

TECHNOLOGICAL UNEMPLOYMENT IN THE PERSPECTIVE OF INDUSTRY 4.0 DEVELOPMENT

Aleksandra Kuzior

Abstract. The article concerns the problem of technological unemployment in the perspective of industry 4.0 development. The purpose of the article is to indicate the positive and negative effects of industry 4.0 development and to define the ways of programming education as a way to counteract the negative effects of industry 4.0 development. The author emphasizes the need for an appropriate education curriculum, aimed at acquiring both professional and engineering competences as well as humanistic, ethical and social competences at the same time. Technological unemployment is defined as a temporary, short-term phenomenon, lasting until human capital is shifted to other applications. The lack of adequate education, including lifelong learning, creates a risk of transition from technological unemployment to structural unemployment, which is much more dangerous for economic and social reasons. The article, therefore, contains an analysis of the labor market in terms of the demand for specific competences in the perspective of industry 4.0 development and forecasts of the demand for competences of the future. There is no doubt that the development of industry 4.0 requires specialized competences combining the skills of an IT specialist and an automation / robotics specialist who has skills in the field of cyber-physical systems integration, operation of advanced production management systems and complex production data analysis systems as well as the application of artificial intelligence algorithms in the production space. At the same time, however, specialists with high communication, interpersonal and social competences will be sought, hence there is a need for appropriate education curriculum.

Keywords: Industry 4.0, technological unemployment, structural unemployment, education, competences of the future

JEL Classification: J23; J24; O33

Author:

Aleksandra Kuzior

Silesian University of Technology in Gliwice, 26-28 Roosevelt Str., 41-800 Zabrze, Poland

E-mail: aleksandra.kuzior@polsl.pl

<http://orcid.org/0000-0001-9764-532>

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1. Introduction

The term "Industry 4.0" is commonly associated with the beginning of the so-called fourth industrial revolution. The term was first used at the international fair Hannover Messe in 2011. Therefore, Germany is considered a cradle of Industry 4.0 development in Europe. In April 2013, a special working group presented the federal government of Germany with a set of recommendations for implementing the industry 4.0 concept. The fourth industrial revolution is characterized by the development of intelligent factories based on cyber-physical production systems and openness to the environment. It is related to the Internet of People, the Internet of Things, the Internet of Services, and the Internet of Data. Industry 4.0 is also developing in Poland. This concept was reflected in the government's Strategy for Responsible Development until 2020 (with a perspective until 2030) (Strategy for Responsible Development), which included the strategic project of creating a national integrator responsible for transforming the Polish economy towards Industry 4.0. As a result of the actions taken, the Polish Platform of the Future was established to support the changes. The Responsible Development Strategy draws attention to the consequences of transformation, indicating that the development of Industry 4.0 will contribute to the displacement of human labor by modern technologies. However, at the same time, the demand for employees with other competences will increase in the labor market, e.g. pro-innovative, interdisciplinary, analytical and digital competences. The development of Industry 4.0 in individual countries of our globe is different. The leading countries are the USA (in the USA, the terms "Smart Manufacturing Leadership Consortium" or "Smart factory" are used for the term "Industry 4.0"), Germany, South Korea. In Poland, the mechatronization of the industry is not yet a showcase of modern times. For 10 thousand employees in Poland there are only 22 robots. Compared to Germany (292 robots per 10,000 employees) and South Korea (450 robots per 10,000 employees), Poland is far behind (Bujera, 2017).

The development of industry 4.0 in Poland is at a stage far from the global or European level. One of the main barriers are economic conditions, first of all the lack of sufficient funds for research and implementation of innovative technologies. The research "Study of the degree of automation of companies in Poland" indicates that only 6% of Polish companies introduce industry 4.0 (ASTOR, 2016). Deloitte's report "Industry 4.0 in Poland – revolution or evolution?" (2020) indicates that the leaders of Polish companies continue to use modern technologies with great caution, being afraid of destroying the proven ways of the organization's functioning, although there is now better accessibility and wide possibilities of technologies offered by Industry 4.0. In addition to limited financial resources, the leaders also point to the lack of appropriate specialists in the teams. Innovative technologies are often evaluated by company leaders as too complex, expensive and unavailable. However, entering the domain of industry 4.0, as well as services 4.0, is a necessity for Poland. The factors driving the technological transformation are primarily customer requirements, the need to increase efficiency and the pressure of competition (Deloitte, 2020). One aspect that has somehow diminished confidence in modern industrial technology is the fear that robots will take human jobs. This problem is related to the issue of technological unemployment.

