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Industry 4.0 and The Future of The Labor Market*

Endüstri 4.0 ve Emek Piyasasının Geleceği

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Abstract

After the introduction of computers and the Internet into our lives with the Third Industrial Revolution, digital developments such as wireless networks, computing, cloud infrastructures, big data technologies, artificial intelligence-enhanced robots, internet of things (IoT), and cyber-physical systems (CPS) are starting of a new technological age. The Fourth Industrial Revolution, known as Industry 4.0, will initiate a transformation in production models, as in many areas, with its technological tools. The aforementioned components of Industry 4.0, cyber-physical systems (CPS), Internet of Things (IoT), and cloud computing, artificial intelligence and robotic technologies have transformed production and changed the nature of many businesses.

This digital transformation puts pressure on the labor market and the transformation of the labor factor and stands before us as a multidimensional problem that needs to be resolved. While these technologies increase competitiveness in terms of cost advantage and efficiency in production, they bring about changes in the production structure. The technology mentioned in all areas of life is planned to serve the "unmanned" mission. With unmanned transportation vehicles, educational institutions, hospitals, factories and many others, human labor will be replaced by artificial intelligence wonder robots, robotic arms and machines in daily life. The perfect example of full automation, dark factories, robots with artificial intelligence technology, robotic arms and machines that communicate with each other, seem to seriously shake the place of labor in production. In this process, the following question comes to mind: Will the machines that are expected to replace labor affect employment negatively or is it possible for labor to keep up with this technological transformation? Considering the unmanned mission of technological transformation, it means that this situation will negatively affect the employment of the labor factor and technological unemployment will increase. However, the disadvantaged position of labor in an environment with a high level of automation should be evaluated in terms of the characteristics of the current labor market. The jobs of the future undergoing technological transformation require more technological knowledge and human skills. Although technological developments leave production to artificial intelligence, robots and smart machines, human intelligence is still needed behind these technological wonders. In all production and service units built on full automation, there will always be a need for technicians and engineers working in the background of the flawless operation of that technology. Although this shows that unskilled labor force will lose the war against technology, it shows that there is always hope for qualified labor force. In the study, the current situation is revealed by making a literature study on the effect of technological developments in the labor market, and the effects of this technological transformation on the labor market are mentioned by giving information about the concept of industry 4.0 and its components.

Possible changes in the labor market due to the intensive use of smart technologies in the production of goods and services are also included.

Keywords: Industry 4.0, technological unemployment, labor market

Öz

Üçüncü Sanayi Devrimi ile hayatımıza bilgisayarlar ve internetin girmesinin ardından kablosuz ağlar, bilgi işlem, bulut altyapıları, büyük veri teknolojileri, yapay zeka ile güçlendirilmiş robotlar, nesnelerin interneti (IoT), siber-fiziksel sistemler (CPS) gibi dijital gelişmeleri ile bugün yeni bir teknolojik çağ başladı. Endüstri 4.0 olarak anılan Dördüncü Sanayi Devrimi beraberinde getirdiği teknolojik araçları ile bir çok alanda olduğu gibi üretim modellerinde de dönüşümü başlatacaktır. Endüstri 4.0'ın beraberinde anılan bileşenleri siber-fiziksel sistemler (CPS), nesnelerin İnterneti (IoT) ve bulut bilişim, yapay zeka ve robotik teknolojiler üretimi dönüştürerek birçok işin doğasını değiştirdi. Bu dijital dönüşüm emek piyasası ve emek faktörünün dönüşümü üzerinde baskı oluşturmakta ve çözüme kavuşturulması gereken çok boyutlu bir problem olarak önümüzde durmaktadır.

