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EXPECTED CHANGES IN SLOVAK INDUSTRY ENVIRONMENT IN TERMS OF INDUSTRY 4.0

Abstract:*Intelligent devices, machines and technologies, virtual reality, 3D printing and cooperative robotic devices are being implemented into the industry currently. These technologies are also transferred to the manufacturing sector, where industrial facilities connect, collaborate and make decisions by means of artificial intelligence. The aim of the paper is to find out the impact level of Industry 4.0 implementation within Slovak enterprises. The research was provided based on the dataset on the Slovak statistical office and the questionnaire survey being carried out during the period of December 2018 till February 2019 by random selection; 350 companies were contacted with a return of 220 responses.From the reactions of the companies, we evaluated the employers' opinion and their readiness on the emergence of smart industry in Slovakia. The result of the study will be an assessment of two key issues concerning the current jobs structure requirements in terms of employees' education structure and, in particular, employers' reactions on the Industry 4.0 implementation reflecting the future job structure in Slovak industry.Based on the results it is proposed the expected positive changes should be transformed into higher productivity, greater flexibility, greater competitiveness, higher profitability, security and ecology. As research limitation there can be mentioned issues such as: some questioners from the survey had to be void, some answers were not relevant.*

Keywords: *Entrepreneurship; Industry 4.0; Robotics, New Jobs Creation.*

1. Introduction

Mura & Ključnikov (2018) argue that Industrial enterprises in Slovakia, represented by their management, have long failed to take into account the challenges of Industry 4.0. They saw it as a Western fashion trend and the implementation of platforms such as the Internet of Things, Big Data and their analytics, cloud computing, virtual reality and 3D printing were not deployed in almost any domestic industrial enterprises. When it comes to foreign investors, the situation was different, especially within the automotive industry and the network of their suppliers. However, the situation has changed over the last two years, with businesses becoming to be more interested in the Industry 4.0 platform (Mura, 2019). The uncertainty remains as to how Industry 4.0 and all its components will be effectively implemented. According to

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Fabus (2018) one fifth of automotive suppliers have already invested in Industry 4.0 and one-third counts on investments in the next two years and investments will be less than 1% for suppliers and 30% for more than 1% of revenues.

As stated by Dudáš & Grančay (2019) at the end of 2016 the Slovak government also responded to Industry 4.0 calls and in its resolution entitled "Intelligent Industry Concept for Slovakia" describes the current situation and requires the relevant ministries to set up the "Intelligent Industry Platform" and to develop an Intelligent Industry Action Plan for Slovak Republic. The area where the government support is expected is the continuing low added value in automotive sector in particular. Belás, Vojtovič & Ključnikov (2016) argue that research and development in Slovak Republic is low and permanently underfunded. Innovations arise away from Slovakia, and industrial enterprises have located just the production parts in the country. The Intelligent Industry Action Plan in Slovakia should include significant support for research and development activities and support, in particular, investments from this area of foreign investors. Support for domestic innovation projects is largely also expected (Noskova & Peracek, 2019).

Some authors such as Kadir & Broberg (2020) and Pardi (2019) argue that the basis on which this change towards a smart industry can take place is a change in education, not for the needs of the current, but for the needs of the future industry. The pace at which this transformation of industry is being executed is bringing to attention of another challenge, lifelong learning, for which government must actively approach. As stated by Ahmad & Seman (2019) and Vasilieva et al. (2017) new technologies would increasingly squeeze out low-skilled and physical work, and emerging jobs would place increasing demands on human intellect. Ongoing discussions on the impact of (unfavorable) changes on employment often give rise to fundamentally diverging views between those ones who expect unlimited opportunities and prospects to increase workers' productivity and release them from physical and routine work, and those ones who envisage massive job replacement in emerging jobs and relocating jobs to other countries (Mura, Havierniková, & Machová, 2017; Batraga et al. 2019).

This paper will discuss the issue how and in what way the impact level of Industry 4.0 implementation corresponds within the Slovak enterprises environment and behavior. For the most objective assessment of changes awaiting the Slovak industry under the influence of Industry 4.0, the questionnaire survey method has been chosen. To put it in other words, this subject deals with the assessment of two key issues concerning the current jobs structure requirements in terms of employees' education structure and, in particular, employers' reactions on the Industry 4.0 implementation reflecting the future job structure in Slovak industry.