Technological unemployment results from technological progress and the development of innovative technologies, which, when implemented in various industries and services, usually result in lower demand for human labor. Activities previously performed by humans are performed by highly efficient machines. Automation and robotization of industry and services undoubtedly reduce the demand for labor (Kuzior, 2017), in some sectors of the economy and in selected industries where modern technologies are increasingly needed. However, technological unemployment is defined as a temporary, short-term phenomenon. It continues until human capital is shifted to other applications. Therefore, one should not be afraid of this phenomenon, generated by the development of modern technologies. However, in order for technological unemployment not to turn into structural unemployment that is much more dangerous socially and economically, it is necessary to monitor economic and social processes, forecast the directions of labor market development and properly manage the processes of education and development, using the available tools and methods (Kuzior, 2017; Grebski & Grebski, 2019; Dzwigol et al., 2020a; 2020b; Kwilinski and Kuzior, 2019; Kwilinski et al., 2020; 2022; Miśkiewicz, R. (2019a; 2019b; Miśkiewicz and Wolniak, 2020; Tkachenko et al., 2019).

2. Literature Review

The interest in the development of Industry 4.0 is very high, both in the business world and among scientists. The SCOPUS database for the query "Industry 4.0" shows 21,271 results (search by titles, abstracts and keywords as of 01/09/2021) and has been growing very significantly in recent years (see Figure 1, presenting the last 10 full years).

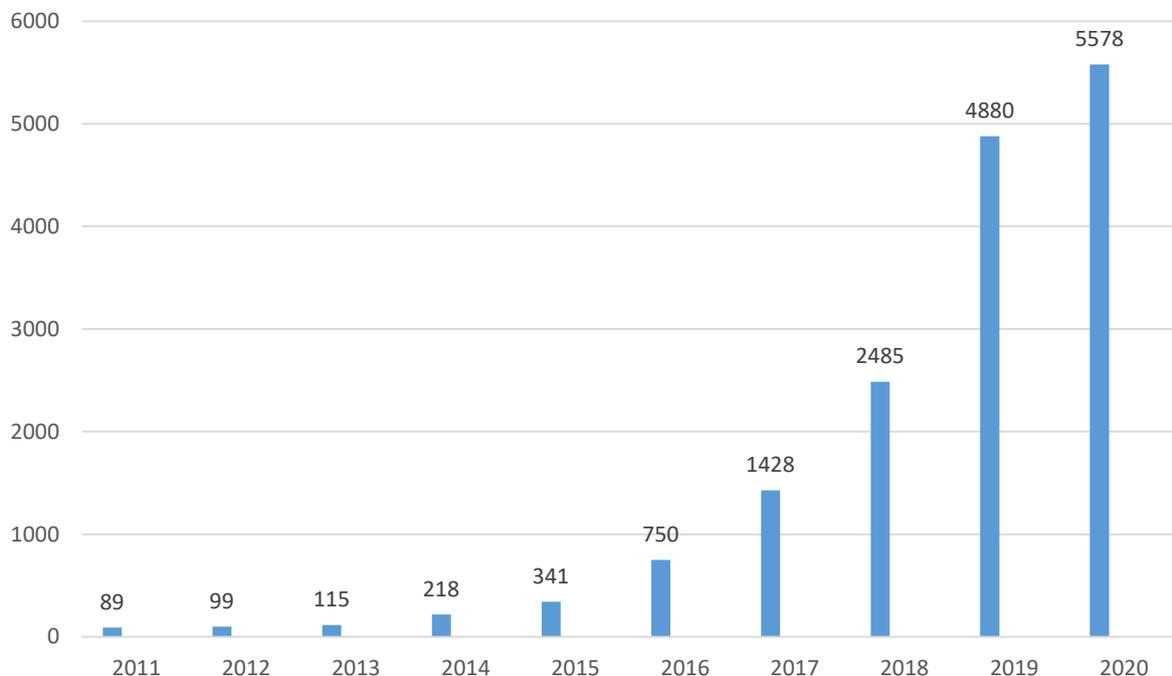


Figure 1. Publications on Industry 4.0 according to Scopus database (access: 1.09.2021)

Source: developed by the author.

