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RESEARCH ARTICLE

HOW EMPLOYEES SURVIVE IN THE INDUSTRY 5.0 ERA: IN-DEMAND SKILLS OF THE NEAR FUTURE

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ABSTRACT

By 2025, when the Industry 5.0 era is anticipated to begin, a new business context designed with automation systems in cooperation with humans, robots, and algorithms is expected to emerge. As a result of the transformation in the way of doing things in businesses, the skills required to perform the work activities will change, which will result in skills gaps. In order to prevent the skills gaps to occur, the in-demand skills should be identified. The purpose of this paper is to briefly explain the concept of Industry 5.0 and explain how Industry 5.0 will create a change in in-demand employee skills for the upcoming years. The conceptual framework of the study is grounded on the skill classification discussed in the two reports of The World Economic Forum (2016 and 2020), which are entitled "Future of Jobs Report". Based on this skill classification, it is anticipated that problem-solving skills will continue to be included in the in-demand skills. Moreover, leadership and social impact skills, technology use and development skills, and self-management skills are expected to be at the forefront. The study is hoped to provide guidance and be a reference for researchers. Additionally, it is hoped to be useful for employees, managers, or employee candidates in all fields, but particularly for the ones in HR departments.

Key words: Industry 5.0, Industry 4.0, Employee Skills, Future Skills, Future Workforce, Human Resources, Society 5.0

"*Tomorrow's illiterate will not be the man who can not read; he will be the man who has not learned how to learn*"
(Alvin Toffler, 1974: 346 cited Herbet Gerjuoy)

1. INTRODUCTION

The beginning of industrial production dates back to the late 1700s, when steam power was introduced in production activities in Europe. Accordingly, in the development of industry, the period between 1784 and 1869 was marked as the age of steam (Industry 1.0). The second period -from 1870 to 1968- was marked as the age of electricity (Industry 2.0), and the third period (Industry 3.0) -from 1969 to 2013- was marked as the information age (Zhou, Liu & Zhou, 2015: 2148). Since 2013, with the transition to industry 4.0, the business world has begun to adapt to a new context that uses advanced technologies, such as The Internet of Things, cloud computing, big data, robotics, and artificial intelligence, all of which paved the way for smart production (Lu, 2017; Yücebalkan, 2020). By 2025, when the Industry 5.0 era is anticipated to begin, a new business context, which is equipped with automation systems in cooperation with humans, robots, and algorithms, is expected to emerge.

Industry 5.0 can be defined as the green and digital technology transformation that aims for a sustainable industry. In this era, an acceleration in automation and the emergence of new industrial fields and new jobs are forecasted. In this line, according to the estimates in the World Economic Forum 2020 report, 85 million jobs carried out by humans are predicted to be automatized (transferred to machines) by 2025. At the same time, the jobs of the future, which are expected to be carried out in cooperation with humans, robots, and algorithms, may require up to 97 million new roles (Future of Jobs Report, 2020:29). In line with these predictions, employee skills should change to adapt to Industry 5.0. In this context, depending on the transformation within the framework of Industry 5.0, "How employee skills will change in association with Industry 5.0?" is the research question of this paper.

The concept of Industry 5.0 was first introduced by Michael Rada in the article "Industry 5.0: From Virtual to Physical" in 2015 (Yücebalkan, 2020: 244). Starting from 2017, Industry 5.0 has started to be discussed in the literature (e.g., Atwell, 2017; Demir & Cicibaş, 2017; Demir, Döven & Sezen, 2019; Nahavandi, 2019;

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Paschek, Mocan & Draghici, 2019; Skobelev & Borovik, 2017; Rada, 2018; Vaidya, Ambad, & Bhosle, 2018; Yücebalkan, 2020). Although the literature has advanced, only a limited number of studies addressed the association between industry 5.0 and employee skills (Breque, De Nul & Petridis, 2021; Doyle-Kent, 2021; Paschek, Mocan & Draghici, 2019). From this point of view, İşcan (2021:92) and Paschek, Mocan & Draghici (2019:131) pointed out the need to examine the in-demand skills throughout the Industry 5.0 era.

