Human Factor in Industry 4.0—Perception of Competences of Graduates and Employees

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Abstract The concept of Industry 4.0 is focused on the production of personalized products in time and cost which are approximate to mass production. The generated technical and organizational solutions force enterprises to change the role of their employees. He stops to be a contractor and becomes a supervisor of the self-initiating production process. The chapter presents the research about the perception of competences of employees and graduates by the enterprises in the context of the discussed strategy of Industry 4.0. This is a part of a wider research carried out using the CATI method on a group of 108 large industrial enterprises located in Poland. They allowed to find out not only how the idea of Industry 4.0 is understood, but also what is necessary to implement it. It gives a chance to formulate guidelines to which areas the attention should be paid to build the competences of future and current staff of industrial enterprises—including logistics—not only in Poland but also in the world.

Keywords Industry 4.0 · Employee's competences · Industrial enterprise

1 Introduction

Enterprises that make a decision to compete on the global market look for ways to reduce costs and acquire commissions to survive on the market. The resulting, inevitable changes are often referred to as industrial revolutions. Since 2013, we have been watching how the world is preparing and attempting to introduce the Fourth Industrial Revolution, called the Industry 4.0 (Dr. Wieselhuber & Partner GmbH, Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA 2015). The concept was proposed by the German government as a direction in development and support for the competitive efforts of German enterprises. The new method of production forces the existing and potential employees, meaning staff educated by

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universities, to acquire and use new skills. The author elected to combine considerations on the competences of the existing and future employee, because the need to expand skills and undertake training on communication and the so-called soft competences exists for the both groups of employees. This creates a special education need, especially among the engineering staff, who must not only prove their technical skills and expertise, but also be willing to introduce changes and drive self-development. For higher education institutions, on the other hand, this represents an area for scientific research and where educational activities can be expanded and updated.

The Industry 4.0 concept aims to accelerate the emergence of smart factories, which should be based on network cooperation with the use of informational and communication technologies for the purpose of combining machinery, processes, systems, products, clients and suppliers (Bembenek 2017). An important role here is played by employees, who receive information at any time and from any place (Wyrwicka and Mrugalska 2017), allowing the production of personalized products, the so-called mass customization. This idea defines a broad spectrum of innovations in IT, production technology and material sciences that impact the implementation of the concept of Industry 4.0. Special attention was paid to challenges resulting from Spath et al. (2013):

- handling large amounts of data,
- the businesses' ability to introduce innovations,
- flexibility of production processes.

These issues may be further expanded with the complexity of enterprise management and ensuring data safety (Spath et al. 2013). As a result, new tasks must be carried out by employees, which, in turn, forces them to acquire different skills and competences.

The use of new technologies gives access to all working parameters in real time and allows analysing massive data bases. This makes it possible to use new steering and control methods with the application of mobile devices and technologies. Consequently, the merging of the real and virtual worlds is observed. An expansion of the traditional concept of the man-machine array (Bendkowski 2017).

2 Employees in Industry 4.0

When arranging the operations of an organisation, one should remember about the individuals tasked with handling it, which most often means the employees themselves. According to Bendkowski, two models of enterprises can be distinguished when analysing work organisation in a smart factory. The first model is based on structures with changing personnel composition that supports the process of learning on a job position and give the units operational flexibility and a high degree of autonomy. Their structure will be based on self-organising activity networks whose purpose is the completion of a specific task. Another organisational model will consist in an

enterprise based on polarisation of qualifications, one that supports a far-reaching work division that is a combination of decentralisation and expansion of the scope of duties, while maintaining a strict division of work and standardisation. The creation of new structures and a different organisation of work may lead to the creation of problems at the intersection of humans, technologies and organisation and their relations to socio-technical systems. This constitutes a determinant for commencing analyses within the area of the impact of technology on shaping social reality. The result is the necessity to mutually adjust the technology and the requirements of organisational structures and work quality criteria (intellectual development, growth of the employees' competences and knowledge, among else) (Bendkowski 2017).

The ASTOR Reports (2017) on Industry 4.0 Engineers contains research that points to the perception of indispensable competences by employees. The necessity of training is noted, on the so-called "hard" skills related to technical competences (new automation systems, programming skills, SAP training), financial and organisational competences, cost accounts, work and production organisation, project management and self-management in time. Among the so-called "soft" competences, the respondents would most often point to human resources management, skills useful for contacting clients and negotiations, acquiring new clients, sharing and transferring competences, competences related to communication, creativity and leadership. At the same time, the report underscores that competences on which cyber security depends will be the basic competences for organisations operating in cybernetic systems (ASTOR 2017). The employees will cease to be executors, but will become work supervisors, so it seems important to combine the activities on the verge of "cybernetics" with, for example, working with robots or using IT and programming tools (2016). Many authors have noted that employees in companies based on the Industry 4.0 concept must not only have expert competences, but they should also be open to varying tasks and low levels of stability and task repetitiveness. They must be ready to process and analyse data from multiple sources, with the use of Big Data tools. This creates the need to know how to choose what is important to analyse a given problem, to evaluate the reliability of data and to draw conclusions (Piątek 2018) It is also noted that the competences of the future will have the client's needs in their centre. Among the analysed features the following are underscored (Szczerblewska 2017):

- client orientation,
- flexibility,
- critical thinking skills,
- openness to digitisation,
- readiness and openness to change,
- easy adaptation to new conditions and environment,
- team work skills,
- comprehensiveness and integrity,
- ability to work in varying cultural conditions.