2. Literature Review

According to many authors such as Snieška et al. (2020), Botlík & Botlíková (2019) and Cepel et al. (2019) the various technologies that supported the emergence of the Fourth Industrial Revolution are in constant development. These include virtual reality, the Internet of Things, artificial intelligence, autonomous vehicles, virtual assistants, investment software, and huge data analysis, 3D printing, and nanotechnology, biotechnology and quantum computers. It is often believed that these technologies are still at an early stage of their development because of their general application already being an integral part of the industries. For example, virtual reality allows us to transform the environment in which product testing is performed (Grabar et al. 2019; Pryima et al. 2018). As stated by Botha (2019) and Gera & Singh (2019) the Internet

of Things connects machines and people to improve work efficiency, and the use of Big Data enables machines to predict possible future errors and perform automated maintenance steps as prevention.

If everything in the manufacturing system and its surroundings is connected to sensors, software, Internet of Things technologies, knowledge systems and customers, the quality of the products being produced can thus be improved (Zhou, Han & Gou, 2019; Barata, Cunha & Coyle, 2019). Armstrong and Taylor (2015) also contend that automation plays a major role here, as well as do typical components of cyber-physical systems and the Internet of Things, allowing quality aspects to be monitored in real time and afterwards robots are reducing error rates. On the other hand, one of the risks of the challenges for the solution is that the more automation the less work for people (Lass & Gronau, 2020; Müller & Kiel, 2018). And the same this applies to other benefits such as the reduction of error rate (the less failure rate, the less technicians being required for service). In industrialized countries of the world economy, the number of jobs in industry has declined rapidly. Schwab (2018) insists that the reason is not only the process automation, but mainly the relocation of production capacities to developing countries where natural resources and labor are cheaper. The relocation of production capacities outside the country does not always concern only the expansion of production, in particular it is about the price of labor (Ślusarczyk, 2018; Kajanová, 2016).

According to Rajiani & Ismail (2019) industrial enterprises are planning to invest into innovations delivered by Industry 4.0 at least 5% of their annual revenue, which is $ 907 billion. In this way, further relocation of parts of industrial enterprises to other countries and the maintenance of production capacity in the home country should be avoided. Krajňáková and Vojtovič (2017) claim that not only businesses but also governments of the countries concerned, including Slovakia, must be prepared for this challenge.

Many authors assert that like the industrial revolutions before, the fourth industrial revolution has the potential to increase revenues globally and improve the quality of life for populations around the world (Stock & Seliger, 2016). Shvindina (2017) is pondering that those who have gained the most from the start of Industry 4.0 today are the customers who have the opportunity to access the digital world. Technology has enabled them to use new products and services and increase their efficiency and intensify their free time in their personal lives. For example, ordering a taxi, securing, and booking a flight, buying products, online payments, listening to music, watching movies, or playing games. All these activities can now be done remotely. In the future, technological innovations will also lead to revolutionary changes in supply processes with long-term efficiency and productivity gains. The cost of transport and communications will fall, logistics and global supply networks will become more efficient, and the cost of running businesses and trade will drastically decrease and all this will open up new markets and lead to economic growth (Bilan et al. 2019; Sima et al. 2020).

Okręglicka et al. (2017) argue that this upcoming 4th industry revolution may also lead to widening disparities, mainly due to adverse labor market changes, so that automation replaces manual labor over the economy. Machine imbalances can widen the gap between capital gains and working-class earnings. Some authors think that on the other hand, there is also a possibility that changes in job opportunities caused by this technology will lead to an overall increase in the number of job opportunities that are safe and very satisfactory (Dobrosotskiy et al. 2019).

3. Goal and Research Methods

The goal of this study is to analyze the current development of employment under the influence of Industry 4.0 implementation in Slovak Republic. For the most objective assessment of the changes being awaited by Slovak industry due to the implementation of Industry 4.0, a questionnaire method has been chosen as the principal research method. We approached Slovak industrial companies via the internet questionnaires. Different sizes of companies were chosen, from different areas of industry sectors and all Slovak regions where they operate. From the reactions of companies, we evaluated the opinion on the start of intelligent industry implementation process in Slovakia and their readiness for it. We evaluated two key issues related to the current job structure requirements in terms of employee education structure, and in particular, employers' expectations from implementing the Industry 4.0 for the future job structure in Slovak industry.

The questionnaire was created and subsequently executed on the Internet as a webpage. Respondents who received an email invitation to this webpage were able to connect and electronically fill out individual questions via the Internet. We obtained contacts from publicly available sources and databases. These were mainly the websites of professional associations and interest groups. Most respondents were selected from the following sources:

- Association of Employers' Associations and Associations of Slovak Republic at http://www.azzz.sk/o-nas/clenovia/`;
- Automotive Industry Association at: https://www.zapsr.sk/about/members/`;
- Database of finstat.sk web portal;
- Industry managers being contacted in person.