The purpose of this paper is to briefly explain the concept of Industry 5.0 and explain how Industry 5.0 will create a change in in-demand employee skills for the upcoming years. The conceptual framework of the study is grounded on the skill classification discussed in the two reports of The World Economic Forum (2016 and 2020), which are entitled "Future of Jobs Report". The importance of the study lies in the fact that it sheds light on possible changes in employee skills through Industry 5.0 era from a human resources (HR) perspective. The study is hoped to be useful for employees, managers, or employee candidates in all fields, but particularly for the ones in HR departments. The study is also expected to provide guidance and be a reference for researchers.

2. LITERATURE REVIEW

2.1. The Concept of Industry and Its Stages

The concept of industry refers to all economic activities of businesses to satisfy the needs and demands of consumers by producing goods or services (Inglezakis & Zorpas, 2011; Olayiwola & Adeleye, 2005). The concept of industry is also defined as sector or industrial field (Gumport, 2007: 151). However, when industry is considered as economic activities in line with its widely accepted definition, it is obvious that the technologies used so far differ in certain periods. These periods, which can be expressed as stages of industry, are summarized in Table 1.

Table 1. Stages of industry*

Stage	Period	Framework
Industry 1.0	1784-1869	The use of water and steam power in manufacturing, leading to the birth of the industry
Industry 2.0	1870-1968	Use of electricity in industry and the start of mass production
Industry 3.0	1969-2013	Introduction of automation to business life with the use of digital and electronic devices
Industry 4.0	2013-2025	Establishment of integrated information systems with the use of big data, The Internet of Things, artificial intelligence, cyber-physical systems, and cloud computing. Going beyond simple automation with smart factories.
Industry 5.0	2025- …	Human-robot-algorithm cooperation, acceleration of automation in mass production, and the prominence of personalized products/services with a focus on sustainability-based bio-economic activities

* The table is compiled from Aslam, Aimin, Li & Rehman (2020), Demir & Cicibaş (2017), and Zhou, Liu & Zhou (2015)

Industry 1.0 (1784-1869) began in the mid-1780s as a result of the industrial production facilities operated by using water and steam-powered machines. Industry 1.0 is also known as the steam age. The main characteristic is mechanization (Özkeser, 2018:424).

In the stage of Industry 2.0 (1870-1968), assembly lines were established and large-scale production facilities were born, which made mass production possible. This stage is also known as the electricity age.

Industry 3.0 (1969-2013) is referred to as the information age (Zhou, Liu & Zhou, 2015:2148). In Industry 3.0, the use of information technology (IT) through digital and electronic devices began. Industry 3.0 can also be described as an information revolution, which is spurred by computers and the internet.

In Industry 4.0 (2013-2025), digitalization is the basic characteristic (Aslam, Aimin, Li & Rehman, 2020:124). Although Industry 4.0 was first introduced at the Hannover Messe (Hannover Trade Fair) in Germany in 2011, it started to gain interest in 2013 with a report presented at the same fair (Zhou, Liu & Zhou, 2015:2147). Therefore, the business world has been trying to adapt to Industry 4.0 for the last 10 years.

Industry 4.0 aims at better quality, less costly, and faster production by taking over the processes through robots that communicate with each other, detect the environment with sensors, and realize the needs by performing data analysis (BTK, 2020:7). Key technologies entering the business world with Industry 4.0 are cyber-physical production systems, mobile internet and internet of things, cloud computing, big data, and advanced analytical techniques (Zhou, Liu & Zhou, 2015:2149). Through the use of these technologies, Industry 4.0 focuses on the network among mobile devices, sensors, and computers. More clearly, Industry

4.0 represents a revolution that marks the transformation of devices into a world in which all of the networks and information are interconnected (Ball, 2019).

