Knowledge and Skills of Industrial Employees and Managerial Staff for the Industry 4.0 Implementation

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Abstract

The development of the Industry 4.0 concept offers completely new technologies' enablers using high level of automation and digitalization. There is a huge challenge for enterprises not only due to the application of modern technologies (such as Internet of Things, Big Data Analytics, Cloud Computing, etc.) related to the creation of Cyber-Physical Systems but also for a human resources development. Scientists and practitioners pay a lot of attention to technological changes in enterprises, but relatively little research is conducted on the issue of human resources development. The problem becomes more interesting in light of the Industry 4.0 era which resulted in changes in the employment structure, requirements for future industrial employees and managerial staff and also to the approach to the education process. The changing demand for skills is a quite well-researched topic in economics and management, but the changing skill demand for the Industry 4.0 is just the newest case of a quite old debate. The case of Industry 4.0 seems to be a particular case for the general change in skill demand due to digitalization. The main aim of the paper is to indicate the key areas of required knowledge and skills of employees essential to implement the Industry 4.0 concept. They are identified on the basis of a critical literature analysis and the conducted survey of selected industrial enterprises. The results of this research are particularly important for adapting the employee training system and the education process for students.

Keywords Industry 4.0 · Knowledge and skills · Human resources · Managerial skills, industrial employees

1 Introduction

The Industry 4.0 concept is a huge challenge for enterprises not only due to the application of modern technologies (such as Internet of Things, Big Data Analytics, Cloud Computing, etc.) related to the creation of Cyber-Physical Systems, but also for a human resource development. The changes in a production organization and an employment structure are observed as a result of this concept implementation and may even lead to use new forms of knowledge and skills [1, 2]. New theoretical knowledge and practical skills of industrial employees and managerial staff are expected [3–7]. Economic problems such as the demand for labor or the role of man in an intelligent factory are also arisen [8].

The development of the Industry 4.0 concept offers completely new technologies' enablers using high level of automation and digitalization. Their implementation leads to gain a much greater flexibility of production processes, equipped with intelligent devices, machines, means of transport, which communicate with each other in real time using the Internet [9, 10]. This means that it is possible to meet the expectations of the consumer without degrading the profitability of the production process by the dynamic adaptation of the autonomous modules of the entire process of preparation, manufacturing and delivery of the product to the consumer [11]. One of the significant assumptions of the transformation within the Industry 4.0 is the application of the Cyber-Physical Systems (CPS) extensively using the Product Life Cycle Management to the creation of a new product concept, virtual documentation, printing models in 3D technology, their simulation, laboratory and industrial research, decision

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about production, manufacturing a product in a virtual production environment, check its correctness, transition from a virtual production environment to the real environment, develop computer-aided production and assembly documentation, warehouse and transport logistics, ensuring maintenance of proper operation, delivery of the product to the customer as well as its service and ultimately recycling [12]. The need to develop new legal standards at least within the European Union area such as patents, utility models, license agreements, etc. is underlined [12]. The solution to the cyber-security problem in the case of data network transmission is strongly highlighted. However, technologies, resources, organizational structure and organizational culture are also very important [13].

The Industry 4.0 concept is an effect of a changing paradigm of customized production, tailored to the needs, personal preferences, tastes and lifestyle of individual customers [14]. Financial and knowledge constraints are a key challenge for the implementation of the Industry 4.0 concept [15]. The changing demand for skills is a quite well-researched topic in economics and management, but the changing skill demand for the Industry 4.0 is just the newest case of a quite old debate. The case of Industry 4.0 seems to be a particular case for the general change in skill demand due to digitalization. Hence, there is a need to conduct research in the field of changes in the demand for qualifications, knowledge and skills of employees in the conditions of the Industry 4.0 concept implementation. This is particularly important for adapting the employee training system and the education process for students. The delivery of new technologies related to the Industry 4.0 concept can help to support human resources and may have a negative effect [14, 16–23]. One of the main fears of experts is a lack of the qualified workers [24].

In the conditions of the debate on the Industry 4.0 concept implementation that has been going on for years, questions arise: What knowledge and skills are needed by employees in the Industry 4.0 environment? How to educate and prepare employees to implement the Industry 4.0 concept? What skills of employees will allow new technologies of the Industry 4.0 to be successfully implemented? Therefore, the main aim of the paper is to indicate the key areas of required knowledge and skills of employees essential to implement the Industry 4.0 concept. They are identified on the basis of a critical literature analysis and the conducted survey of selected industrial enterprises. The results of this research are particularly important for adapting the employee training system and the education process for students. The novelty in relation to the research presented in other articles is that the research concerned a set of enterprises implementing the concept of industry 4.0. The surveyed companies indicated the need for specific competences of employees and managers that facilitate the implementation of the Industry 4.0 concept and the functioning of smart factories in the future. The article completes the research

gap in the areas of knowledge and competences of employees, which should be developed by the education system at each level of education and the employee training system.