The number of records generated by the system for the query "Industry 4.0" on 01/09/2021 was 3920 (data for 8 months of 2021). The analysis was performed on the first 500 results generated by the system. The analysis showed that majority of the articles are directly related to Industry 4.0, albeit to a different extent. Some refer to the fourth industrial revolution (e.g., Ariffin & Ahmad, Ali, 2021; 2021; Gu et al., 2021; Xiong, 2021; Bigerna et al., 2021; Balog & Demidova, 2021), and, thus, indirectly to Industry 4.0 as well. However, 76 of the 500 articles generated were not related to Industry 4.0 at all. Despite the inaccuracy of just over 15% of the search results, the analysis carried out in this way indicates a large scale of interest in this subject (Kuzior, 2021a). The problem of unemployment in general is even more popular in scientific studies, but the problem of technological unemployment is rather rarely discussed. From the Scopus database, the system generated only 1098 results. However, for the query "Industry 4.0 AND technological AND unemployment" there are only 24 results, and two articles do not refer directly to the issue discussed. Thus, there is relatively little indexed in the analyzed database of studies on technological unemployment in the context of the development of Industry 4.0. Thus, this article fills the research gap in this area.

The analyzed papers on technological unemployment describe and evaluate this phenomenon from various perspectives. L. Novakova (2020) analyzes how technological progress in production processes can affect the shape of the labor market in Slovakia. A.R. Ahmad, P.A.P. Segaran and H.R.M. Sapry (2020) draw attention to the need in adapting education to the requirements of the changing labor market to overcome the problem of unemployment in Malaysia. Popkova and Zmiyak (2019) and V. Filatov et al. (2020) analyze this problem in the Russian Federation. The high technological unemployment related to the development of robotization and various applications of artificial intelligence is pointed out by N. V. Putilo et al. (2020). G. Szabó-Szentgróti, B. Végvári and J. Varga (2021) analyze the problem of technological unemployment due to the development of Industry 4.0 in relation to the theory of M. Keynes. They indicate that changes in the labor market create problems with the stability of employment. And undoubtedly, the development of Industry 4.0 will reduce the amount of labor needed. The authors suggest that this will bring us closer to the Keynesian vision of limiting the demand for labor to 3 hours a day. They indicate that the scale of technological unemployment is determined by the digitization strategy of a given country as well as the readiness of the education system to retrain certain groups of employees, adjusting their qualifications to the needs of the labor market. On the basis of the available reports of consulting companies, K. Koput (2020) analyzes the Polish labor market, indicating that in the 10-year perspective, unemployment will increase to 40% as a result of the development of solutions based on artificial intelligence and robotization. In order to meet the future demand for specialists, it is necessary to properly prepare staff to supply the labor market. The problem of education in connection with changes in the labor market caused by the development of modern technologies was also analyzed earlier, not only from the perspective of technological unemployment, but also the development of society 4.0 (Kuzior, 2017).

3. Methods

In the preparation of the article, an analysis of the literature on the subject of technological unemployment in the context of the industry 4.0 development was used. The articles indexed in the Scopus database were mainly analysed. Given the topic discussed, it was also necessary to use the databases of official statistics. Therefore, the desk research method was applied, which consists in recording and analysing the available data sources, including in particular their compilation, verification and processing. The data was analysed using the method of time series analysis, i.e., a sequence of observations of a certain phenomenon in the adopted time units. Time series are the basis for the analysis of the dynamics of the phenomena observed, measured and analysed. Additionally, a pilot diagnostic survey was conducted among students of management and sociology at one of the Silesian universities (Poland). Quantitative research allowed determining the students' attitude to the development of modern technologies and related risks, including technological unemployment. The research conducted in June 2020 on a pilot sample of 120 students allowed for the verification of the research hypothesis (H1 - the young generation feels the risk of technological unemployment as a negative phenomenon generated by the development of modern technologies used in Industry 4.0). Additionally, in-depth interviews were conducted with four people suffering from technological unemployment, none of them was classified as long-term unemployed, meaning the one whose unemployment period exceeds 12 months. The interviews allowed for the verification of the hypothesis (H2 - people affected by technological unemployment negatively evaluate the phenomenon of accelerated technological development, believing that robots take people's jobs, which leads to negative psychological effects). Triangulation of methods and techniques was used in the research.

4. Results and Discussion

In the 1990s, J. Rifkin in his book "The end of work: the decline of the global labor force and the dawn of the postmarket era" (Rifkin, 1995) presented the next stages of technology expansion into the spheres of human functioning and predicted a gradual elimination of mass employment for automation and robotization. He also indicated the need to prepare for these changes.