Dalgın (2021) emphasized that the ultimate goal of Industry 4.0 is to accelerate automation and digitalization. In this context, smart factories are one of the important issues in Industry 4.0 (Osterrieder, Budde & Friedli, 2020). These factories, a.k.a. 'dark factories' or 'lights out factories' (Öztemel, 2019 :22), refer to facilities that are operated with high efficiency using smart technologies without the need for people in the production process (Duman & Akdemir, 2019). The way to do this is to create an open and smart industrial information network (Vaidya, Ambad & Bhosle, 2018:234). Considered one of the basic building blocks of Industry 4.0, smart factories provide advantages such as low operational cost, high efficiency, and high flexibility.

Along with the positive effects of Industry 4.0, it is seen that the efforts in the transition to Industry 4.0 differ from one country to another. Advanced economies adapt to Industry 4.0 faster than developing economies. For instance, a study from Turkey, which was conducted in 2016 using data from 1,000 private sector organizations in Turkey, shows that the digital maturity of Turkey is between Industry 2.0 and Industry 3.0 by the year 2016 (TÜBİTAK, 2016:4).

2.2. The Scope of Industry 5.0

Industry 5.0 can be defined as the green and digital technology transformation that aims for a sustainable industry (Arslanhan, 2021). It has also been conceptualized as a greener and more human-oriented version of Industry 4.0 (Dalgın, 2021). Another definition is the cooperation between humans and robots in the production process (Johansson, 2017:13). This cooperation can be achieved by placing the human factor at the center of the integrated system established by Industry 4.0. Hence, Industry 5.0 refers to a new era, which is human-centric and built on the basis of collaboration among humans, robots, and algorithms.

From a broad perspective, there are two key goals of Industry 5.0 that stand out. The former is the provision of personalized production/service with human and robot collaboration supported by algorithms. The latter is building a sustainable economy. In other words, while Industry 5.0 is expected to lead the way for a new working system that is in cooperation with humans, robots, and algorithms, it also aims to create a global bio-economy that is based on sustainability (Demir, Döven & Sezen, 2019:690).

According to Atwell (2017), the role of human beings in the production process is to combine the high speed of industrial automation with cognitive and critical thinking skills. Mechanical and repetitive work will be provided by the automation of machines and the human factor will come into play in creative work. Therefore, within the scope of Industry 5.0, employees are expected to increase their added value with upskilling and reskilling.

In order to better understand the emphasis of Industry 5.0 on "human", it would be useful to mention the concept of Society 5.0. The purpose of Society 5.0 is to use the integrated information systems created with Industry 4.0 primarily to improve the well-being of the community. Society 5.0 is based on the integration of information that belongs to every citizen in the society regarding industry, health, and other fields of activity and providing personalized products and services. In Society 5.0; people, objects, and systems are associated with each other in a virtual environment and the results are transferred to the physical environment (Akın, Mayatürk Akyol & Sürgevil Dalkılıç, 2021:581). Within the context of Society 5.0, it is a priority to provide a high quality of life for people (Fukuyama, 2018:48). From this point of view, science, technology, and innovations would be developed not only for a limited segment of society but for all people to live better (Harayama, 2019).

While the efforts within the scope of Society 5.0 are expected to lead the society to the desired prosperity, Society 5.0 will also make significant differences in the industrial process. Consequently, two limitations of Industry 4.0 are criticized in Society 5.0. One of these limitations is the disregard of the human factor, another is the use of advanced technologies solely by the manufacturing sector (Skobelev & Borovik, 2017: 307). These limitations are tried to be overcome in Industry 5.0.