2 Literature review and background of research

2.1 Article selection

The present study uses a systematic literature review approach. An initial search of articles was conducted on Web of Science (WoS) and Scopus databases between 2011 (when the Industry 4.0 concept was created) and 2019. The following combination of keywords was used for searching relevant papers: a) "knowledge and skills" AND "Industry 4.0"; b) "human resources" AND "Industry 4.0".

22 articles were found in the Web of Science (WoS) database containing the keywords "knowledge and skills" AND "Industry 4.0" included 7 journal papers while 25 articles were found in the Scopus included 8 journal papers. They were published from 2016 and 2019.

51 articles were found in the Web of Science (WoS) database containing the keywords "human resources" AND "Industry 4.0" included 19 journal papers while 139 articles were found in the Scopus database included 47 journal papers. They were published from 2014 and 2019.

This initial search provided in total 73 papers in the WoS and 164 in the Scopus databases. 20 articles were selected for analysis using the criterion of the 5 most cited journals and conference articles in each of the two categories separately at the WoS and Scopus database. The number of citations was checked on October 16, 2020. The results of the selection of articles are presented in Table 1.

2.2 Knowledge and skills of industrial employees and managerial staff indispensable to implement of the industry 4.0 concept

The implementation of the Industry 4.0 concept is possible mainly due to ubiquitous digitization, the development of the Internet, virtual reality and the ability to collect and process huge amount of data in real time. As a result, digitally supported manufacturing technologies, Data Mining, Big Data Analytics and ICT telecommunications are today created. It means a change in the way of production control, including dynamic changeover of machines initiated by information transferred in the manufactured product or its components. There are great organizational and also technological and strategic challenges. This concept requires broadband communication, including at the level of individual device sensors, biosensors and actuators in real time and in extensive network environments [11, 25]. The advantage of these

Table 1 List of the articles selected for a literature analysis

No	Authors	Title and bibliographic data of selected articles	Cit.
		"knowledge and skills" AND "Industry 4.0" WoS	
1	Posselt G, Boehme S, et al.	2016. Intelligent learning management by means of multi-sensory feedback. 6th CIRP Conference on Learning Factories, Norway, JUN 29–30, 2016, Procedia CIRP 54:77–82.	9
2	Bueth L, Blume S, et al.	2018. Training concept for and with digitalization in learning factories: An energy efficiency training case. Procedia Manufacturing 23:171–176.	6
3	Gonzalez I, Calderon A J	2018. Development of Final Projects in Engineering Degrees around an Industry 4.0-Oriented Flexible Manufacturing System: Preliminary Outcomes and Some Initial Considerations. Education Sciences 8(4):214.	5
4	Ghislieri C, Molino M, et al.	2018. Work and Organizational Psychology Looks at the Fourth Industrial Revolution: How to Support Workers and Organizations? Frontiers in Psychology 9:2365.	5
5	Graczyk-Kucharska M, Szafrański M, et al.	2018. Model of Competency Management in the Network of Production Enterprises in Industry 4.0-Assumptions. Advances in Manufacturing, Lecture Notes in Mechanical Engineering 195–204.	3
		"knowledge and skills" AND "Industry 4.0" Scopus	
6	Roy R, Stark R, et al.	2016. Continuous maintenance and the future - Foundations and technological challenges. CIRP Annals - Manufacturing Technology 65(2):667–688.	114
7	Sackey SM, Bester A	2016. Industrial engineering curriculum in industry 4.0 in a South African context. South African Journal of Industrial Engineering 27(4):101–114.	37
8	Ras E, Wild F, et al.	2017. Bridging the Skills Gap of Workers in Industry 4.0 by Human Performance Augmentation Tools - Challenges and Roadmap. ACM International Conference Proceeding Series Part F128530:428–432.	26
9	Bueth L, Blume S, et al.	2018. Training concept for and with digitalization in learning factories: An energy efficiency training case. Procedia Manufacturing 23:171–176.	12
10	Perez-Perez M.P., Gornez E, et al.	2018. Delphi prospection on additive manufacturing in 2030: Implications for education and employment in Spain. Materials 11(9):1500.	11
		"human resources" AND "Industry 4.0" WoS	
11	Benesova A, Tupa J	2017. Requirements for Education and Qualification of People in Industry 4.0. Procedia Manufacturing 11:2195–2202.	66
12	Schneider P	2018. Managerial challenges of Industry 4.0: an empirically backed research agenda for a nascent field. Review of Managerial Science 12(3):803–848.	30
13	Kazancoglu Y, Ozkan-Ozen YD	2018. Analyzing Workforce 4.0 in the Fourth Industrial Revolution and proposing a road map from operations management perspective with fuzzy DEMATEL. Journal of Enterprise Information Management 31(6):891–907.	19
14	Sangil P, Jun-Ho H	2018. Effect of Cooperation on Manufacturing IT Project Development and Test Bed for Successful Industry 4.0 Project: Safety Management for Security. Processes 6(7):88.	15
15	Mohelska H, Sokolova M	2018. Management Approaches for Industry 4.0 - the Organizational Culture Perspective. Technological and Economic Development of Economy 24(6):2225–2240.	11
		"human resources" AND "Industry 4.0" Scopus	
16	Hecklau F, Galeitzke M, et al.	2016. Holistic Approach for Human Resource Management in Industry 4.0. Procedia CIRP 54:1–6.	153
17	Benesova A, Tupa J	2017. Requirements for Education and Qualification of People in Industry 4.0. Procedia Manufacturing 11:2195–2202.	100
18	Shamim S, Cang S, et al.	2016. Management approaches for Industry 4.0: A human resource management perspective. IEEE Congress on Evolutionary Computation CEC, 7748365:5309–5316.	61
19	Schneider P	2018. Managerial challenges of Industry 4.0: an empirically backed research agenda for a nascent field. Review of Managerial Science 12(3):803–848.	43
20	Sivathanu B, Pillai R	2018. Smart HR 4.0 - how industry 4.0 is disrupting HR. Human Resource Management International Digest 26(4):7–11.	33

