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Requirements for specialists in the Industry 4.0 environment: problems and solutions

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Abstract

The new industrial revolution is changing human life and activities beyond recognition. The development of digital technologies, the application of cyber-physical systems and the use of artificial intelligence lead to an increase in the standard of living of certain groups of the population, and economic growth in several areas of the economy. At the same time, it brings a number of problems.

An important condition for ensuring competitive activity of the enterprise in the environment of Industry 4.0 is human capital - training of qualified personnel with digital skills.

The article examines the advantages and disadvantages of the application of digital technologies in the industry 4.0 environment, the problems that arise, and ways to overcome these problems. Existing approaches for defining a list of new skills and habits in terms of the requirements for specialists now and in the near future are analyzed and summarized. Suggestions and recommendations are given for developing these skills and habits.

Keywords: Industry 4.0, Digital competencies, Human capital

1. Introduction

Artificial intelligence, robotics, internet of things, 3D printing, nanotechnologies, quantum computing, big data – these are all technological realities that form the basis of the fourth industrial revolution. These technologies are designed to provide humanity with everything it needs, including ensuring the security of the individual, society and the state.

The application of digital technologies leads to job losses. According to the forecast of the World Economic Forum, millions of people in several countries of the world will face the threat of losing their jobs as a result of the application of robots in the future.

An important condition for ensuring competitive activity of the enterprise in the environment of Industry 4.0 is human capital - training of qualified personnel with digital skills. On the other hand, the content of the most required skills and habits has changed significantly in recent years, and new training methods have appeared. This requires constant updating of programs designed for personnel training and skill development.

Application of cyber-physical systems in industrial enterprises, management of production processes and other processes with computer programs requires ensuring high level of cyber security. Currently, in the modern digital world, cybercrime is the main threat factor for the development of the world economy. Previously, there was an opinion that strong software development and technical methods were sufficient to prevent unauthorized access to information resources. However, it is not possible to ensure information security only with software and technical means. The solution of information security problems also depends on the culture of people and their behavior in relation to information.

Research shows that the majority of security breaches are caused by human error. Therefore, enterprises should prepare their employees in a better way in order to increase the level of information security of their resources and increase the resistance of employees to cyber threats.

2. The essence and possible consequences of Industry 4.0

Today we are on the threshold of the 4th industrial revolution. The project Industry 4.0 was one of the 10 "Projects of the Future" identified by the German government as part of the "High-Tech Strategy 2020" Action Plan [1].

The concept of Industry 4.0 was proposed in Germany in 2011. Its essence lies in the combination of real and virtual labor organization systems, as well as in the integration of people with digitally controlled intelligent machines that widely use the Internet and information technologies. Production is characterized by automation, computerization and robotization. All devices in the production line interact with each other and shape an intelligent system.

The main components of Industry 4.0 are cyber-physical systems, the Internet of Things, IOS and intelligent systems. Smart products are sub-components of cyber-physical systems. The intelligent systems are estimated to be the main components for the successful development of society.

The 4th industrial revolution leads to a strong connection between the real and virtual world in cyber-physical systems, that is, the new industrial concept called Industry 4.0 means the integration of IT devices and solutions into production processes to increase production efficiency and flexibility. Industry 4.0 specifies new directions for changes in production and management, and at the same time affects various aspects of society.

Economic initiatives related to Industry 4.0 are gradually increasing. The propagation of Industry 4.0 is causing changes in many areas of society and economy. The range of changes is quite wide and it is impossible to list them all, or even to define them completely. Against the background of ongoing changes, the question arises: what are the social expectations of the 4th industrial revolution?

The changes taking place are changing the structure of the labor market. This is due to the fact that new technologies allow the automation of a large part of the processes, resulting in the reduction of jobs [2]. Second, new technologies create new opportunities for business, which, in turn, means the creation of new jobs.

Industry 4.0. affects the complete transformation of the industry in three directions:

- Digitization of production, i.e., data management systems and production scheduling;
- Automation, i.e., a system of data collection from production lines through multiple machines;
- Integration of production sites in a complex supply chain, i.e., automatic data sharing.

Any industrial revolution is not only accompanied by technical innovations, nevertheless, gradually covers all spheres of society and leads to fundamental cultural and social changes [3].

As a result of the introduction of new technologies, the automation of labor and the increase of productivity are expected. Technological development and the possibilities of artificial intelligence can completely destroy a number of professions and lead to an increase in unemployment.