3. INDUSTRY 5.0 AND EMPLOYEE SKILLS

In the era of Industry 5.0; the complexity of cyber-physical systems is anticipated to rise. Thus, people are expected to focus more on making strategic decisions by dealing with more complex problems (Doyle-Kent, 2021:154). In this era, employees will work in collaboration with robots and algorithms to hand over ordinary, repetitive, and dangerous tasks to collaborative robots (Gotfredsen, 2016). In turn, employees could

manage the processes more effectively and provide higher added value by demonstrating their creativity. In order to reach this potential, it is a prerequisite to acquiring the in-demand skills throughout Industry 5.0.

In the field of human resource management, skill refers to the human, technical, or social characteristics that an employee must possess in order to accomplish the relevant work or task (Turan, 2015:45). On the other hand, the lack of skills to perform the work is defined as "skills gap" (Erikli, 2015:22). As a result of the change in the way of doing things in business with Industry 5.0, the skills required to perform the work are expected to change, which will result in the emergence of skills gaps. Businesses that anticipate these skills gaps with proactive moves can gain a strategic advantage in the Industry 5.0 era. However, the anticipation of the skill gaps is primarily based on identifying the in-demand skills. At this point, the research highlighted at The World Economic Forum, which focused extensively on employee skills, is considered to act as a guideline. The in-demand skills for the years 2015, 2020, and 2025 are included in the two papers (Future of Jobs Report, 2016; 2020). The top 10 in-demand skills in the relevant papers are compiled and compared as shown in Table 2.

Table 2. Top 10 in-demand skills**

	2015	2020	2025
1	Complex problem-solving	Complex problem-solving	Analytical thinking and innovation
2	Coordinating with others	Critical thinking	Active learning and learning strategies
3	People management	Creativity	Complex problem-solving
4	Critical thinking	People management	Critical thinking and analysis
5	Negotiation	Coordinating with others	Creativity, originality and initiative
6	Quality control	Emotional intelligence	Leadership and social influence
7	Service orientation	Judgment and decision making	Technology use, monitoring and control
8	Judgement and decision making	Service orientation	Technology design and programming
9	Active listening	Negotiation	Resilience, stress tolerance and flexibility
10	Creativity	Cognitive flexibility	Reasoning, problem-solving and ideation

** The skills in Table 2 are compiled from Future of Jobs Report (2016, 2020).

The top 10 in-demand skills provided in Table 2 for the year 2025 are divided into 4 categories (Future of Jobs Report, 2020):