solutions is that data is available immediately, but also that the intervention protocol can be prepared in advance and the available information reduces the length of the decision-making process and forced downtime [26]. Besides, a quick response to customer demand is much more easy [27]. The literature analysis indicated that the implementation of the Industry 4.0 concept is especially important in the automotive and electronics industries to achieve a competitive advantage in the market, but the ripple effect is clearly observed across all sectors in industry [26].

The level of applied manufacturing technologies (intelligent machines and devices, autonomous means of transport, etc.) requires a highly qualified staff employed, the ability to knowledge transfer, teamwork and openness for changes. The importance of lifelong learning increases. Manufacturing companies need to promote the climate of innovation and learning and to change the learning culture, which means a change in values and expectations [7, 28]. They should build the learning management system and procedures to evaluate and control a learning progress and knowledge transfer results

[29, 30]. The exchange of knowledge and skills within the network of enterprises can be also a crucial for their quickly updating [31]. The Industry 4.0 technologies will automate many processes in enterprises, what allows more efficient and leaner work teams to be built but still requires a completely new approach to talent development staff [32].

Ahrens and Spottl point out that employees need a specific knowledge and a new skill paradigm [33], because the number of workspaces with high level of complexity increases significantly [34]. The demand for new skills results from: 1) a growing need for comprehensive integration and information transparency; 2) increasing automation of production systems, 3) self-management and decision-making by objects, 4) digital communication, 5) interactive management functions, 6) staff flexibilization [33].

In the last years one of the most important challenge for future human resources development is digitalization. The Internet of Things and Cloud Computing play a major role within the Industry 4.0 context [35–37]. The digitalization is the most promising enabler for increasing the overall performance of production systems [35, 36]. The digitalization should increase effectiveness of operative management, the efficiency of manufacturing and supporting processes [38]. Such effects can achieve by reducing operational costs for manual data acquisition, their recurring analysis and evaluation [2]. The quickly advancing digitalization requires using a training as an object and should consist of three basic modules including a theory and application part: 1) technological basics; 2) systematical approaches; 3) digitalization, which introduces Industry 4.0 hardware and software step by step. The biggest mistake of teaching digitalization is that employees only learn how to operate the software interface, but they do not acquire competencies of method-based acting and the ability to assess the effectiveness and accuracy of the applied measurement and analytical activities. Changes in boundary conditions can lead to the uselessness of this knowledge [2].

Nowadays educators and policy makers play a key role in preventing competence obsolescence. They are responsible for the continuous updating and development of knowledge and skills required by the current and future labor market [39]. Gonzalez I. and Calderon A. J. underline a need of learning students as well as teachers. They propose to develop final projects in engineering degrees as a form of learning containing the following main scope of knowledge and skills: advanced automation, supervision, robotics and industrial network communications included system integration, sensors, actuators, etc. [40].

