Human-Organization Relation in the Perspective of Industry 4.0

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Abstract. The main aim of this paper is to present the prospective changes in human-organization relation in enterprises caused by the technological progress, the progressive global digital transformation of tools and processes in particular, and to define the competences which should be currently developed in order to maximize future competence matching. The paper indicates groundbreaking innovations in the concept of Industry 4.0. It shows the most significant changes in organizations caused by the fourth industrial revolution. The main focus was the human-organization relation. Prospective changes in the functions of employees and in the scope of competence needs of enterprises were determined in the HR area. It was based on the literature analysis and the results of empirical, primary and secondary research.

Keywords: Human · Organization · Industry 4.0 · Relation · Change

1 Introduction

Civilizational breakthroughs, globalization and the expansion of opportunities to compete on the global marketplace, technical and technological progress, the development of the knowledge-based economy as well as the uncertainty and high dynamics of change that characterize these phenomena constitute economic realities in which modern organizations have to function and cope with [1]. These phenomena determine a great deal of changes in organizations. The most significant ones include changes of organizational structures, models of operation and the working environment. This translates into an increased complexity of management processes regardless of the kind and type of the organization. However, it is not the end of changes, on the contrary. Many researchers express a view that the greatest changes are still awaiting mankind. E.g., Klaus Schwab, the founder and chairman of the World Economic Forum, believes that "we are on the verge of a technological revolution, which will fundamentally change the way we live, work and coexist. In its scale, scope and complexity this transformation will be something humanity has not experienced yet…" [2]. These changes in relation to production activity are referred to as the fourth industrial revolution – Industry 4.0.

The term Industry 4.0 has become widely accepted in Europe. In some countries, such as Poland, the term Industry 4.0 is used to describe a new conception of industrial development. There are numerous synonyms for the Industry 4.0 conception in other

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countries, e.g.: Nouvelle France Industrielle – in France, Produktion 2030 – in Sweden, Fabbrica Intelligente – in Italy, Made Different – in Belgium and the Netherlands, Industria Conectada 4.0 – in Spain, Produktion der Zukunft – in Austria, Industry Connected 4.0 – in the United States [3].

In the perspective of Industry 4.0 scientific studies increasingly often include concepts such as: Management 4.0 [4], Human Resource Management 4.0 [5], Marketing 4.0 [6], Digital Society 4.0 [7] and Economy 4.0 [8]. With regard to these terms, the Industry 4.0 conception takes precedence, and the subsequent ones imply changes in particular areas caused by technological progress.

The implementation of the Industry 4.0 conception in enterprises causes changes both in manufacturing and management systems. The relation between human and organization is also subject to transformation. Along with the development of automation and robotization, people are "eliminated" from the direct process of manufacturing, which will shape new relations between the organization and its human resources. Behaviors and functions of employees, both managers and executive workers, will change.

The main aim of this article is to present the prospective changes in the human-organization relation in enterprises caused by the technological progress, the progressive global digital transformation of tools and processes in particular, and to define the competences which should be currently developed in order to maximize future competence matching.

2 The Prospect of the Fourth Industrial Revolution in Enterprises

The following transformations such as: "mass" digitization of processes, decision-making based on virtual simulations and real-time data processing, human-to-machine and machine-to-machine communication and new manufacturing technologies are referred to as the fourth industrial revolution on the basis of which the Industry 4.0 conception was developed [9, 10]. The current "transformation" is preceded by prior technological changes related to mechanization of manufacturing processes – industry 1.0, electrification – industry 2.0 and computerization – industry 3.0. The Industry 4.0 conception was initiated in Germany in 2011–12 [11, 12]. It is based on the assumption that internal processes in enterprises should be digitized, automated and robotized to the greatest extent in order to make them faster and more efficient than hitherto [13]. Enterprises are to evolve towards smart factories, which is expected to result in a sharp surge in their productivity [14]. It will consequently lead to an intermingling of the real and virtual world [15, 16]. The number of companies in the world with a high level of digital development, which is characterized by the ability to combine current activities from the virtual word with the real world, is increasing. According to the research conducted by Zebra Technologies Corporation – a manufacturer of technical printing equipment, including devices for printing and programming RFID radio tags – the number of companies defined as "The Intelligent Enterprises" doubled to 10% in 2018 [17]. Breakthrough innovations in the Industry 4.0 conception include: machine learning, predictive analysis, blockchain, virtual and augmented reality as well as the

Internet of Things and Internet of Services, which along with Big Data will create a new brand of artificial intelligence – cyber-physical systems (CPS)[1] [18, 19]. These technologies are being increasingly used in the organizational practice [20], and until recently they have been presented as visions for the distant future. Many technologies, which will certainly be the main driver of innovativeness and can change the direction of business and social policy development, are still in the phase of research or first market tests. For example, researchers from the Massachusetts Institute of Technology classified 10 breakthrough technologies in 2018, including: 3D metal printing, artificial embryos, sensing cities, artificial intelligence for everybody, dueling neural networks, speech and context recognition in real time expression, perfect online privacy, reduction of CO2 emission in electrical energy production, disease risk analysis of genetic material and materials' quantum leap [21].