The aforementioned J.M. Keynes, in his considerations covered by the Economic "Possibilities for Our Grandchildren" (1930), indicated that in 100 years a person would only work three hours a day while maintaining an adequate standard of living and satisfaction, which was opposed to the generally prevailing opinion of pessimists at that time about progressive inevitable recession. He pointed out that the main reason for the pessimistic attitude is the too fast pace of changes, anomalies related to the progressive unemployment in a world full of needs and short-sightedness that does not allow looking into the future and forecasting this future. Keynes avoided these mistakes by envisioning further technological improvements and capital accumulation. He argued that the speed of change that occurred in the eighteenth and nineteenth centuries, after a long period of relatively slow development, allowed for optimistic forecasts for the future with regard to capital accumulation and pace of development, improvement of the efficiency of industrial production and food production, all by means of merely a quarter of the human effort so far, human work. At that time, he was

already writing about technological unemployment as a temporary phenomenon in the perspective of solving economic problems as the basic ones with which humanity is struggling more or less cyclically. Over the centuries, solving economic problems has been the primary goal of mankind. Without this goal, the humanity may not be able to cultivate the art of living in and of itself. A person will have to work to be happy, but three hours a day (15 hours a week) is enough to keep a person happy. When capital accumulation is no longer essential, there will also be changes in humanity's moral code and many pseudo-moral principles that have placed negative qualities on a pedestal of virtues. People will have a chance to estimate the value of money in terms of its true value in an art of living based on economic justice (Keynes, 1930). However, it is not the purpose of this article to thoroughly analyze Keynes' vision of the future in a clash with the current economic, social and moral reality, but only to refer to the issue of technological acceleration and technological unemployment. The perspective of caring for human moral perfection is material for other considerations. In any case, according to Keynes, technological unemployment is a transitional phase that should not cause concern, and technological development will help a person with less involvement in work to enjoy life (cultivate the art of living), resigning from the desire to accumulate one's own capital in favor of engaging in other people's affairs.

However, people who suffer from technological unemployment view it negatively. From a psychological point of view, the lack of acceptance of this phenomenon is justified. To confirm the hypothesis (H2), qualitative research was carried out – in-depth interviews with four people who, as a result of technological changes in workplaces, had been affected by technological unemployment and were not yet retrained to do another job. These people approach technological development with distrust and a lot of negative emotions. They blame employers who have not prepared them for the changes to come. They are not motivated to receive education and gain new qualifications, and they do not want to work on basic cleaning activities, although in this service industry, automation and robotization more and more often require having appropriate skills, and sometimes also specialist qualifications.

Quantitative research conducted on a pilot sample of 120 students allowed for the verification of the research hypothesis (H1), however, the results of the research did not confirm the hypothesis. On the contrary, the analysis of the results showed that the young generation (respondents aged 20-25) does not feel the risk of technological unemployment as a negative phenomenon generated by the development of modern technologies used in Industry 4.0 (see Figures 2, 3, 4).

There were no significant statistical differences between the responses of men and women in this survey. Although the young generation (respondents aged 20-25) does not feel the risks associated with the development of Industry 4.0 in the context of technological unemployment, there is no doubt that it may be a phenomenon generated by the development of technology and modern technologies. However, it should be noted that not the technology itself is the cause of technological unemployment, but the whole complex of phenomena, situations, activities, objects and people (scientists, businessmen, politicians) guided by various interests (Afeltowicz, 2007). Hence the need for a proper humanistic, ethical

education of engineers (Kuzior et al., 2019a), which seems to be the first link (subject) of creating technological innovations and ethical education of all political, economic and social actors who have a significant impact on the directions of development.

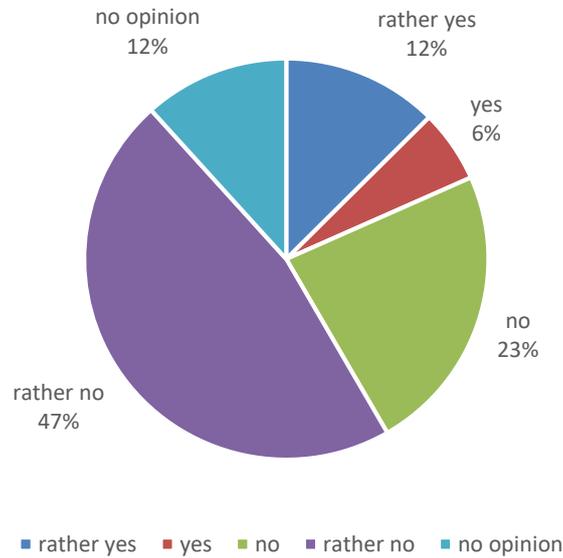


Figure 2. Responses to the survey question: Do you think that intelligent robots will "take" human jobs?

Source: developed by the author.