1. Problem-solving,
2. Working with people,
3. Technology use and development,
4. Self-management.

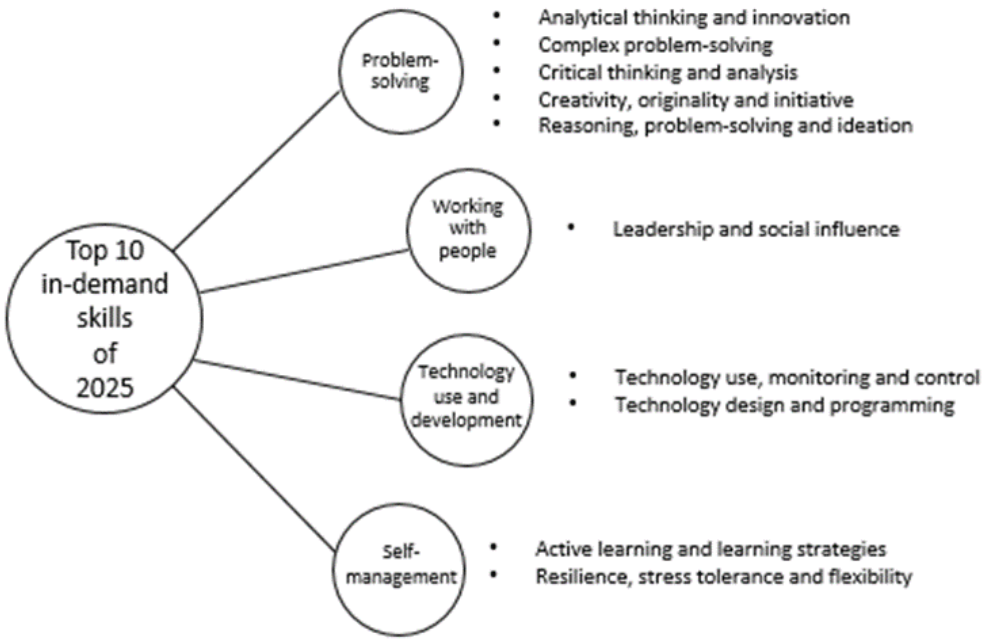

Figure 1. Top 10 in-demand skills of 2025

3.1. Problem-Solving

Under the category of problem-solving, the skills of i) analytical thinking and innovation, ii) complex problem-solving, iii) critical thinking and analysis, iv) creativity, originality, and initiative, v) reasoning, problem-solving, and ideation are included.

Table 2 indicates that complex problem-solving, critical thinking and creativity have been in the in-demand skills since 2015. These skills are projected to remain in their position in the next 5 years. Moreover, analytical thinking and innovation, originality, initiative, reasoning, problem-solving, and ideation are expected to be among the problem-solving skills.

The increase in automation throughout Industry 5.0 creates a potential for employees to add more value by dealing with more complex problems. In this context, employees will have the opportunity to think more critically. Hence, employees are expected to use their problem-solving skills both in the process of satisfying customers' personalized product/service demands and in the human-robot-algorithm cooperation process.

3.2. Working with People

The green and digital transformation with Industry 5.0 is anticipated to influence the communication process among employees. While cooperating with robots and algorithms, employees must also be able to work effectively with people inside and outside the organization. Leaders also need to demonstrate the leadership style that is appropriate both for the dynamic structure of the organization and the competitive environment in order to ensure the adaptation of employees and increase their motivation. Hence, leadership and social impact are in the category of working with people in Table 2.

Due to the human-centric orientation of Industry 5.0, transformational leadership and collaborative leadership behaviors are considered to be effective tools. In the era of industry 5.0, attempts to increase the level of engagement, empowerment, and participation are meaningful approaches (Eraslan, 2011; Little & Little, 2006; Perry, Pearce & Sims, 1999). Thus, employees can adapt to the transformation and increase their contributions towards achieving organizational goals. Demonstrating leadership behavior in accordance with Industry 5.0 in the organization will increase the social impact of both leaders and employees (Aprilisa, 2020:547). Based on the Social Impact Theory of Latané (1981) social impact is defined as a social effect in which one could change others' values, feelings, thoughts, attitudes, and behaviors. In the industry 5.0 era, it is expected that influencing people both inside and outside the organization will be among the in-demand skills.

3.3. Technology Use and Development

Under the category of technology use and development; i) technology use, monitoring, and control, ii) technology design and programming skills are included. Although these skills are not included in the in-demand skills of 2015 and 2020, having technology skills is of the essence in the Industry 5.0 era. As expected, prominent positions such as data analyst, big data specialist, digital marketing and strategy specialist, business automation specialist, AI and machine learning specialist (Future Jobs Report, 2020) have already started to require advanced technology skills.

Effective use of technology, particularly digitalization, is a source of self-reinforcing competitive advantage (Knudsen, Lien, Timmermans, Belik & Pandey, 2021). Hence, employees with the skills associated with technology usage and technology development have the potential to offer distinct contributions to businesses. Moreover, these employees are not restricted to IT departments. In other departments such as HR, marketing, production, and sales, the ways of executing some specific tasks may change. For instance, the increase in the use of AI in job interviews (Suen, Chen & Hu, 2019) may pave the way for the hire of AI specialists in HR departments. Similarly, promotion activities in marketing departments may be handled by data analysts in the near future.