It can be assumed that comprehensive digitization and optimization of internal processes constitute one of the stages of exploiting the potential that new technologies bring. It contributes to the creation of innovative products and services and new business models [22], which can certainly have a much greater impact on the level of competitiveness of enterprises than process optimization alone [23]. It is necessary to involve all the company employees in the process of creating innovative products, not just the team responsible for innovations.

The fourth industrial revolution will result in a paradigm shift from the "centralized production" to "decentralized production". In the paradigm of the "centralized production", complete production tasks are conducted in a single enterprise. Such systems are based on centralized management and control. The paradigm of decentralization means a departure from centralized management and control [24]. "Networks of autonomous production resources capable of controlling themselves in responding to different situations, self-configuring, knowledge-based, sensor-based, spatially dispersed and including appropriate planning and management systems" will arise [13, 25]. Functioning in the network imposes on enterprises a need to focus on their own key competences and to shift other activities to their business partners [24].

The human-machine relation will also change. The development of intelligent interfaces will transfer into a higher level of "cooperation" between man and machine/robot. The function of the employee will evolve towards "managing" the activities performed by the cooperating machines. People will become so-called "digital conductors" [23]. The human-machine system will be an integrator of contextual human decision making and the precision and regularity of machines.

The challenges that are already emerging may not be too unambiguous and clear yet, but even such challenges indicate that the transformation processes associated with the implementation of the Industry 4.0 idea will be of a revolutionary rather than merely evolutionary nature [7].

Numerous market analysts treat digitalization as a new factor in development of countries [26, 27]. There are also those who do not treat the digitization phenomenon in

[1] A cyber-physical system is a combination of hardware, software and communication elements, with a particular emphasis on communication. The idea is for machines to become more intelligent: they would communicate with each other, use shared data and create their own "social networks".

the category of opportunities, but in the category of "to be or not to be". Compared with other Central and Eastern European countries, Poland has worse indicators, e.g. in terms of digital skills of the society in all age groups and the use of Big Data tools or cloud computing by enterprises from the SME sector. Poland is struggling with a shortage of breakthrough technologies. Most initiatives have a negligible importance for the economy – they are only micro-innovative. That is why the Polish government, similarly to other EU countries, has established a new entity in Poland to act as an integrator – the Future Industry Platform Foundation, whose task will be to intensively disseminate knowledge and skills necessary to function in the realities of Industry 4.0[2].

3 Changes in Human-Organization Relation in Enterprises in Perspective of the Fourth Industrial Revolution

The Industry 4.0 conception determines significant changes in the relation between man and organization. New business models will require a re-examination of competence models and corporate culture of enterprises in the light of expected new competences and the need to attract and maintain adequate human capital [2]. The ongoing transformation of the organization triggers the need for significant changes, especially in organizational structures, mechanisms of leadership, corporate culture and competences, both organizational and individual [28]. The modern model of workplace presence will be changed due to the ability to remotely communicate with devices and to control their work. This will provide workers with an opportunity to flexibly configure their physical presence time at the workplace. It will lead to a creation of new business models in the field of participation in online production processes.

The activities of organizations are currently focused on the aspiration to increase the effectiveness of people in the organization. As a result, they mainly focus on developing proper methods of motivation, control and human resource management in the broad sense. In the situation when optimization of organization's operations results from the digitization of processes (automation, computerization and robotization), employee's functions in the organization will change. It will entail the need to possess a greater deal of different competences than those needed today. The function of professional competences will decrease in favor of mental and interdisciplinary competences such as: entrepreneurship, creativity, communicativeness and teamwork. The abilities to communicate, both in the human-to-human (P2P) and human-to-machine (P2M) relation, to search for knowledge, its creative and innovative creation, will become more significant than the abilities to pass or use the possessed knowledge.