The criterion as the size of the enterprise was often used in the questionnaire classification. To make it clearer, the criteria for micro, small and medium-sized enterprises and large enterprises have been defined in terms of the breakdown according to the Statistical Office of Slovak Republic, as follows:

- enterprises up to 9 employees - micro-enterprise;
- enterprises from 10-49 - small enterprise;
- enterprises from 50-249 - medium enterprise;
- enterprises from 250 employees - large enterprise.

In this breakdown, to be simpler, we did not take into account the turnover of the company because the research is focused on expected changes within the quantity and skills of workers in enterprises. We approached 350 industrial companies and 220 enterprises sent us back the questionnaire replies.

The questionnaire was named "Who we will be wanted after the intelligent industry implementation and who will not be necessary anymore". The questionnaire contained 14 questions and the collection of answers lasted 78 days. Started on 06.12.2018 and the last reply was received on 21.2.2019.

The aim was to find out the current knowledge concept state in terms of industry 4.0 in industrial enterprises in Slovak Republic, the degree of its application, the current structure of manufacturing and non-manufacturing workers and the view of these enterprises on the future needs of workers in terms of the emergence of Industry 4.0. In the next chapter selected results from the questionnaire replies are to be presented.

4. Results and Discussion

The key question in the research questionnaire through which we determined the expectations of employers in industrial sector was stated precisely: "What changes

within employees being wanted do you expect after the implementation of Industry 4.0 elements". The workers were divided into office staff and workers, in other words, production and non-production workers. Furthermore, each group of employees was divided according to education and training into workers with general education and workers with vocational training. The participants expressed their expectations for individual categories of employees in terms of whether their demand would be higher, lower or with no change after the implementation of Industry 4.0 elements.

Anticipated changes in employee needs after the implementation of Industry 4.0 elements - this question in questionnaire was the most important indicator for the next employment development within the breakdown by manufacturing and non-manufacturing workers, highlighting the specialization of their education and training. The results of changes in employee needs from the collected responses are shown in Figure 1.

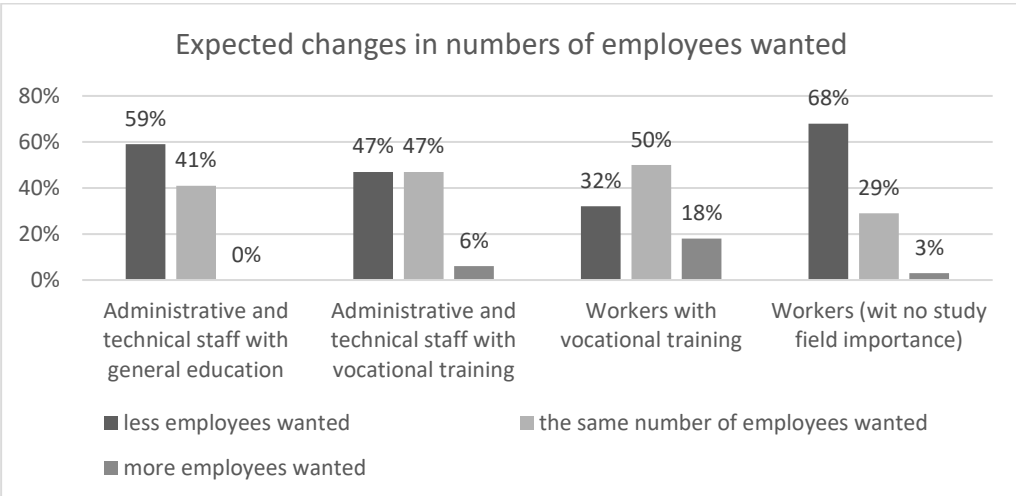

Figure 1. Expected changes in numbers of employees wanted
Source: own processing by research results

Of the total sample of respondents involved, 59% of enterprises expect to reduce the number of administrative workers with general education, 41% of enterprises expect to maintain the current status. The assumption of a reduction in the number of administrative and technical staff with vocational training is slightly lower. For this group of workers, even 6% of businesses expect increased demand in the future. There was a significant difference in working professions. While half of the companies expect to keep their numbers regarding the workers with vocational training, up to 68% of industrial enterprises expect to reduce their numbers regarding the workers with general education. Overall, across all groups of workers, vocational training one is expected to have the highest demand due to the implementation of Industry 4.0.