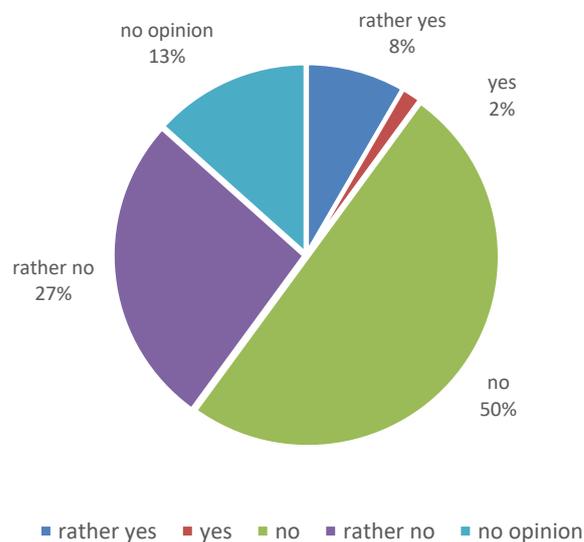


Figure 3. Responses to the survey question: Do you think that the development of Industry 4.0 generates technological unemployment?

Source: developed by the author.

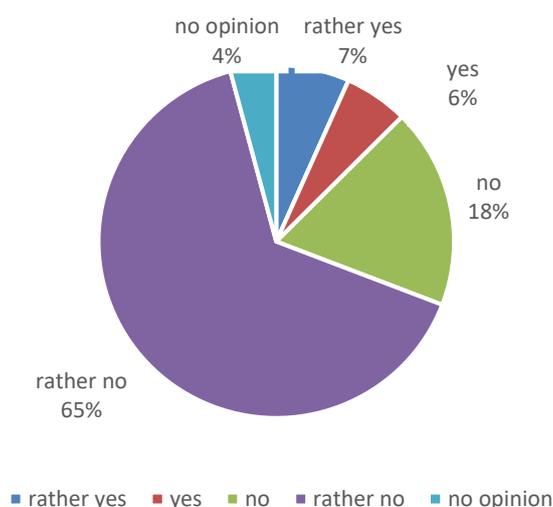


Figure 4. Responses to the survey question: Are you concerned that you may face technological unemployment in the future?

Source: developed by the author.

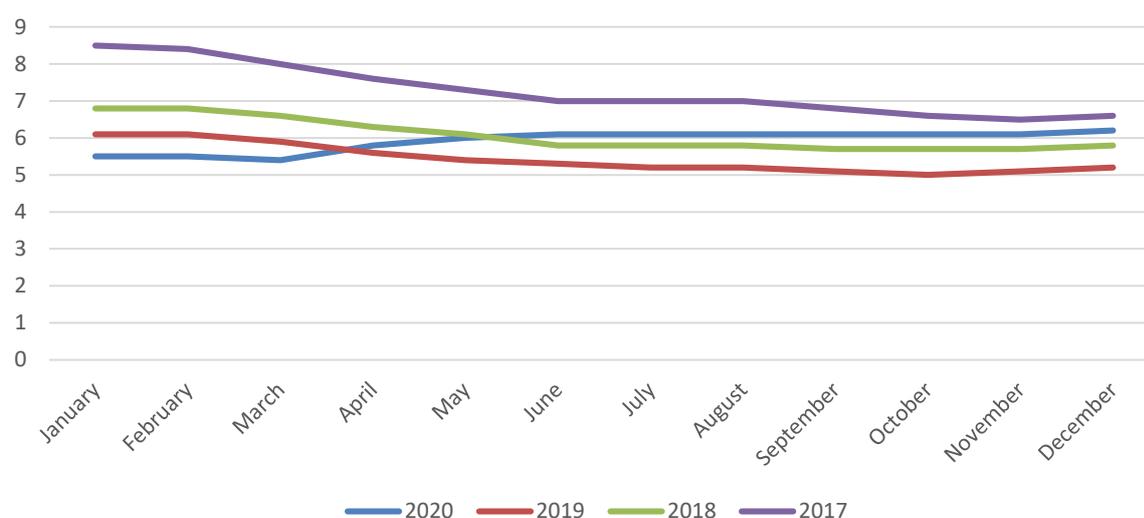
The development of science and technology should be programmed in such a way as to bring tangible benefits for man and society (Kuzior, 2021a). In other words, innovations, as an instrumental value, should serve people in shaping better living, work and rest conditions, and serve to protect the natural environment. However, the development of innovation is not a clearly positive process, the end result may also have negative effects (Kuzior, 2014; Kuzior, 2021b). It is also not the same in every country (Grebski, 2021a; Grebski, 2021b, Shvindina, 2017), which causes inequalities, both in the economic and social dimensions.