The new technical reality put forward strict demands on specialists, namely, having knowledge in the field of ICT, mathematics and finance along with the main profession. The usefulness and efficiency of a person in the labor market will depend on his/her ability to think critically, creatively approach the problem solving, his/her initiative, ability to constantly adapt and adopt new skills and approaches in various contests.

3. Digital skills for Industry 4.0

As a result of the impact of the 4th industrial revolution, we are witnessing the changes in employment conditions and requirements for professional skills. The key component for the successful implementation of Industry 4.0 technologies in enterprises and the expansion of opportunities for future activity is the employees'

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skills. G20 analyst report predicts the demand for non-standard analytical skills related to creativity, problem solving, communication, teamwork and entrepreneurship to increase.

The guarantee of successful implementation of Industry 4.0 in enterprises is the acquisition of new knowledge and skills by employees and their constant self-development. Therefore, each enterprise must define specific digital skills specific to the enterprise in the future.

Talent and skills are the main driving force behind the successful implementation of Industry 4.0. Advanced manufacturing concept can be realized with the help of skilled and well-trained workforce. The success of Industry 4.0 depends not only on technologies, but also on people [4].

One of the nine main pillars forming the basis of Industry 4.0 is additive manufacturing. Additive manufacturing is considered to be one of the most innovative technologies. This is of great interest to industrial enterprises, educational institutions and public authorities. In this regard, training the workforce and preparing it for new realities is one of the most central tasks.

EU countries implement numerous projects to increase the qualifications and develop the digital skills of not only employees, but also the general population, i.e., citizens, teachers, students, and various professions. For example, "Digital Competencies for Citizens (DigComp)", "Digital Competencies for Consumers (DigCompConsumers)", "Competencies for Entrepreneurs (EntreComp)", etc. [5].

The DigComp model of digital competencies envisages competencies in five areas [6]:

1. Literacy in the field of information and data (searching information, extracting and storing the necessary out of the information found, etc.);
2. Communication and cooperation (interacting, communicating and participating in the life of society using digital technologies, etc.);
3. Competencies for digital content creation (creating and editing digital content in various formats, being aware of and applying copyright and licensing);
4. Competencies in the field of security (risks and threats in the digital environment, protection of devices and data, awareness of security measures, data privacy, knowledge of the impact of digital technologies on the environment and its prevention);
5. Solving emerging problems (using digital tools to apply innovations to processes and products).

The World Economic Forum analysts believe that the following competencies that are important for successful operation in the conditions of the 4th industrial revolution are [7]: complex problem solution; critical thinking; creativity; people management; coordination skills (interaction); emotional intelligence; reasoning and decision making; service-oriented (customer-orientated); ability to negotiate; cognitive flexibility.

The fundamental skills model of the digital economy developed by Burning Glass [8] includes four blocks. The model develops a list of fundamental skills.

Table 1. Fundamental skills model of the digital economy

Human Skills	Domain Knowledge	Digital Building Block Skills	Business Enabler Skills
Critical thinking, creative approach, analytical analysis, communication and cooperation	Strategy, economics, marketing, communications/public relations, talent development/human resource management, research and development/product development;	Data analysis, Big Data and data management, software development, ensuring information security	Project management, decision making, data visualization and communication.

In this model, skills are divided into three levels: primary skills; basic skills; special skills.

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4. Conclusion

The introduction of Industry 4.0 technologies leads to a number of changes. Digitization and automation of production affects the nature of the organization of work in enterprises and the employment of population. As a result of automation, the following changes are observed:

- Reduction of some jobs;
- Change in the nature of works performed;
- Creation of new jobs;
- Inconsistency between required and offered skills;
- Change of working conditions (remote work).

The importance of the skill mismatch problem is also shown in international studies. Lack of basic skills is the third most important factor preventing the increase in the enterprise performance [9].

For the successful implementation of Industry 4.0 technologies, employees must have appropriate qualifications. It is extremely important to have a flexible system capable to perform training, upgrading and retraining of personnel within the enterprise. For this, enterprises should perform the following activities:

1. Preparing and systematizing the list of digital skills important for the enterprise (general and specific skills);
2. Employees' digital knowledge and skills should be assessed and the necessary knowledge and skills should be determined according to the assessment results;
3. A training program should be prepared and constantly updated, allowing to acquire the required knowledge and skills;
4. A budget should be allocated for training and the training process should be managed;
5. New training methods (open educational resources, virtual reality, games, etc.) should be applied in the training process.

Thus, for the successful implementation of digital technologies, employees must have the appropriate skills. Retraining and increasing the qualification of the existing labor force is one of the important conditions for future economic growth and increasing the stability of society.

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