In order to better assess the impact on changes in employees being wanted, it was necessary to divide responses by the enterprises size. An overview of such a distribution is shown in Figure 2 for small enterprises, Figure 3 for medium-sized enterprises and Figure 4 for large enterprises.

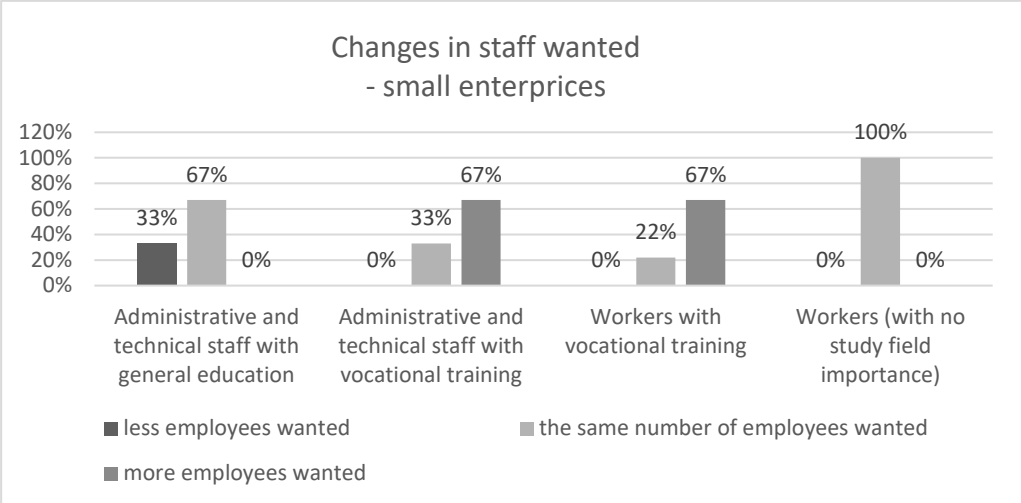

Figure 2. Changes in staff wanted - small enterprises
Source: own processing by research results

From the research results being obtained from small businesses (Fig. 2), it can be expected that administrative and technical staff with general education would keep their jobs. A third of the small businesses being surveyed expect a decrease in their job numbers. Two-thirds of respondents can be expected to have more demand for administrative and technical staff with vocational training as well as professional workers. Workers without an importance of a field of study are expected to keep their employment at current level. The reason for the demand for workers with vocational training in small enterprises is also due to the fact that small enterprises do not have the capacity for the required training for workers as medium and especially large enterprises. Therefore, they prefer to employ so-called "finished people", putting an increased demand on the training of graduates in the particular fields.

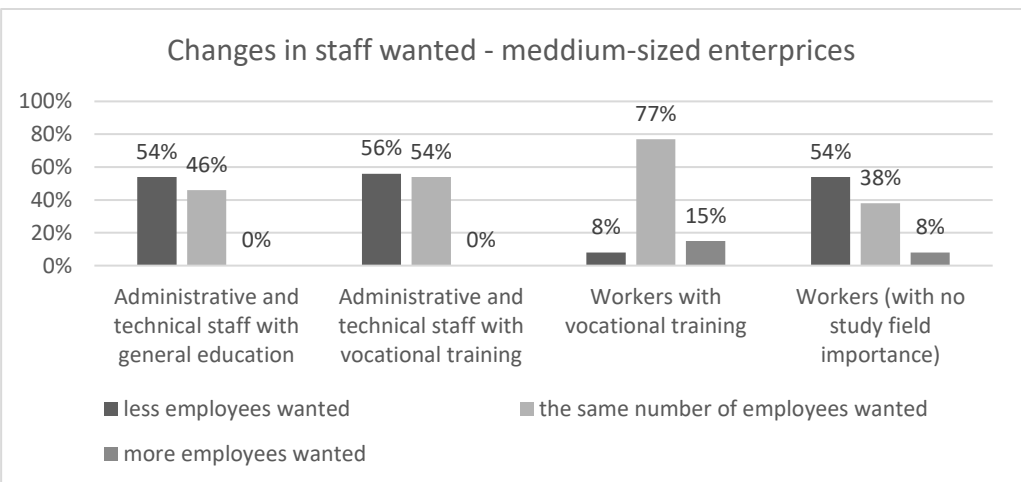

Figure 3. Changes in staff wanted - medium-sized enterprises
Source: own processing by research results

The results for medium-sized enterprises (Fig. 3) indicate that, for administrative and technical staff with general education, as well as workers without the importance of the field of study, the modest majority of medium-sized enterprises tend to expect a decline in employment for this group. Only a small fraction of medium-sized enterprises (8%) are expected to increase their employment for workers without the importance of the field of study. For administrative and technical staff with vocational training, a modest majority of medium-sized enterprises tend to maintain employment. Workers with vocational training can be expected to have the best prospects to keep their employment, with up to 77% in terms of medium-sized enterprises. Even 15% of medium-sized enterprises expect increased demand for such workers.