The social effects of unemployment in general, including technological unemployment, can be very severe. The statistical data of the Central Statistical Office in Poland are, however, optimistic. At the end of December 2020, the unemployment rate in Poland was 6.2%, and the average annual rate was 5.91%, i.e., only slightly above the acceptable frictional unemployment rate (3%-5%) regulating labor market relations. Compared to 2019, the unemployment rate in 2020 increased by 0.48% (see Table 1), which is not a worrying result considering the conditions related to the spread of the Covid-19 pandemic. In January and February 2021, an unemployment rate of 6.5% was recorded, which, compared to the results from December 2020, shows an increase of only 0.3%, and the upward trend compared to January and February 2020 is 1%. This is an acceptable level and does not indicate a drastic change related to the Covid-19 coronavirus pandemic. In the Polish economy in the previous years, there were greater fluctuations and disturbing indicators, e.g. at the end of December 2002 the unemployment rate was as high as 20%, in the corresponding period of 2003 also 20%, and in 2004 19% (all data from the Central Statistical Office refer to registered unemployment).

Table 1. Unemployment rate (%) in Poland according to Central Statistical Office data

Year/ month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
2021	6.5	6.5	6.4	6.3	6.1	6.0	5.9	5.8	-	-	-	-	-
2020	5.5	5.5	5.4	5.8	6.0	6.1	6.1	6.1	6.1	6.1	6.1	6.2	5.91
2019	6.1	6.1	5.9	5.6	5.4	5.3	5.2	5.2	5.1	5.0	5.1	5.2	5.43
2018	6.8	6.8	6.6	6.3	6.1	5.8	5.8	5.8	5.7	5.7	5.7	5.8	6.08
2017	8.5	8.4	8.0	7.6	7.3	7.0	7.0	7.0	6.8	6.6	6.5	6.6	7.28

Source: Developed by the author on the basis of the Central Statistical Office data

**Figure 5.** Unemployment rate in the years 2017-2020.

Source: Developed by the author on the basis of the Central Statistical Office data

Analyzing the dynamics of the increase or decrease of the unemployment rate in specific time series and extrapolating the presented results, it can be concluded that the forecasts of unemployment increase in 2030 to the level of 40% (Koput, 2020) are rather excessive and strongly pessimistic. The Covid-19 pandemic also did not significantly increase the unemployment rate (the analysis concerned only registered unemployment), although it significantly changed work processes (Kuzior et al., 2022). Statistics directly related to technological unemployment are not kept by the Central Statistical Office, but in the Astor Whitepaper report (2016) entitled "The Study of the Degree of Automation of Companies in Poland" indicated that 76% of companies are partially automated, 15% are fully automated, and only 6% introduce Industry 4.0. The report "Readiness of manufacturing companies to implement Industry 4.0 solutions", prepared at the request of PSI Polska by the PMR company in 2019, clearly shows the increased interest of enterprises in the technological solutions of Industry 4.0. Of the 228 large and medium-sized companies surveyed, 52% know the assumptions related to the development of Industry 4.0 and as many as 70% of this group are planning or have already implemented Industry 4.0 solutions. Large companies are leaders in implementing these solutions, which seems to be understandable due to the costs that must be incurred to implement these solutions. A report published by the analytical company

Markets and Markets (MaM) in 2020 informs that the global market for Industry 4.0 solutions worth \$ 71.7 billion in 2019 will grow to \$ 156.6 billion in 2024, with an average annual growth in 2019-2024 of 16.9%. Surveys conducted by the *Inżynieria i Utrzymanie Ruchu* magazine (2020) show that 23% of companies in Poland have adopted a strategy for the implementation of the industry 4.0 concept, and in 31% of companies, the strategy is being developed. In 2020, 46% of companies did not have such a strategy yet. Thus, more than half of the companies in Poland (54%) are seriously considering or have already introduced Industry 4.0 solutions. (Kuzior, 2021a). The previously mentioned Deloitte report "Industry 4.0 in Poland – revolution or evolution?" (2020) indicates, however, that the leaders of Polish companies still use modern technologies offered by Industry 4.0 with great caution.

As shown by the Central Statistical Office research cited, the automation and robotization related to the development of Industry 4.0 did not translate into an increase in the unemployment rate, although Polish companies already use various technologies related to the Industry 4.0 concept (data for 2020, see Figure 6): devices intelligent (sensors) (65%), use of robots, including cooperating (58%), predictive maintenance (43%), mobile devices (notebooks, tablets, smartphones) (42%), use of Internet of Things technology - IoT and Industrial Internet of Things - IIoT (29%), cloud computing (28%), augmented reality - AR (15%), digital twins and production digitization (14%), Big Data (14%).