Hecklau et al. also mention the ability to transfer knowledge, media skills, understanding IT security or tolerance of ambiguity (Hecklau et al. 2016).

The omnipresent computerisation will also lead to increased complexity of production processes. It is also assumed that the basic competences will include the ability to solve complex problems and to learn at work. Smart factories will also require employees who can collaborate with others in the pursuit of a common goal within the value creation process. A view present in literature posits that production workers will have to improve their skills in the area of flexible manufacturing (among else to acquire and improve digital competences in manufacturing, assembly and auxiliary areas related to preparing and planning production, quality management and logistics). They are also expected to have competences allowing to fulfil the process owner role—sponsoring and designing it, managing changes, introducing improvements. Employees should also strive to take the role of process managers, whose duties included planning and coordinating activities related to carrying out the process, monitoring it and reporting it. The need to have skills in counteracting any disruptions that may stem from the growing complexity of manufacturing processes is also seen (Bendkowski 2017).

Analyzing the above, it is worth noting that Polish universities educate more and more graduates—currently 27.2% of Poles have a university degree (the average in the EU is 28.7%). However, Polish graduates still lack the qualifications needed at work. Poland achieved a result of only 3.9 according to the Global Competitiveness Index scale (where 7 is the highest assessment of matching students' competences to their future work). The average for EU countries in this respect is 4.897. This may suggest that it is only at work that young Poles acquire useful competences. What may be noted here is the role of employers in educating staff based on the skills gained from the university. The increasing degree of automation causes an increase in demand for employees with high technological and digital skills. Higher cognitive skills and socio-emotional skills also seem important. Both the education sector and the companies themselves will have to help employees adapt to this demand. In this context, retraining strategies are important, including lifelong learning and formal employee training. In Poland, adults do not often continue their education. (McKinsey and Company 2019).

3 Evaluation of Competences of Graduates and Employees

Research methodology

The survey was performed using CATI method, on a sample of 108 respondents. They were performed as a part of the design works of financing the Youth Staff of the Faculty of Engineering Management of the Poznan University of Technology (No. 11/141/DSMK/0586). The survey was completed at the turn of November and December 2019. Large production enterprises (with over 250 employees) located in Poland were selected for the survey. The questionnaire featured open-ended and close-ended questions. The majority of respondents were employed as specialists,

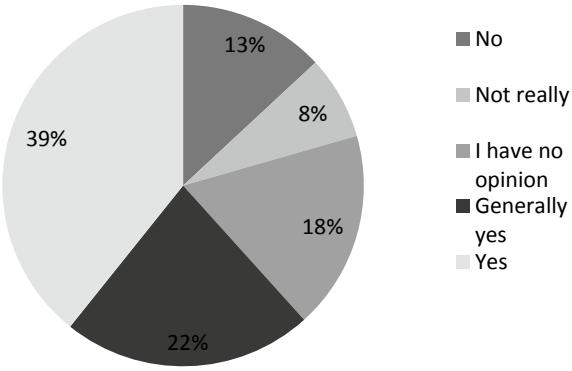

Fig. 1 Summary list of the survey participants' responses to the question: "Do the existing employees' competences allow the implementation of the Industry 4.0 idea?"

head managers or directors (more information: Stasiuk-Piekarska and Mrugalska 2020).

The presented results apply to viewing the competences of employees of the examined organisations and the respondents' evaluation of matching the students' competences for the purpose of implementing the Industry 4.0 strategy and they constitute a part of the conducted examination.

Competences of employees

The first questions aiming to evaluate viewing the possession of competences by individuals from the organisation's environment (employees or graduates in the labour market) was the request to evaluate the statement "Do the existing employees' competences allow the implementation of the Industry 4.0 idea?". To better illustrate the results, the responses were rated according to Likert scale (1–5), where: 1—no, 2—not really, 3—I have no opinion, 4—generally yes, 5—yes. The results are presented in Fig. 1.

The responses to the open-ended question "Do the existing employees' competences allow the implementation of the Industry 4.0 idea?" show that 19 in 108 respondents have no opinion in the examined area.

The responses of 24 survey participants (22% of the surveyed) were considered statements close to "generally yes". The respondents had doubts expressed by such statements as "the managerial and engineering staff yes, but not necessarily the older employee", "depending on the field" or declarations related to training and improving qualifications of their employees. The responses of 42 survey participants were qualified as the confirmation that the employees of the examined organisations have competences allowing the implementation of the Industry 4.0 idea. The respondents in this group used rather decisive language in their evaluation, with expressions such as "yes" and "definitely yes", assessing them as good.