3.4. Self-Management

In order to adapt effectively to the Industry 5.0 era, employees are expected to have the skills to manage themselves. These skills, which are summarized as self-management skills in Table 2, are grouped into two categories. These are i) active learning and learning strategies and ii) resilience, stress tolerance, and flexibility. Although these skills are considered to be in the context of soft skills, since they enable employees to ensure their strong existence, these skills have the potential to be labeled as power skills.

One of the skills under self-management is active learning and use of learning strategies. In order to adapt to Industry 5.0, employees should comprehend the change. For this, they should acquire or develop learning

skills. Such that, in 2025, when Industry 5.0 is expected to begin (Skobelev & Borovik, 2017:307; Yücebalkan, 2020:242) 85 million jobs are anticipated to be displaced by a shift in the division of labor between humans and machines. Additionally, 97 million new roles that are in line with the requirements of the new industrial age may emerge (Future of Jobs Report, 2020: 29). In addition, it is declared in a report that 85% of the jobs that will be available in 2030 have not yet appeared (DELL, 2017:14).

The emergence of new jobs in the coming years addresses a significant skills gap. In order to manage these gaps, employees need to reskill or even upskill. One of the basic requirements for reskilling and upskilling is active learning, which does not solely focus on receiving the provided information. Active learning includes asking, discussing, and reasoning (Petress, 2008). The employee with active learning skills can gain new skills and thus find meaning in the work. Based on the Business Characteristics Model, as the employee perceives work meaningful, the levels of motivation, job satisfaction, and performance will increase. Consequently, the employee may contribute to the organization and welfare of the society.

The remaining skills within the framework of self-management are stress tolerance, resilience -which refers to the ability to adapt successfully in the face of stress and adversity (Wu et al., 2013)-, and flexibility. Dündar, Tüzüner and Atay (2020: 165) classified 5 types of flexibilities, which are time flexibility (flexible working hours), numeric flexibility (number of people working short-time and full-time within businesses), space flexibility (remote working), wage flexibility, and functional flexibility. Among the types of flexibilities, functional flexibility can be considered as an employee skill. An employee with functional flexibility has multiple specialties, can hold different positions in the organization, adapts to rapidly changing technological conditions and different levels of workloads (Dündar, Tüzüner & Atay, 2020: 165). Considering the increasing roles of employees, functional flexibility is expected to be one of the in-demand skills in the near future.

4. CONCLUSION

Industry 5.0 can be defined as the green and digital technology transformation that aims for a human-centric and sustainable industry. In this process of transformation; an increase in automation in shifting the tasks that employees execute, the emergence of new industrial fields and new jobs are expected. Hence, employee skills should change to adapt to Industry 5.0. In this study, the concept of Industry 5.0 is briefly explained and the question of “How employee skills will change in association with Industry 5.0?” is discussed. The conceptual framework of the study is grounded on the skill classification discussed in the two reports of The World Economic Forum (2016 and 2020), which are entitled "Future of Jobs Report".

Industry 5.0 focuses on the sustainability and collaboration between humans, robots, and algorithms (Demir & Cicibaş, 2017). This cooperation can be achieved by placing the human factor at the center of the integrated system established by Industry 4.0. Accordingly, Industry 5.0 has also been conceptualized as a greener and more human-oriented version of Industry 4.0 (Dalgın, 2021).

As of 2025, when Industry 5.0 is anticipated to begin, job descriptions, job requirements, and needed employee skills will differ. In order to prevent the possible skills gaps to occur, it is necessary to identify the skills that will be needed. Based on a report of the World Economic Forum (Future of Jobs Report, 2020), 4 skill groups are anticipated to be at the forefront. These skill groups are as follows (Future of Jobs Report, 2020):

1.Problem-solving,

2.Working with people,

3.Technology use and development,

4.Self-management.

In the era of Industry 5.0, similar to the previous years, **problem-solving skills** are expected to be among the top in-demand skills. The need for these skills in the near future primarily arises from the development of advanced technologies such as automation and cyber-physical systems. The advanced technologies may set the stage for employees to create more value. In doing so, employees will engage in more cognitive efforts and exhibit complex problem-solving skills in their work.