Figure 4. Changes in staff wanted - large enterprises
Source: own processing by research results

On the other hand, as shown in Fig. 4, large enterprises expect a reduction in demand for workers across the entire spectrum being observed, but in particular within the workers' professions. Reducing the need for employees is most reflected for workers without the importance of a field of study where demand is expected by up to 89% within the large enterprises. The largest percentage regarding job sustainability is found in large enterprises by administration and technicians with vocational training. Here, businesses have long declared that the key capital source are to be resources bringing innovation. Our survey results imply that businesses see these resources in vocational training.

According to data obtained from the Statistical Office of Slovak Republic the 2,392,807 workers in 2018 was the average number of persons being employed by economic activity. Of these, 696,900 were employed in industry, which is 27.2% of the total. This figure includes the Statistical Office of Slovak Republic including tradesmen. In order to draw up the most relevant conclusions from the research, we asked the Statistical Office of Slovak Republic to make out the most up-to-date statistics on employment in industry by size category of enterprises. The criteria were entered as follows:

- Economic activities => Industry
- Employee Categories=><1-49>; <50-249>; <250+
- Value => number of employees

The Statistical Office was able to work out statistics only from monthly surveys which collection is carried out in enterprises with 20 employees. For this reason, the Statistical Office of Slovak Republic changed the category of small enterprise from <1-49> to <20-49> employees. To fill in the missing data for industrial enterprises with up to 20 employees, we used the statistics: Average number of persons employed by economic activity (SK NACE Rev. 2) under the designation [pr2051qs], in which all employees are classified according to the same classification. The result of calculation and the number of employees' breakdown is shown in Table 1, showing the average number of employees by size of enterprises, where the total number of employees being broken down by the size of enterprises is added.

Table 1. Average registered number of employees in persons – 2018 (own processing by the Slovak Statistical Office)

The size category of enterprise by number of employees	Special Grouping industry activities according to SK NACE Rev.2					Total economy
	B	C	D	E	SR in total	Average number of employed in SR 2018
<1-19>	522	123 755	474	3 001	127 751	xxx
<20-49>	584	37 846	1 713	1 532	41 675	xxx
<1-49>	1 106	161 601	2 187	4 532	169 425	621 493
<50-249>	1 206	116 462	3 396	4 989	126 053	403 445
<250+	4 034	236 946	11 279	11 544	263 803	730 119
Self employed						637 750
SR in total	5 823	391 255	16 388	18 064	431 530	xxx
SR in total including up to 20 employees	6 345	515 009	16 862	21 065	559 281	1 755 057
SR in total including employees and self employed						2 392 807

B	Mining and quarrying
C	manufacturing
D	Supply of electricity, gas, steam and cold air
E	Water supply: sewage treatment, and waste disposal services
<20-49>	Enterprises with up to 49 employees
<50-249>	Enterprises with 50 to 249 employees
<250+	Enterprises with more than 250 employees

The data were taken from the monthly questionnaire PRIEM 1-12 for the year 2018 and supplemented by the total numbers according to the report: Average number of persons employed by economic activity (SK NACE Rev. 2) [pr2051qs]

We figured the category of employees <1-49> by calculation, where we deducted the number of employees supplied in specialized statistics from the Statistical Office of Slovak Republic from the total number of employees in industry. Employees within the <1-49> employee category were calculated according to the following formula:.

Calculation of the <1-49> category of employees (own processing)

$$\sum_{n=1}^{49} L = \sum_{n=1}^{\infty} L - \sum_{n=20}^{\infty} L + \sum_{n=20}^{49} L$$

n = employer´s size category (1)

L = Number of employees

From this way calculated data it can be stated that small enterprises of size <1-49> employ 169,425 employees representing 30% of all employees in the industry. Medium-sized enterprises of size <50-249> employ 126,053 employees representing 23% of the total number of employees in the industry in Slovakia. Almost half, 47% of industry employees, are employed by large enterprises with 250 or more employees, being 263.803 employees. Because the industrial companies being surveyed, in terms of their size, had significantly different views on the changes in employee needs after the implementation of intelligent industry elements into their enterprises, we conducted an impact assessment for each enterprise size separately.