Many researchers highlight the role of employees' knowledge on IT and production technologies, awareness of IT security and data protection in the Industry 4.0 environment [41–43]. The significant IT job profiles are as follow: Informatics Specialist, PLC Programmer, Robot Programmer, Software Engineer, Data Analyst, Cyber Security while production job profiles include:

Electronics Technician, Automation Technician, Production Technician and Manufacturing Engineer [42]. The curriculum enhancement initiatives for the Industry 4.0 should include aspects connected with data, its automated gathering, processing and communication such as: data science, big data analytics, data communication, advanced simulation, virtual plant modeling, networks and system automation, novel human-machine interfaces, digital-to-physical transfer technologies (e.g. 3D printing), real-time inventory, closed-loop integrated product and process quality control and management systems; and logistics optimization systems [44–47]. There is also a need to train next generation leaders and young talent for Performance Augmentation for Industry 4.0 [48] and for Additive Manufacturing, which allows shorter production runs, the capacity to manufacture parts with geometries impossible using current methods, generating unique items and flexibility with respect to design changes to be obtained [49].

Nevertheless, the implementation of the Industry 4.0 concept is also a challenge for management sciences and requires research in the following areas: strategy and analysis, planning and implementation, cooperation and networks, business models, human resources, change and leadership [50]. Employees need also knowledge and skills in a decision making and process management [41, 51]. In the future will be needed a stronger partnership between manufacturer, customer and the supply chain supported by an internal organizational culture. The novel business models should be developed which share the risks of guaranteeing the through-life performance [37].

2.3 Literature gaps

Based on the reviewed literature on knowledge and skills of human resources to implement the Industry 4.0 concept, the following literature gaps were identified:

- employees need a specific knowledge and a new skill paradigm resulting from digitalization which should lead to increase the overall performance of production systems, effectiveness of operative management and the efficiency of manufacturing and supporting processes [2, 33–37];
- there is a need for highly qualified staff employed, who has the openness for changes, the strong ability to knowledge transfer and teamwork [7, 28, 31];
- the employees' knowledge on IT and production technologies in Industry 4.0 environment is important [41–43] as well as on management sciences such as strategy and analysis, planning and implementation, cooperation and networks, business models, human resources, change and leadership [41, 50, 51];
- the importance of lifelong learning definitely growing in the Industry 4.0 environment, what requires: 1) to promote the climate of innovation and learning; 2) to change the

learning culture [27, 28] and 3) a new approach to talent development staff [32];

- enterprises should build the learning management systems and procedures helping a learning progress and knowledge transfer within their own organization as well as within the network of enterprises [29–31].

3 Methodological framework

This study initially conducted a systematic literature review to indicate the key areas of required knowledge and skills of human resources and main directions of a needed approach to training and education process for industrial employees, managerial staff and students in the Industry 4.0 environment.

The identified areas and approach were further tested through survey research. The methodological framework which was adopted in the conducted research is presented in Fig. 1.