14 respondents negatively evaluated the competences of the employees of their respective enterprises in relation to satisfying the requirements of the Industry 4.0 concept. 8 survey participants evaluated this area as rather unfitting to the requirements of the examined idea. Some of the surveyed noted the lack of financing for

training, however, some of them assured that their organisation would surely support such activities in the future. The lack of certain competences is also identified, but the specific skills are not named.

One of the respondents replied in a manner disregarding the topic, stating that at the time of reply it is generally difficult to retain employees.

The analysis of the obtained information shows the necessity to not only reiterate the request to identify what competences the employees miss, but also the need to analyse the correlation between the job position and the level of assessment of the employed staff.

Shaping the competences of future staff

Another examined issue that was supposed to examine the view of having competences by the individuals in the organisation's environment (employees or graduates in the labour market) was the request to assess the statement "In your opinion, do universities educate staff that supports the development of automation and production customisation?". Similarly to the analysis of responses to the previous question, to better illustrate the results, the responses were rated according to Likert scale (1–5), where: 1—no, 2—not really, 3—I have no opinion, 4—generally yes, 5—yes. The results are presented in Fig. 2.

To the question "In your opinion, do universities educate staff that supports the development of automation and production customisation?" 11 respondents (10% of the surveyed) had no opinion with regard to the examined issue, citing the lack of contact with graduates or the relatively small comparison group ("I don't know, I recently hired 1 person and got good results, but this is not enough").

10 respondents (10% of the surveyed) believes that universities generally prepare the graduates to support the activity of businesses in terms Industry 4.0. The used wording was related to the respondents' own experience ("I have graduates several years ago, but I think that [the situation] is improving every year and that the education gets better; the universities are developing and introducing practical classes") and references were made to collaboration with selected academic units. ("We are now seeing improvements in mutual relations and attempts to share skills, knowledge and growth"). The positive side is that as many as 51 of the survey participants

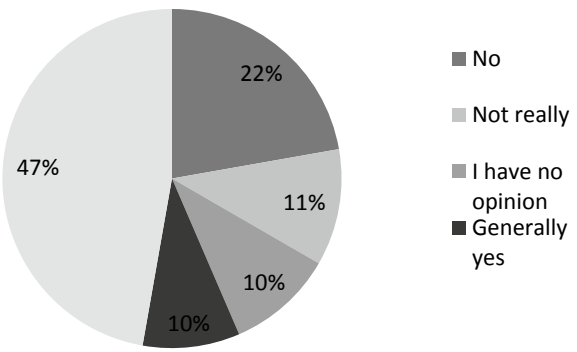

Fig. 2 Summary list of the survey participants' responses to the question: "In your opinion, do universities educate staff that supports the development of automation and production customisation?"

assessed the examined issue—whether universities educate staff that supports the development of production automation and customisation—as "yes", "definitely yes" or "absolutely yes". Still, even these opinions came with reservations that there are few such universities or that the graduates lack practical knowledge and on-the-job practice.

24 of the 108 respondents underscored that universities do not or definitely do not educate their graduates adequately for the needs of Industry 4.0. This group also included respondents who used phrases such as "the university is visibly delayed in terms of the latest technologies" or "the knowledge is there, but there is motivation for work" among the graduates. The surveyed would also use phrases like "not enough and the availability of such personnel is inadequate". In relation to the examined issue, 12 respondents believe that there is generally no support for the education supporting Industry from the universities or that there is not enough of it. Moreover, one opinion stated that the graduates have high financial demands.

We may consider it a positive that the respondents make references to working with universities and building mutual win-win relations. On the other hand, we may consider it an alarming trend that graduates are assessed to have low motivation for work, but this may result from the generational gap and the entering of millennials into the labour market. In this regard, universities can support not only their own graduates, but also Gen Xers and Gen Yers, with the purpose to improve human collaboration. We should also not forget about the use of the newest technologies and teaching them to the students.

4 Conclusions

This chapter serves as an initial review of literature with regard to competences seen as necessary for implementing and functioning of companies based on the Industry 4.0 concept. Then, the chapter presents the results of examination of the assessment of the degree to which such competences are possessed by employees of large, industrial enterprises operating in Poland and by graduates of higher education institutions. Significant optimism can be seen among the respondents, as evidenced on the conducted examinations. Nearly 60% of the respondents assessed that the employees of their respective organisations have or generally have competences necessary to implement the concept of Industry 4.0. Nearly 70% of the surveyed evaluated positively or largely positively the competences of graduates in terms of supporting customised and automated production in their enterprises. We should remain mindful that there is no way to develop business without collaboration with and support from the external environment, also in the areas covered by the educational system.

The conducted examination constitutes a foray into the evaluation of the readiness of enterprises to introduce the Industry 4.0 concept. At the same time, we see the need to deepen the research, if only to address the remarks of the respondents on which competences they consider to be key in terms of developing business according to the analysed strategy.

Summing these considerations up, a conclusion can be made that the analysed area may constitute a certain group of determinants for the implementation of modern strategies, such as Industry 4.0. However, in order to be able to obtain highly customised products, it is not only necessary to declare the openness to collaborate with clients and suppliers, but also a more extensive preparedness with regards to production management that coves, among else, digitisation and automation of processes.

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