The total number of employees in industry was divided according to the size of enterprises as well as administrative and production workers. The expected changes in the need of employees according to the results from Figure 2, Figure 3 and Figure 4 were applied on the employees' breakdown. Changes being expected by employers because of Industry 4.0 elements implementation recalculated to the number of employees are shown in Figures 5, 6 and 7 describing the changes in jobs positions being affected by the Industry 4.0 implementation for different types of enterprises by the size like small, medium and large enterprises.

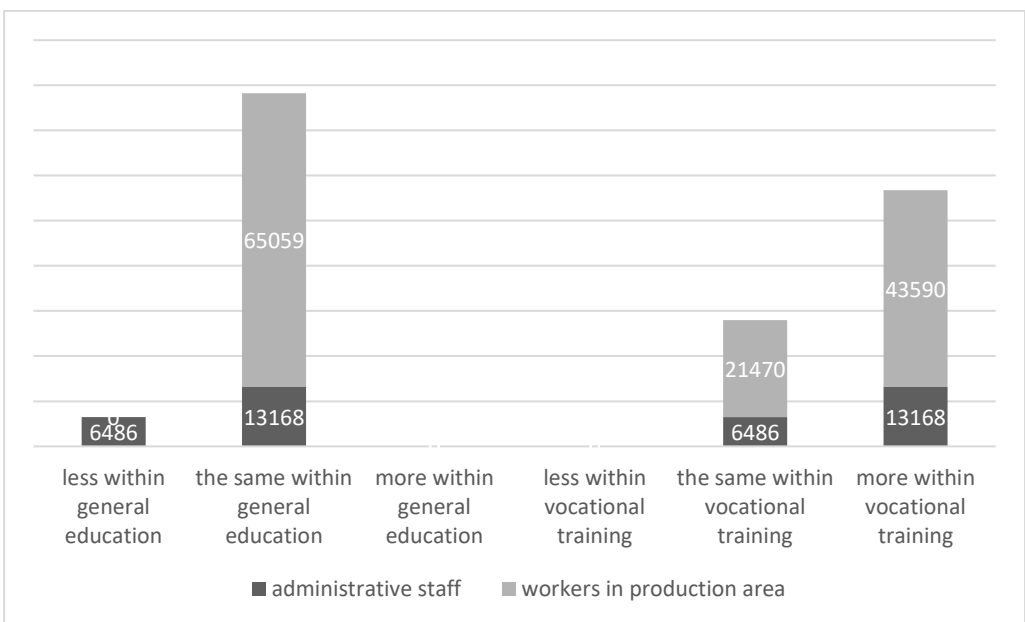

Figure 5. Expected changes regarding the numbers of employees in industry – small enterprises
Source: own processing by research results

Due to a more detailed explanation regarding the categories of workers being described, it should be mentioned that administrative staff with general education was designated as administrative and technical staff without the importance of the field of study. This means that this category also includes administrative and technical staff that does not have their study major in line with their work being executed. Production workers with general education were designated as workers without the importance of a field of study. This means that workers who do not work in their field of study are included in this category. It does not mean that they must have a general education.

Figure 5 shows that in terms of small businesses, blue-collar professions have the greatest prospects for the future. Small industrial enterprises expect a significant increase in the number of jobs for workers with general education and for skilled workers. For administrative and technical staff, the employment segment will be shifted gradually to skilled and professionally trained workers.