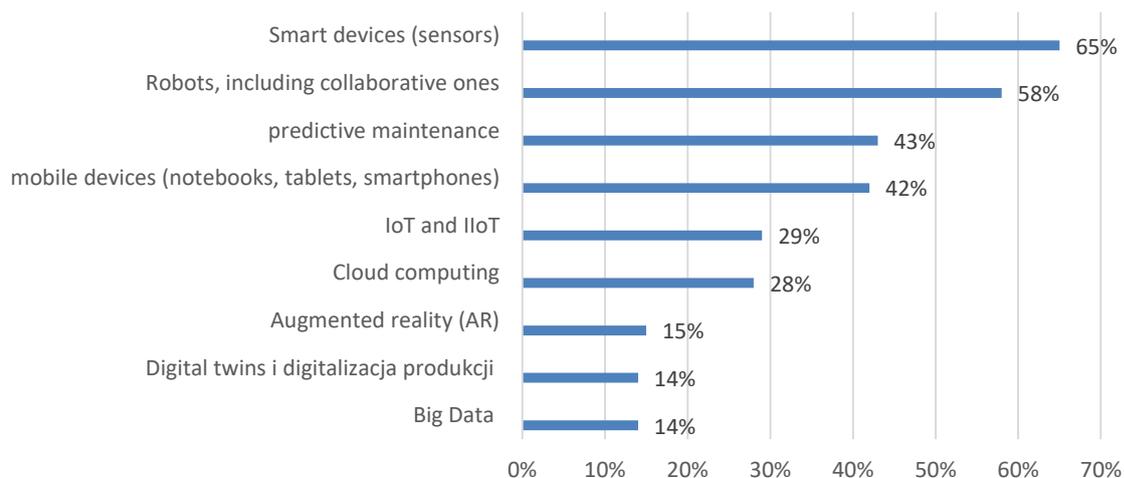


Figure 6. The use of Industry 4.0 technology in Polish companies

Source: devised on the basis of a survey by the magazine *Inżynieria i Utrzymanie Ruchu* (2020).

The cited research results show that in 2016 there was no threat in Poland related to the increase in technological unemployment rates generated by the development of Industry 4.0. However, the following years brought such a large increase of interest in implementing innovative Industry 4.0 solutions that the threat of technological unemployment may become real. Perhaps, however, the tendency will be the opposite (current data from the Central Statistical Office of Poland authorize such a statement), as in Germany, the cradle of European Industry 4.0. As the research shows, the increase in industrial automation under the German Industry 4.0 program even translated into a reduction in unemployment (Astor, 2016),

although in this case it is difficult to talk about direct cause and effect relationships, as a number of other factors influence this type of processes (Kuzior, 2017). In the context of Industry 4.0 development, ethical problems and dilemmas are also discussed (Fobel & Kuzior, 2019). Pessimists bluntly claim that robots and artificial intelligence will take people's jobs. This trend will increase with the development of specialized tools. Scientists from Oxford predict that 50% of current jobs will disappear by 2050 as a result of the "invasion" of robots. On the other hand, there are estimates according to which robotics will create 3 million new jobs worldwide only in the next 5 years" (Wierzyński, 2016). The report "Will the robot take your job? Sectoral analysis of computerization and robotization of European labor markets", prepared in 2014 by the Warsaw Institute of Economic Studies (WISE), indicated that Poland is one of the countries most susceptible to automation. Therefore, it can be expected that in the next 20 years, 36.1% of occupations in Poland may be threatened with technological unemployment. It will primarily affect workers in the food processing industry, administrative workers, monetary workers, miners, cooks, drivers, office and house cleaners (Mejssner, 2015). However, ManpowerGroup's report "Skills Revolution 4.0. Do robots need people?" from 2019 indicates that 87% of employers in Poland intend to increase or maintain employment as a result of automation. Companies invest in innovative information technologies by delegating tasks to machines, but at the same time put emphasis on improving qualifications and acquiring new skills by their employees so that they can perform tasks complementary to those carried out by robots. Generally, not only in Poland, but also globally, the demand for engineers, managers and employees for direct customer service will increase. Employers will require soft skills such as communication skills, negotiation skills, leadership, and adaptability. Staff reductions can occur in the administration and office sectors. As the desk research shows, there are no clear answers to the bothering questions related to the development of Industry 4.0, but undoubtedly these changes need to be properly prepared, because the demand for new engineering specialties will increase, such as: robot coordinator, simulation expert and optimization, service engineer using digital technologies, specialist in designing IT systems and data processing, specialist in modeling and interpretation of production data with "soft skills", including the ability to work in a team (also virtual), interpersonal skills, in particular the ability to communicate effectively (Astor Whitepaper, 2017). In the report "Professional Competences of the Future 2020", prepared by the Institute for the Future, competences of the future were mentioned, such as: discovering meaning and giving meaning, social intelligence, unconventional and adaptive thinking, intercultural competences, computational thinking, skills in using new media, transdisciplinarity, design thinking, cognitive load management, virtual collaboration. The complement should also include such competences as: broad contextuality, self-reflection, emotional intelligence, environmental friendliness, variability, equality competences, learning ability (Sobotka, 2020). The team of researchers from the Infuture Hatalaska Foresight Institute forecasts that the demand for contractors of such professions as: ABA therapist, visual designer, machine learning engineer, food clerk, associate scientist, Ruby on Rails developer, scientist, RF engineer, regulatory affairs manager, data scientist will increase. The study also identifies potential professions of the future: meaning of life consultant (advising clients on setting personal goals, diagnosing competences, discovering passions), robot consultant (advice on purchasing a robot that best suits the needs of a given person), robot therapist