As it has been already indicated in the introduction to the present paper, new technical solutions will lead to the "elimination" of people from the direct process of manufacturing, which will result in the need to redefine the profiles of existing workstations, create completely new jobs and possess new competences such as skills enabling the "operation" of intelligent machines/systems and the skills necessary to

[2] The Future Industry Platform Foundation bill was adopted by the Polish government in October the 23rd 2018.

service and repair them. Technological development creates a demand for new occupations, for which technologies become work tools. Competences development will be perpetual. It will be integrated into production processes. It is assumed that it will be supported by the introduction of digital employee assistants.

3.1 Change in the Function of the Employee in the Enterprise

Creating new professions and positions or redefining existing ones and assigning the desired competences to them will require a look at the organization, its every branch, employee and task from the perspective of the "human domain" and "machine domain". When creating a new working environment it is necessary to define the activities which will be performed by people and the ones which will be performed by machines in order to assign the roles properly. Therefore, it is necessary to analyze the strengths of people and machines in the first place and then to divide the tasks so as to highlight the elements that can be done better by man and the ones that can be handled better by machines. The implementation of this task requires a creative and imaginative approach. Do not be afraid to assign to machines all the tasks that they can do better than a human being.

The elementary human domains include above all: entrepreneurship, innovative and creative thinking, heuristic reasoning, intuition, generating innovations and empathy. The elementary machine domains include the following features:

- they can easily perform tedious, repetitive tasks – the machine performs repetitive tasks much more precisely than a human being and does not make mistakes,
- they are faster and more efficient in mathematical, logical and statistical operations than human,
- they can easily perform tasks that require rapid analysis (in real time) of large amounts of data coming from many different sources,
- they analyze the answers to structured questions more quickly and are "able" to answer them.

New technologies are used not only in the processes of direct manufacturing of products, but also in many other areas of the enterprise's operations such as customer service or the provision of technical support services – relieving consultants in repetitive activities. Chatbots, computer programs which simulate "living users" operations, are increasingly being used in these areas. They replace humans with simple and repeatable conversation patterns[3]. Their precision and practicality will surely increase over time.

It does not mean there are no barriers to the development of this trend. The biggest barrier is people themselves, the real human nature. According to the research conducted by Capgemini, consumers prefer interactions with humans, which can be

[3] For example, the Polish company Budmimex, which employs almost 5,000 employees, intends to use a chatbot in the recruitment process, with which candidates will be able to communicate via a facebook Messenger. A digital recruiter will ask every applicant about their skills, knowledge of foreign languages and financial expectations. Responses will be compared with the employer's requirements and capabilities – an objective assessment of candidates. Those of whom the robot accepts, will receive invitations for interviews in the real world.

supported by artificial intelligence tools, rather than with machines themselves – 55% of those surveyed in Europe and the USA [29].

New technologies will not be able to replace a human being in all areas and aspects of the organization for a long time[4]. They have not yet reached a sufficient level of maturity to compete with human creativity, flexibility and intuition. Advanced analytical tools and artificial intelligence can only support human knowledge and creativity. The inalienable domain of people will continue to be, among others, creation of new business models and innovations – innovative products and services.

The Industry 4.0 conception in relation to the HR area of the organization should be properly perceived. The following thesis can be boldly proposed: new technical solutions are aimed at increasing the capabilities of employees and not at replacing them [30]. A replacement of man in manufacturing processes ought to be perceived not as a threat to humanity but as an opportunity. Thus, man in the organization will be able to primarily focus on what he does best – what is his domain.

3.2 Competence Needs of Enterprises

"The demand" for new competences (finding employees with the desired competences) as a result of technical and technological progress will be one of the most significant problems in the HR area, which future organizations will have to deal with. "The demand" for key interdisciplinary competences in organizations is already high, whereas there is a "deficit" of them in the labor market. For example, entrepreneurs highly evaluate the usefulness of such competences as: entrepreneurship, creativity, communicativeness and teamwork – the average level of usefulness of the highlighted competences is 4.2 on a scale from 1 – competence completely not needed, to 5 – competence needed very much and systematically used (Fig. 1). On the other hand, the level of their absorption by people is relatively low – the average level of mastery of the highlighted competences in the surveyed group of students is 3.2 on a scale from 0 – competence not mastered to 5 – competence mastered at very high level (Fig. 2)[5].

[4] For the time being, the horizon 2030 is indicated. Until then, abilities such as: intuition, thinking and emotional intelligence are characteristic only for people. However, it cannot be excepted that in the long term, machines will also be characterized by them.