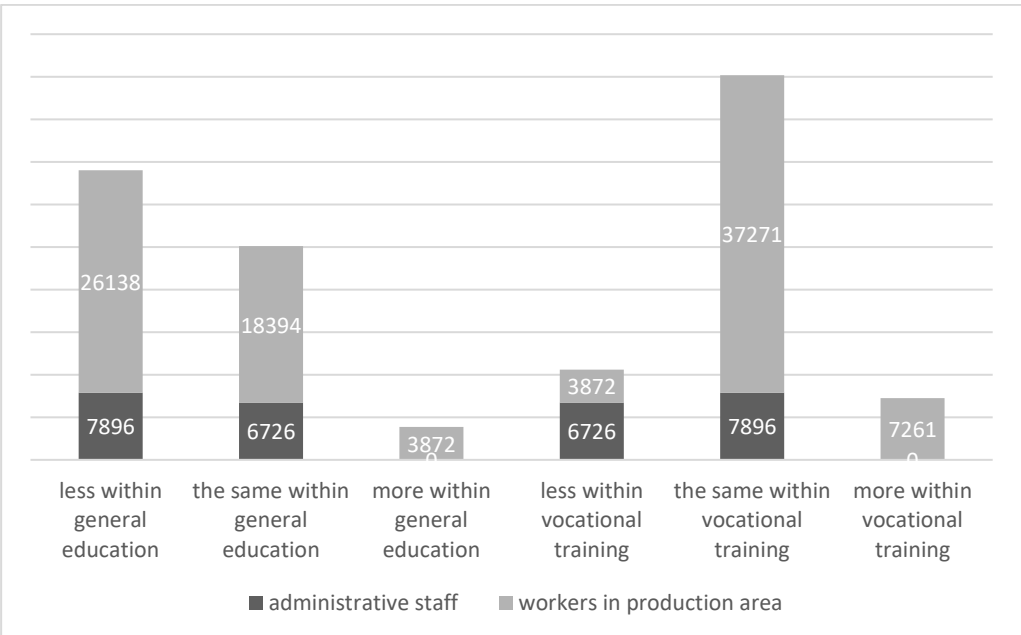

Figure 6. Expected changes regarding the numbers of employees in industry – medium-sized enterprises

Source: own processing by research results

In Figure 6 medium-sized enterprises expect a significant reduction in the number of workers, especially in terms of workers without adequate education, and vice versa, in terms of suitably trained workers the significant job retention is expected. In this category of workers, the upward trend is even doubled compared to the expected reduction of jobs. It can be assumed that after the necessary retraining and raising of suitable secondary school graduates, job losses in medium-sized enterprises will be negligible. Reductions in the number of jobs will have to be foreseen in terms of administrative staff.

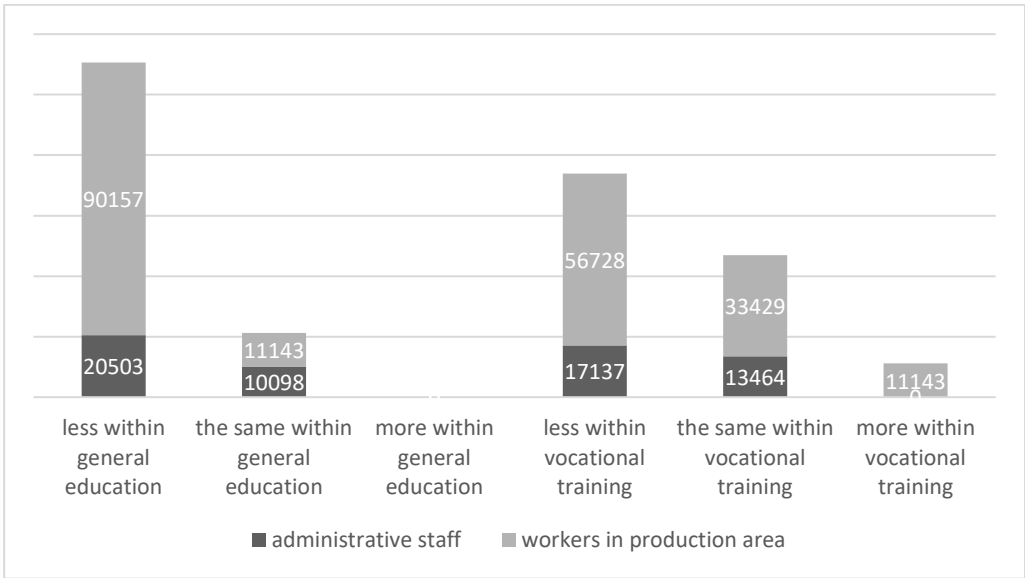

Figure 7. Expected changes regarding the numbers of employees in industry – large enterprises
Source: own processing by research results

From the questionnaire survey results in terms of large enterprises (Fig. 7) we can see the most significant changes that will be made regarding the implementation of Industry 4.0 elements into production and other processes. In order to optimize all processes, in large enterprises a routine, repetitive, difficult and dangerous work will be gradually replaced by technologies. This is one of the reasons why their need for employees without vocational training, in terms of their professional activity, will decrease significantly. The reduction of jobs for professional workers, both administrative and technical workers and workmen is also expected. Only workers with vocational training are also expected to see low demand in the future. This situation is also reflected in Table no. 2 summarizing changes in the number of jobs being affected by the implementation of Industry 4.0 elements.