(teaching robots human emotions). Key competences are still important, although in the face of the practically unlimited development of modern technologies, which can generate both positive and negative effects, the most important are ethical competences defined as honesty and responsibility in all aspects of human activity, following the principles of good, focus on subsidiarity, solidarity, respect for oneself and others, respect for basic human rights, tolerance and respect for people and the natural environment (Kuzior, 2014).

These competences determine the right interpersonal relations, and perhaps also in the future, relations with robots (robot ethics), as well as the appropriate – prudent – approach of engineers to creating technological innovations and knowledge management (Grebski & Grebski, 2018; Kuzior & Zozul'ak, 2019; Kuzior & Kuzior, 2020; Kuzior & Czajkowski, 2021).

An engineer of the future, the so-called Engineer 4.0, as defined by the Astor Whitepaper team, should be a professional in his field and a humanist at the same time, because he designs systems for individual people and human communities (Astor Whitepaper, 2017).

Industry 4.0 tools create a new type of organization, highly flexible, intelligent, capable of self-optimization, constantly monitoring its own needs and the organizational environment, skillfully communicated with various entities. Such an organization requires qualified staff with technical and humanistic competences, openness and flexibility. Appropriate programming of training to prepare staff to support Industry 4.0 may minimize the negative impact that may manifest itself in the future in the form of technological unemployment (Kuzior, 2017; Ulewicz & Sethanan, 2019).

5. Conclusions

The presented issues of technological unemployment, the needs of the changing labor market in the perspective of the development of Industry 4.0 and the demand for new competences needed to operate modern technologies allow for a rather optimistic look into the future. Nevertheless, it is necessary to properly prepare for these changes by programming the education processes in such a way as to equip the next generations entering the labor market with the competences needed to operate innovative technologies. In terms of handling Industry 4.0, lifelong learning will also be important, allowing for continuous improvement of competences and gaining new qualifications needed in the changing labor market. Engineering education should include a combination of vocational (engineering) education with education focused on humanistic and ethical values. Along with the implementation of technological innovations, social innovations should be implemented, which, on the one hand, could eliminate technological exclusion, preparing modern people to skillfully use available technical solutions, and, on the other hand, prepare them for the selective and critical use of Internet resources and artificial intelligence solutions. In conclusion, however, it must be stated that the mechanization and mechatronization of the economy, although it gives rise to many discussions about the dangerous social effects, technological unemployment, technological exclusion and, consequently, also social exclusion, should not be viewed only from the perspective of negative consequences. It brings many positive solutions that, when

properly applied and targeted, can contribute to the improvement of the quality of life of a person and entire societies. The basic condition, however, is that artificial intelligence is equipped with ethical values and that humans have appropriate technological competences to operate and use solutions based on artificial intelligence algorithms. In this regard, the European Union has already taken some steps with the creation of a "White Paper on Artificial Intelligence" which sets out a European approach to AI excellence and trust. To be able to speak of a trustworthy artificial intelligence, the following principles must be followed: the guiding and supervisory role of a man; stability and security; privacy and data protection; clarity; diversity, non-discrimination and justice; social and environmental well-being; responsibility (White Paper, 2020). Only then the application of intelligent robots in various spheres of professional and personal life can be focused on. Robots can help people out of their work in difficult conditions and optimize production processes. The principle of optimization and visions for the development of the factories of the future, however, still cause concern. Optimization is one of the determinants of the activity of a "sustainable company", which in its activities is guided by the principles of responsibility, prudence, prevention, prevention and optimization. However, one should remember to keep the balance between the established principles of a "sustainable enterprise" functioning, not focusing only on optimization.

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