Industry 5.0 will also change the communication processes between employees. In this direction, working with people becomes an important skill, which can be demonstrated through **leadership and social impact**. Leadership is key to enable employees to adapt to the transformation of Industry 5.0. Focusing solely on

improving employees' technical skills will not be adequate for transformation (Özmen, Eriş & Özer, 2020: 64). Therefore, leaders need to demonstrate the leadership style that is suitable for the new business context. In addition, while employees are expected to collaborate with robots and algorithms in the Industry 5.0 era, they are also expected to create a social impact on people inside and outside the organization.

Another skill group among the in-demand skills is **technology use and development skills**. The demand for this skill group mainly arises from the focus of Industry 5.0 on the collaboration between humans, robots, and algorithms. Accordingly, technology use and development skills, which were not among the top in-demand skills in previous years, are anticipated to be among the top 10 skills by 2025, when the effects of Industry 5.0 are expected to be seen (Future of Jobs Report, 2016; 2020). In the following years, these skills may need to be acquired by all employees in businesses, regardless of function. Because these skills are needed not only in IT, R&D, or production departments but also in any other department where technology can be actively used. For instance, with the increase in the use of artificial intelligence in interviews (Suen, Chen & Hu, 2019) AI experts can play an active role in human resources departments. Similarly, promotional activities in marketing departments can be executed by data analysts.

In order to have all the skills associated with Industry 5.0 in this study, employees must also have **self-management skills**. With the new industrial revolution, it will not be adequate for employees to receive only the available information. Rather, employees need to take into account all the information available. Moreover, employees are also required to acquire or improve skills to evaluate, compare, and interpret information. In addition, employees need to develop learning strategies that enable them to manage themselves. As a consequence, they could reskill or upskill. In addition, employees need to develop the skills of resilience, stress tolerance, and flexibility in order to overcome the challenges they will confront in the transformation to Industry 5.0.

Frankiewicz and Chamorro-Premuzic (2020) stated that the transformation in industry 5.0 is more about human beings than technology. Because although organizations focus on acquiring advanced technology and digitization, this transformation will only be carried out by employees. This transformation will also make a difference in employee skills. Therefore, organizations will be able to adapt to the transformation only by identifying the in-demand skills of the future and meeting skills gaps they will encounter. In this context, it is anticipated that the roles and responsibilities of HR departments will increase in order to meeting skills gaps in organizations during the Industry 5.0 era (Demir, Döven & Sezen, 2019:693).

In order to support the acquisition of new skills requirements of employees, employers should conduct education and training programs. Employees should be trained to have the ability to "learn how to learn". Hence, employees will be able to upskill and reskill, which are considered to be essential in the adaptation process to Industry 5.0. Moreover, contemporary approaches, for instance, the use of reverse mentoring (Güğerçin, 2017) programs, are expected to support the adaptation process in Industry 5.0.

One of the limitations of the study is that the stages of industry differ from one country to another, which is an obstacle for generalizing the results. As a matter of fact, the transition to the Industry 4.0 process started earlier in developed countries than in developing countries (Bogoviz, Osipov, Chistyakova & Borisov, 2019). For instance, a study from Turkey, which was conducted in 2016 using data from 1,000 private sector organizations in Turkey, shows that the digital maturity of Turkey is between Industry 2.0 and Industry 3.0 by the year 2016 (TÜBİTAK, 2016:4). Therefore, the need for the skills discussed in this study may arise in developed countries and developing countries at different times. Thus, the skills expected to emerge as a result of Industry 5.0 should be evaluated taking into account the difference among the countries.

Future studies may focus on how the in-demand skills of the future will differ according to industry segment. Moreover, empirical analyses of the adaptation level of employees to Industry 5.0 will contribute to the literature. Finally, it is thought that it will be useful to examine the effects of Industry 5.0 on employee competencies.

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