[5] Research conducted within the framework of a scientific project "The acceleration method of development of transversal competences in the students' practical training process" – http://www.awt.org.pl/projekty/o-projekcie/?lang=en. The project leader was Poznan University of Technology – a higher education institution, and the partners include: Czestochowa University of Technology (represented, among others, by the Authors of the present paper), Wroclaw University of Economy, Western Chamber of Industry and Commerce, in Gorzow Wielkopolski, Centria - ammattikorkeakoulu (Finland), JEDU Jokilaaksojen koulutuskuntayhtymä (Finland), Univerza v Mariboru (Slovenia) and Univerzita Mateja Bela v Banskej Bystrici (Slovakia). The project was conducted within the Erasmus+ programme – the key action: Cooperation for innovation and good practice. Project implementation time: from October the 1st 2015 to August the 31st 2018. The main aim of the project was to develop and implement an innovative method accelerating the development of students' transversal competences by improving the practical education use. In the project the analyses were narrowed down to four transversal competences (the effect of the adopted project assumptions): entrepreneurship, creativity, communicativeness and teamwork. The author of this paper was a research team member.

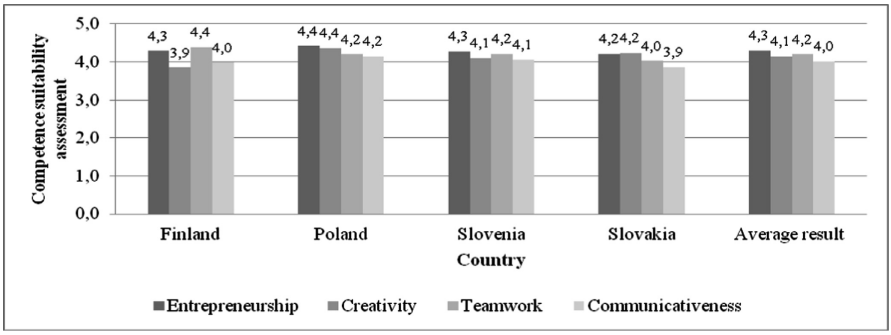

Fig. 1. Competence suitability assessment – aggregated results obtained in individual countries. Source: own elaboration.

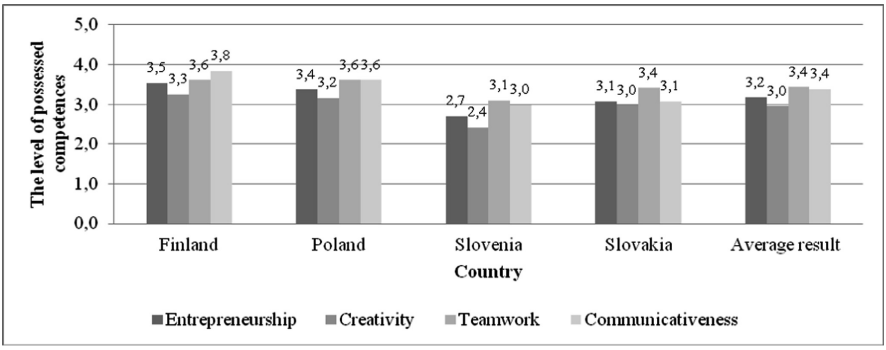

Fig. 2. The level of possessed competences – aggregated results obtained in individual countries. Source: own elaboration.

Therefore, it is not easy to find proper employees anymore. According to the ManpowerGroup studies [31]:

- 52% of Polish companies declare that they have problems with finding "talented people",
- 8% - report deficiencies in hard skills,
- 1% - report deficiencies in soft skills and communication skills,
- 12% - say that the candidates lack experience,
- 18% - say that there are employees who meet all the requirements of HR directors, but they value themselves too high.

ManpowerGroup's results are based on Polish realities, but it is highly probable that the global economy is facing a similar problem.

The competence gap may relate to different skill categories. A very important category of competence are competences in the field of new technologies. Surveys conducted by PricewaterhouseCoopers show that enterprises see a growing competence gap in the area of technical skills related to new technologies. Respondents in the survey indicated that their companies lacked suitably qualified teams (63% of respondents), most notably in the areas of cyber-security as well as data protection and data analytics. They also predicted that this gap would widen in the future (39% of respondents) [32]. Reducing the competence gap in this area will also be one of the priority challenges facing enterprises. Management should be aware of the fact that the digital transformation is a complex and costly process that requires a lot of resources. Only those companies that are able to use technology in a creative way will achieve success.

