemens Amberg plant, which achieves 99.99885 % faultlessness, can be mentioned here as an example. The quality plays a significant role in companies' costs, with the EU estimating a total of €160 billion in 100 major European producers.
- Productivity will increase due to a number of Industry 4.0 elements, for example, the productivity increase, after predictive maintenance are incorporated is defined at 20% as a consequence of 50% reduction in downtime. Another type of productivity increase is staff number optimization and their utilization,
- the concept also provides a higher level of customer involvement in the product development process, because the process of returning European production from low-income countries (if Europe is the primary outlet) will bring the customer closer,
- a change in business models intended to move away from cost-based competition purely to a competitiveness scheme that includes, in addition to costs, innovation speed, flexibility in the degree of customization.

"Strategic Policy Forum on Digital Entrepreneurship" (from the English phrase, refers to an institution, company, or research group, typically in the field of politics or economics) has been established by the European Commission. It predicts that the "internet economy" will create 400,000 - 1.5 million of new jobs. It also estimates the growth potential of companies that can use modern technologies. Such businesses achieve ten times better results than their competitors.

The Forum is the center of representatives from entrepreneurs, universities, organizations, and politics. The report looks at new opportunities emerging from digital technologies. It identifies key European challenges and submits thirteen recommendations to governments and entrepreneurs that should ensure that Europe is better in the availability of labor and the subsequent growth.

3 Research results

An analysis of the current state, problems and challenges associated with the implementation of Industry 4.0 rules and the digitization of the processes constituting the added value, among other things, has highlighted a number of important facts:

- almost three quarter of businesses do not expect digitization to have an impact on the number of staff, but there is a noticeable difference between small and medium-sized enterprises (SMEs) and large enterprises.
- 15% of businesses see a risk in the qualification of employees, in data security and the level of investment which is needed for the greatest risks and obstacles.

3.1 The way of processing and collecting the input data

In the following section of the paper we provide selected facts from a survey that we have elaborated on the basis of theoretical knowledge of the Industry 4.0 initiative and on the basis of consultation with an adviser in IPA Slovakia.

The questionnaire was sent to 150 industrial companies in Slovakia electronically. Business contacts have been accumulated in several ways. Electronically, via the Internet and electronic communications, individually thanks to the contacts of the author and, last but not least, thanks to consultants and author´s fellow students who helped find contacts in industrial companies willing to answer the survey on Industry 4.0.

We have obtained 92 duly completed questionnaire forms. In spite of the fact that there are only slightly more than a half of respondents (exactly 61.33%), the data range could be considered to be a success, since previous experience with the response to electronic questionnaires was below 25% of respondents. Then, we analyzed the 92 duly completed responses.

In this text, only selected issues related to the expected impact of automation and digitization on the workforce position in companies will be addressed.

Among the companies concerned that sent a duly completed questionnaire form were 32 micro-companies (1-9 employees), 28 small enterprises (10-49 employees), 19 medium-sized enterprises (50-249 employees) and 13 large enterprises (250 or more employees). Percentage values have been rounded to integers.

Industry 4.0 is a "future trend" in Slovak conditions – for many businesses it will represent a substantial part of their strategic agenda in the near future. Already today, businesses trying to overtake competition in Slovakia combine advanced connectivity capabilities, advanced automation, cloud computing, sensors and 3D printing, computer-controlled processes, intelligent algorithms, and the Internet of things to transform their business. More than 50% of enterprises have said that digitization and integration processes are at least sufficiently developed and, given the trend in digitizing processes in the surrounding world (and which at the same time indirectly affects Slovak businesses), it can be said that this number will continue to grow.

3.2 Expected impact of digitization on the number of employees in companies

As many as 71% of the companies surveyed do not expect a change in the number of employees related to the implementation or development of digitization. It should also be added that this percentage is so high, in particular for the number of small and medium-sized enterprises (SMEs) that have answered this question. If we look at the response structure, we can see a difference in the perception of the effect of digitization on employment between SMEs and large enterprises.

Large enterprises are clearly more aware that digitization should have an impact on employment. Their expectation is that the number of employees could fall. In this case, it is about working in administration or working with data from the production. Digitizing processes working with data is extremely beneficial for large companies because computers can collect, analyze, and model different types of data incomparably faster than a person would do by means of manual computing. The amount of data in large companies that are processed by computers is a more disjointed factor because a computer can process data for 100 or more workers in less time. The larger the database that a business needs to work with, the more convenient it is for it to digitize the value-added creation processes.

In case of SMEs, management trends are not expected to change in more than three-quarters of responses. This can be explained in particular by the fact that the database used by SMEs is significantly smaller than with large companies, and therefore, even if a certain number of employees are replaced by computers, roughly the same number of new employees will have to be recruited for the management, maintenance and use of information technology (ICT).

Chart 2. Impact of digitization on the number of employees

	Large enterprises	Small and medium-sized enterprises	Total enterprises
Not expected to change	61 %	78 %	71 %
The number of employees rises	8 %	14 %	13 %
The number of employees drops	31 %	8 %	16 %

With the consistent application of Industry 4.0 principles, certain jobs will not be sought by employers and thus, they will cease to exist. However, this cannot be seen unilaterally and predict a rapid decline in employment. After all, there are dozens, if not hundreds of jobs that have already disappeared over the historical development. On the contrary, Industry 4.0 is expected to increase the overall need for the workforce. This idea is also shared at the European Union level, which has identified a huge potential in the internet economy and expects to create 2.6 new jobs for every offline vacancy cancelled.

In the context of the positions at risk, these are mainly jobs which are not of great interest in the Slovak Republic, so foreign workers are recruited for these positions. Therefore, the will of the Ministry of Economy should be the introduction of elements of Industry 4.0 which eliminate professions with a lower level of qualification.

4 Conclusion

Slovakia has great potential to take advantage of the fourth industrial revolution because of a highly developed automotive and electrotechnical industry. There is a very strong structure of production companies and their supply chains, which is suitable for experimenting with new practices and techniques brought about by the digitization of industrial processes.

The fourth industrial revolution has also the potential to fulfill the ambition to increase global production to meet growing human needs without harming the environment. In other words, it helps to increase environmental sustainability by continuously improving production and non-production processes.

However, the digitization of companies will change the nature of work and increase the demands and requirements for skilled workers. Demand for workforce will continue to increase as businesses will develop new professions with demands to reflect the digitization of production and logistics.

Note
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