4 Results of the direct research

4.1 Description of the survey research

The CAWI method (standardized computer-based Internet interview) was used in the research. The survey research was conducted in a group of 50 intentionally selected enterprises from different parts of Poland. From the group of large and medium Polish industrial enterprises were selected those that declare the implementation of the Industry 4.0 solutions. The study was conducted in the period 2018–2019. The research
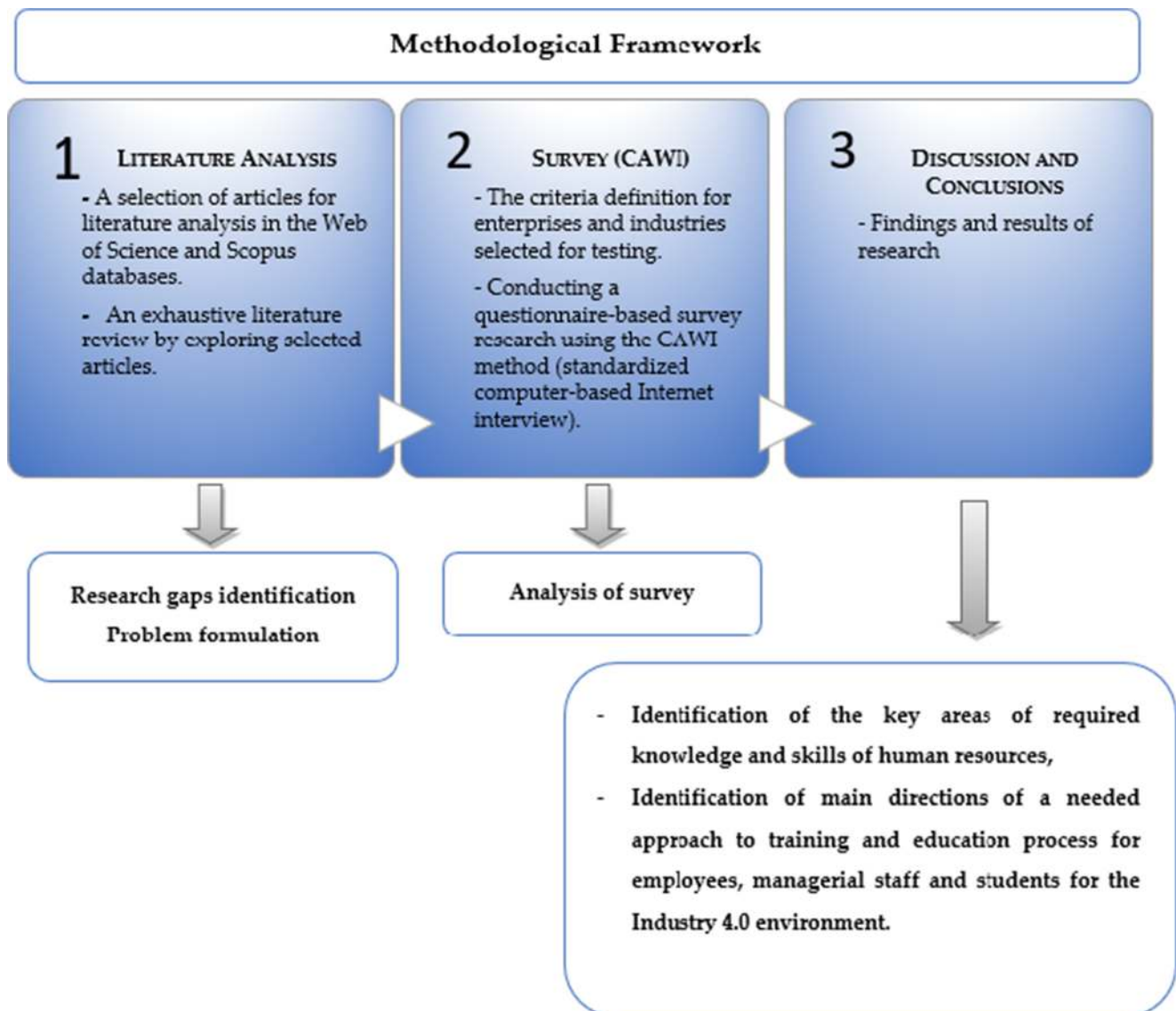

Fig. 1 The methodological framework of conducted research. Source: own study

tool was a questionnaire consisting of 10 specially prepared questions. The questionnaire was validated among 10 experts from Polish and Slovak universities with knowledge of the Industry 4.0 concept. The correctness and comprehensibility of the questions were initially verified on a group of 10 randomly selected production companies. As a result 20% of questions were changed.

4.2 Results of the survey research

The conducted survey has shown that the one of the most important problems of the Industry 4.0 implementation is a lack of qualified employees (77% of respondents), what was confirmed by the literature analysis. Besides, until 75% of respondents indicated too low level of expected return on high investment expenditure in information technologies, automation and digitization of production. Next identified barrier noted by entrepreneurs is a lack of ready-made business models for Industry 4.0 (72% of respondents). Many respondents also emphasized that they see the need to change the business model used so far. The respondents pointed that they have too low level of data security (68%), automation and robotization of production systems (58%). Except that, entrepreneurs highlighted high costs of consulting in the field of new technologies (55%) and a lack of knowledge about the Industry 4.0 technologies (41%). Only 38% respondents noted a lack of used ICT as a problem to implement the Industry 4.0 concept. The key problems related to the Industry 4.0 implementation are presented in Fig. 2.

Then, the demand for employees in industrial enterprises implemented the Industry 4.0 concept was verified (Fig. 3.). The received answers show that the greatest demand is for mechatronics and electromechanics (78%), data analysts and cyber security experts (75%). Besides, high demand occurred for logistician, process engineer, Information and

Communication Technology engineers and machine operators. Until 62% of respondents reported a demand for production engineering managers who combine managerial knowledge with technical knowledge. This fact shows that it is possible to confirm the conclusions of the literature analysis that, apart from technical knowledge, the knowledge of management sciences in managerial staff is also very expected.

The survey research has shown that the long-life learning is required from the managerial staff (83% of respondents). Respondents noticed the growing role of social media and believe that it is an area that must be important for managers (74%). Besides, connection technical and management skills, the ability to work in the team (72%) and openness for changes (68%) are significant. More accurate results of survey which tested required skills for managerial staff in the Industry 4.0 environment are presented in Fig. 4.