The paper shows that the competences which will be desired in new human-organizational relations – as a result of technological progress referred to as the fourth industrial revolution – are primarily mental, communication, interpersonal and leadership competences. They can be used for various types of tasks in many areas of company's operation. Such competences are also referred to as transversal, interdisciplinary competences. These competences are also desirable in the current economic reality, which is confirmed by the results of the own research as well as the results of research by other authors/institutions, whereas there is a "deficit" of them in the labor market. The problem will escalate. Therefore, it is extremely important to define the "future" competences already today and to develop them at the various stages of education. Such actions will prevent the competence gap from widening.

4 Discussion

It seems that the most appropriate strategy for modern organizations is ambidexterity strategy [33]. It consists in balancing exploitation activities (short-term perspective, current tasks orientation) and exploration activities (long-term perspective, future orientation, search for opportunities and threats in the long time span), seemingly contradictory, in order to obtain benefits from both. The ambidextrous approach to the strategy cognitively corresponds to the phenomenon which have been defined as a dualism in the organization management by theoreticians. On the one hand, organizations are forced to run their current business perfectly, but on the other hand, to manage better strategic changes. In this situation, the organization management and change should be concurrent and not sequential [34].

Exploratory activities are considerably more difficult than exploitation activities. According to the uncertainty management concept [35], various scenarios for the unknown future (from more realistic, through less realistic, to almost impossible), which are the trigger of the built or modified organization's strategy, including HR, should be taken into account. The organization's competence potential analysis should focus not only on the current competence needs, but also on the prospective ones, which may turn out to be crucial in the future.

Currently, the most realistic scenario for the new technologies development is the state in which machines, devices and products (i.e. things) will communicate with each

other in order to cooperate [36], without human intervention. Therefore, major efforts are being made in this direction, both in the science and business field. Intensive design and experimental work is being carried out, particularly in the science field, in order to implement given concept. It is one thing to develop an idea and another to implement it [37]. According to this scenario, the direction of employee competences development is also postulated – both those that enable the new solutions creation (conceptual, technical and engineering competences) and those that will be essential due to changes in the people's fundamental roles in organizations, taking place under their influence (conceptual, technical and interdisciplinary competences). It is certain that both hard and soft competences will be desirable in these actions – apart from professional and engineering competences, such skills as intuition and creativity are also necessary, which in combination with innovativeness will turn into innovation.

Given scenario presents an assumption that "things" will communicate with each other in "good faith", i.e. in order to optimize the production or service processes. But is this the only possible scenario? It cannot be excepted that in the future "things" will also communicate with a destructive attitude in order to harm other entities, bearing in mind their "own" benefit above all. An even worse variant is possible – intelligent machines will want to take control of people and the world. Such a scenario, although unlikely to happen, should also be taken into consideration.

In order for the first scenario to come true, the future competences need to be shaped appropriately. People need to be prepared to anticipate. They should focus even more on the intuition and other characteristics that constitute human nature. They must also acquire knowledge and skills in new technologies. Competences should be shaped in such a way that the domain of the Industry 4.0 concept would be better cooperation between man and technology, not competition with technology for jobs.

Such competence building requires systemic actions in which the state and supranational organizations play a significant role. It is desirable, for example, to integrate graduates of technical and economic universities, i.e. to integrate engineering and scientific competencies with managerial and interdisciplinary competencies.

5 Summary

The use of new technologies in the Industry 4.0 conception will determine changes in practically every area of enterprise activity. The impact of technological factors is expected to be stronger than the influence of economic and market factors. Technological factors influence not only the organization of production processes and products, but also relations with customers, partners in supply chains and competitors. As a result, enterprises are forced to develop new strategies and new business models. New technologies also have an impact on human resources management, organizational structure of the enterprise and work organization. As technology advances, the working environment evolves, which requires employees to possess new and specific competences.

The digital transformation in the HR area brings both opportunities and challenges for organizations and employees. New technologies and automation will not replace human competencies, but they force employees to be more flexible. The ability to

retrain and acquire new skills in order to keep pace with the changes driven by the digital transition will be a key factor in staying in the labor market. The biggest threat to the business sector will be the lack of people with the right set of competences. The talent management strategy in organizations needs to change to respond better to the challenges of the future.

The paper is a synthetic presentation of theoretical and empirical analyses in the scope of the Industry 4.0 conception and its prospective impact on the functioning of enterprises, concerning the formation of human-organization relations in particular. The paper poses a significant contribution to further research and empirical analyses in this area, as it is difficult to predict exactly what further changes will appear in the incoming years. There are also no proven solutions in management theory that show how to prepare both organizations and employees for the changes ahead.

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