Table 2. Expected changes within wanted employees after the Industry 4.0 elements implementation (own processing by research results)

	fewer employees will be wanted	the same number of employees will be wanted	more employees will be wanted
Administrative and technical staff with general education	34 884	29 993	-
Administrative and technical staff with vocational training	23 863	27 846	13 168
Workmen with vocational education	60 601	92 170	61 994
Workmen (without the importance of the field of study)	116 296	94 596	3 873
Total jobs concerned	235 643	244 605	79 034

By synthesizing the collected and analyzed data on the expectations of industrial enterprises due to a change in jobs in industry in Slovak Republic within the intelligent industry implementation, a prediction has been worked out showing how many jobs may be affected. As it is apparent from Table 2, most at risk are jobs in which workers have general education or their work is not related to their field of education. This can affect almost 35 000 administrative and technical staff and more than 116 000 manual professions. The favorable prognosis is optimistic to workers' occupations with vocational training who would be able to fully utilize their expertise in the work process. These workers are most likely to keep their jobs without major problems. Administrative staff with vocational training would have to take into account that they might lose their job however the assumption points out that this may concern around 10 000 jobs.

The implementation of Industry 4.0 will certainly change the structure of jobs in industry. Great emphasis will be placed in the future on the expertise of education and the ability to learn new knowledge and skills. Changes in industry may involve 235 000 jobs for which reductions will be envisaged. Based on today's knowledge of Industry 4.0 as the next stage of the technical revolution, it can be stated that this will be the fastest implementation of any industrial revolutions we have seen so far. This phenomenon will not only affect production lines, but will change the way the company operates. Also Chandran & Rasiah (2013) agree that it will not only affect business processes, but also principally, the way how communication between employees and employers, customers and manufacturers, or service providers takes place. Avilova et al. (2017) ponder that due to the speed and complexity of changes brought by the fourth industrial revolution, it will be necessary to respond appropriately and flexibly to this challenge.

In Slovak Republic the industrial sector is dominated by automotive industry and it is about the transformation processes in this area where there will be the greatest impact on changes that will, among other things, affect the structure of jobs. Already today, industrial companies are facing a lack of labor at all. In this context, the workforce being available on labor market is no longer in a structure that meets the demands of employers in current industry (Çera, Belás & Strnad, 2019). At present, companies experience a lack of professionals, regardless of their level of education, mainly in technical fields, but mostly in full secondary and higher education. Ustaev et al. (2018) also note that to other most wanted workers in industrial sector belong the graduates of computer science education; here every second enterprise is looking for such a work power. Industrial enterprises are also largely looking for employees without an importance regarding the field of study, which points out two important facts. One is the absolute shortage of labor and the next one is the ability of companies to train workers from other departments to workers suited to the job being sought (Galli, 2020; Simionescu et al., 2019).

Industrial enterprises in Slovakia see as the greatest benefits of intelligent industry implementation especially the production processes efficiency enhancement and the improvement of information flows within the company. As a significant advantage from the implementation of Industry 4.0, companies also expect to reduce production and operating costs. Also authors such as Navickas, Vojtovic, & Svazas (2017) and Obadi & Korcek (2018) note that the lineup of Industry 4.0 in industrial enterprises will be an increasingly pressing matter on the job structure issue.

5. Conclusion

Our research has shown that companies will put emphasis on the workers´ training in order to handle the work with new technologies the best. For these workers, there is no reason to worry about finding employment in the future. Currently, this is also contributing to a situation with an acute shortage of any workforce. Based on the research results we have arrived to the conclusion that the impact on jobs will also vary depending on the size of enterprises, while small enterprises expect employment to be maintained, medium-sized and especially large enterprises would expect jobs reduction, particularly concerning the blue-collar professions. However, Industry 4.0 has been creating new jobs for several years now and people are already employed in positions that did not exist ten years ago. Generally speaking, the intelligent industry will undoubtedly bring revolutionary changes within the understanding of society, communication and jobs. Either way, it will also bring many new opportunities and it is the duty of governments and businesses to be prepared for these challenges as good as possible.

Based on the results it is proposed the expected positive changes should be transformed into higher productivity, greater flexibility, greater competitiveness, higher profitability, security and ecology. As research limitation there can be mentioned issues such as: some questioners from the survey had to be void, some answers were not relevant, statistical data varies depending on the source being used, each organization has different approach how to process data and information thus comparison may not be too accurate.

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