Without doubt, respondents have different requirements towards managerial staff and industrial employees (see Fig. 5). Technical skills are most desirable (91% of respondents). Otherwise, ability to solve problems (82%), ability to use IT systems (76%), analytic capacity (74%) and communications (72%) are also expected. Respondents highlighted also a need of long-life learning (71%).

5 Study findings and discussion

Without doubt, the Industry 4.0 concept is a new business trend, which change significantly an industrial reality based on new technologies such as the Internet of Things, Big Data Analytics, Cloud Computing, etc. The Industry 4.0 technologies give completely new perspectives for industrial companies through an increased intensity of processing huge amount of data in real time as well as the efficiency, productivity and

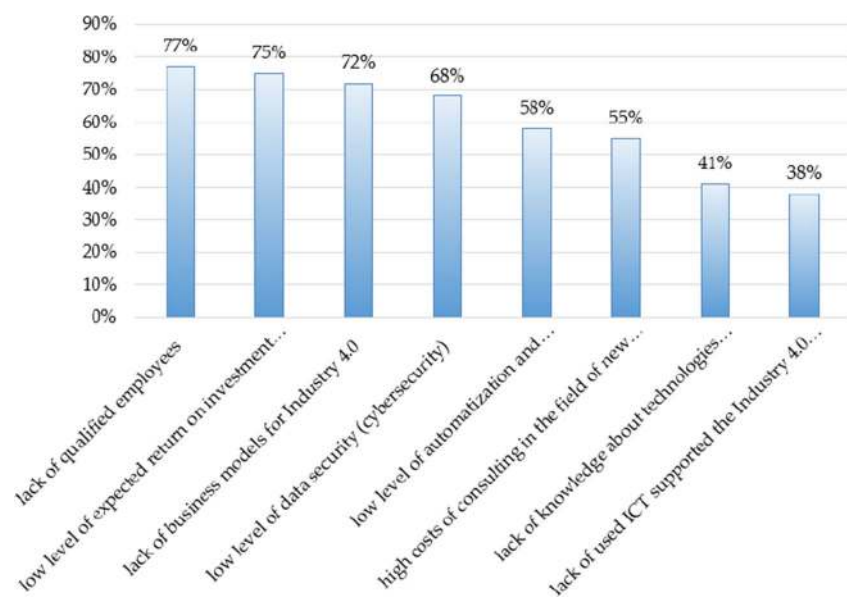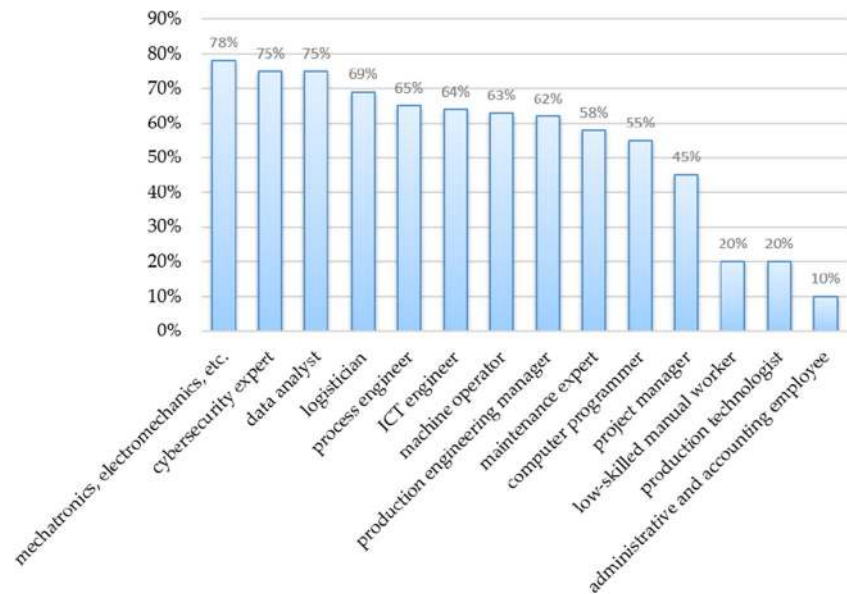**Fig. 2** Key problems related to the Industry 4.0 implementation. Source: own study

Fig. 3 The demand for employees in industrial enterprises implemented the Industry 4.0 concept. Source: own study

flexibility of production processes and much better customer orientation [52]. They lead direct or indirect to the sustainable development [53]. Despite that the implementation of the Industry 4.0 approach offers multiple benefits, which are highlighted by many authors, there are also considerable concerns and obstacles. One of them is a lack of high qualified managerial staff and industrial employees. This fact was confirmed by the results of the survey. Until 77% respondents pointed out this problem. All research and forecasts indicated that the progressive digitalization of production and focus on advanced technologies will entail the significant changes in the requirements for knowledge, skills and professional qualifications of both the managerial staff and employees [2, 8, 33, 37, 38, 54, 55].

The implementation and maintenance of new technologies related to the Industry 4.0 requires interdisciplinary knowledge and combining technical, organizational and social competences and qualifications. The results of the surveys clearly confirmed that employees who have interdisciplinary knowledge, technical and management skills are needed in the Industry 4.0 environment. This is a very interesting observation that can be particularly important for adapting the employee training system and the education process for students. Nowadays universities, courses and training usually do not combine these areas and sometimes even clearly separate them. Therefore, there is a need to reconstruct student education programs at universities and vocational schools. A detailed analysis of the demand for employees' qualifications

Fig. 4 Required skills for managerial staff in the Industry 4.0 environment. Source: own study
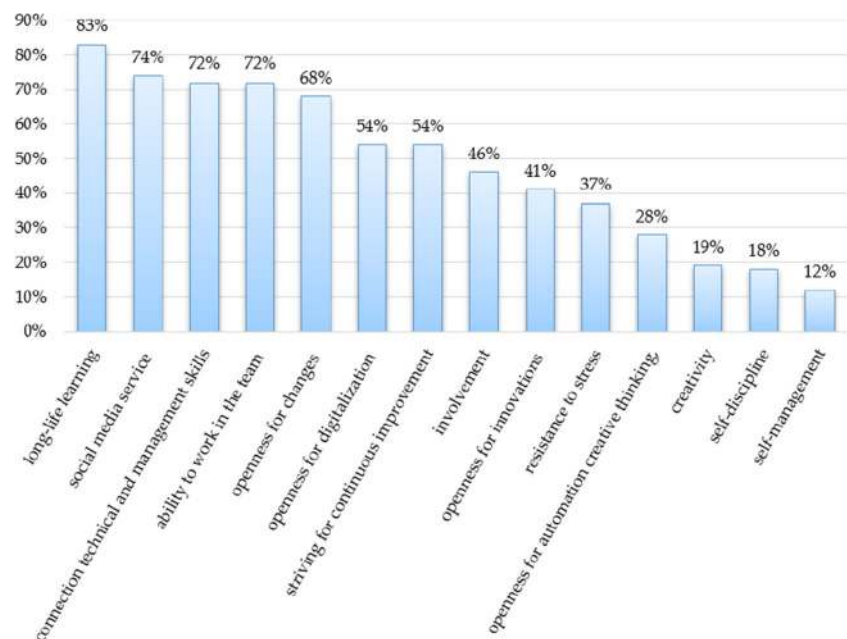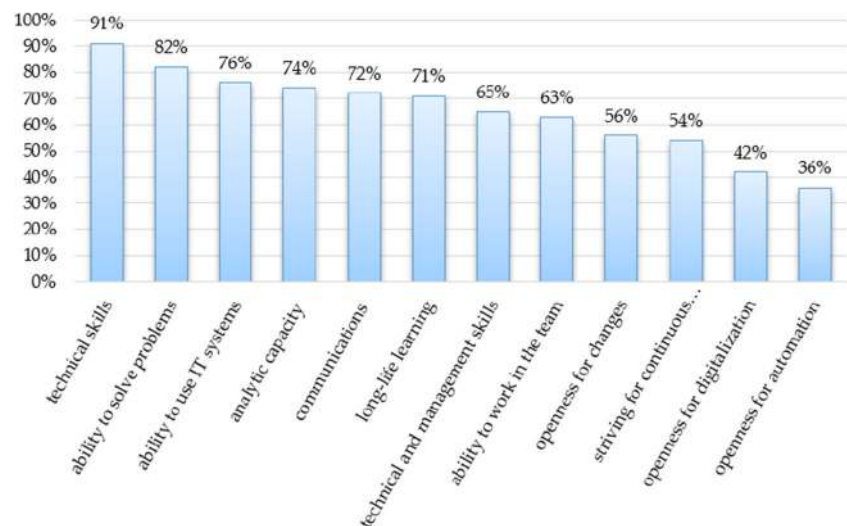
Fig. 5 Required skills for industrial employees in the Industry 4.0 environment. Source: own study

and competences is strongly required as well as the development of particularly interdisciplinary study programs in the areas of production engineering, management and logistics. This requires strengthening the cooperation of industrial enterprises with the academic community not only in the field of research but also within student education [56–60].

Digitalization and automation of the economy will result in the need to raise qualifications of employees in industry. Progressing digitalization will make production processes more demanding and complex. In this situation, process knowledge in conjunction with the ability to use available information will gain in importance [61]. The basic competences will also include the ability to solve complex problems, learning in the workplace and flexible action [8]. Especially managerial competencies are particularly important in the process of making decisions about innovation or changing the modus operandi focused on business cooperation. The manuscript [62] presents the results of surveys in selected enterprises of the automotive and pharmaceutical sectors, where eight key competences that can support the Industry 4.0 are indicated. There are: creativity, entrepreneurial thinking, problem solving, conflict solving, decision making, analytical skills, research skills, efficiency orientation. The research emphasized the importance of knowledge development, which is an indicator of the enterprise potential. Employees with entrepreneurial thinking skills are especially needed because they tend to think creatively and take responsibility for their work and are productive. This finding put the focus on the importance of creativity and creative thinking development. The importance of competences related to the decision making, ability to solve problems, conflict resolution and efficiency orientation are highlighted. This thinking probably stems from the view that the ability to make optimal and effective decisions is the only way to increase productivity and gain strategic advantage. Unfortunately, the level of the ability to conduct research, the respondents evaluated as low [62]. This

generally confirms the unwillingness to innovate and implement new technologies based on knowledge transfer.

The necessary managerial competences are particularly needed in the field of innovation focuses on innovation skills, diversity, creativity development, etc. The attention should be paid to the ability to create an innovation environment and workspace that support creative thinking and action, innovation in corporate culture, innovation teams (strategic, technical and organizational skills), customer oriented skills (skills focused on value creation), skills oriented on business point of view (ability to generate and design new business models, concepts, schemes, etc.) [63]. Besides, a need of connection technical, transversal and contextual skills in the training of the Industry 4.0 experts is underlined [56]. Also, the results of research show that two additional standards should be introduced: Industry Engagement, and Workplace Learning [64]. Sackey and Bester identified main areas of training in the field of the Industry 4.0: advanced simulation and virtual plant modelling; digital-to-physical transfer technologies, such as 3-D printing; closed-loop integrated product and process quality control/management systems; data communication and networks and system automation; real-time inventory and logistics optimisation systems; novel human-machine interfaces; and teaching and learning demonstration infrastructure [44].

The automation of business models and the need to constantly adapt to changing conditions of the enterprise environment require completely new employee competences. The conducted considerations show that the most developed and sought-after competences will be in the near future: skills related to data collection and management, both in relation to creating information architecture and developing algorithms related to analyzing collected data in real time; skills in using technologies related to the functioning of the Cyber Physical Systems; the ability to program integrated systems of intelligent machines, devices, robots and autonomous means of transport; and skills related to

cyber security (protection of collected data). In addition, the implementation of this concept will also require qualifications in the field of: cooperation with engineers and other experts in design and development of telecommunications technologies, software and products; analysis and design of work processes; adaptation and programming of production planning and control systems in terms of the Industry 4.0 operational requirements; maintenance, maintenance and optimization of systems (telematics application, RFID readers, devices etc.); data management; control, stabilization and optimization of logistics processes throughout the supply chain; and development and implementation of software and additional services regarding, for example networking with other enterprise information systems creating platforms for the design of temporary partner networks [61].

6 Conclusions

The current industrial revolution due to the development of intelligent interfaces and the use of the Augmented Reality changes the way of cooperation between people and the production system. The employees' role will evolve in the direction of managing the activities performed by the robots and intelligent machines cooperating with them. It means no demand for low-skilled employees, but at the same time an increase in demand for employees performing supervisory activities, often remotely, without the need for physical presence in the enterprise. In general, all employees at intermediate level of qualifications will have to face greater complexity, abstractness and problem-solving requirements as interaction increases and interconnects technical systems in general processes. However, a scope of work will decrease in particular for low-skilled workers. In the future, the employees will have fewer opportunities to intervene in the work process and they often will only have to follow certain work steps.

It is worth mentioning the need to develop soft competences that are needed for cooperation, communication and the ability to build interpersonal relationships, especially for employees at managerial levels. The development of qualifications and competences requires the creation of a work organization that supports horizontal learning based on new, interactive forms. The speed of changes and the far-reaching ambiguity of the goals mean that employees have to keep learning at the workplace. The enterprises should connect with local universities, technology parks and VET organizations to shape the skills they need and bring new ideas to the industrial companies. Strengthening the qualifications of the workforce in order to adapt it to the requirements of the digital economy is a priority and currently, along with the low level of modern technologies, one of the most important barriers in implementing the Industry 4.0 concept.

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