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Bu teknolojiler üretimde maliyet avantajı ve verimliliği yükseltmese bakımından rekabet gücünü arttırırken, üretim yapısında da değişiklikler meydana getirmektedir. Yaşamın her alanında bahsi geçen teknoloji "insansız" misyonuna hizmet edecek şekilde planlanıyor. İnsansız ulaşım araçları, eğitim kurumları, hastaneler, fabrikalar ve daha niceleri ile günlük hayatta insan emeğinin yerini yapay zeka harikası robotlar, robotik kollara ve makinalar alacaktır. Tam otomasyonun kusursuz örneği karanlık fabrikalar, yapay zeka teknolojisine sahip robotlar, robotik kollar ve kendi aralarında iletişime geçen makinalarıyla, emeğin üretimdeki yerini ciddi anlamda sarsacak gibi görünmektedir. Bu süreçte akla şu soru gelmektedir: Emeğin yerini alması beklenen makineler istihdamı olumsuz etkiler mi yoksa emeğin bu teknolojik dönüşüme ayak uydurması mümkün müdür? Teknolojik dönüşümün insansız misyonu göz önüne alındığında, bu durumun emek faktörünün istihdamını olumsuz etkileyeceği ve teknolojik işsizliğin artacağı anlamına gelmektedir. Ancak yüksek düzeyde otomasyonun sağlandığı ortamda emeğin dezavantajlı konumda olması mevcut emek piyasasının nitelikleri açısından değerlendirilmelidir. Geleceğin teknolojik dönüşümden geçen işleri, daha fazla teknolojik bilgi ve insan becerisi gerektirir. Her ne kadar teknolojik gelişmeler üretimi yapay zeka, robotlar ve akıllı makinalara bırakıyor olsa da hala bu teknoloji harikalarının arkasında insan zekasına ihtiyaç bulunmaktadır. Tam otomasyon üzerine kurulu tüm üretim ve hizmet birimlerinde, o teknolojinin kusursuz işlemesinin arka planında çalışan teknisyen ve mühendislere her zaman ihtiyaç duyulacaktır. Bu durum, niteliksiz emek gücünü teknoloji karşısında savaşı kaybedeceğini gösterse de, nitelikli emek gücü için her zaman umudun olduğunu göstermektedir.

Çalışmada teknolojik gelişmelerin işgücü piyasasındaki etkisine yönelik bir literatür çalışması yapılarak mevcut durum ortaya konulmuş ve endüstri 4.0 kavramı ve bileşenleri hakkında bilgi verilerek bu teknolojik dönüşümün işgücü piyasasına olan etkilerinden bahsedilmiştir. Mal ve hizmet üretiminde, akıllı teknolojilerin yoğun kullanımı nedeniyle, işgücü piyasasındaki olası değişikliklere de yer verilmiştir.

Anahtar Kelimeler: Endüstri 4.0, Teknolojik İşsizlik, İşgücü Piyasası

1. INTRODUCTION

While the First Industrial Revolution brought mechanical innovations such as steam engines and railways to our lives, the second Industrial Revolution brought the concept of mass production, and the Third Industrial Revolution brought computer and Internet technologies (Bahrin et al., 2016). Digital developments such as computing, cloud infrastructures, big data technologies,wireless networks, internet of things (IoT), artificial intelligence-enhanced robots, smart factories, cyber-physical systems (CPS) have created a lot of technological developments that pave the way for the Fourth Industrial Revolution today (Thames & Schaefer, 2017; Li et al., 2019). The Industry 4.0 concept was first presented at the Hannover fair in 2011 (Bortolini et al., 2021). Industry 4.0 is a strategic initiative of the German government that has traditionally supported the development of the industrial sector. It should come as no surprise that this initiative came from Germany, which has one of the most competitive manufacturing industries in the world. Industry 4.0 has been a common topic of discussion in the research, academic and industrial communities in many different situations in Germany since its introduction (Rojko, 2017). With such technological developments and the emergence of the Fourth Industrial Revolution, the issue of how to produce products has also come to the fore. With the increase in automation and concerns about the future of jobs, necessary skills and retraining workers are discussed. Integrating this developing technology with smart factories for production systems, rapidly adapting to the pace of technological innovation and increasing automation in production will be important to change the production model and continue to produce high quality goods and services (Kumar, 2018; Lasi et al., 2014).

2. COMPONENTS OF INDUSTRY 4.0

With the introduction of Industry 4.0 into our lives, a new era of technology has begun in which the entire production model will be transformed. The components of Industry 4.0 will start the era of dark factories by transforming production in big data analytics, cloud computing, cyber-physical systems (CPS), internet of things (IoT), virtual reality and 3D technologies, artificial intelligence and robotic technologies. Under this title, these technological advances that underlie the discussion of Industry 4.0 today are briefly mentioned.

2.1 Big Data Analytics

Today, there has been a tremendous data explosion due to emerging technological developments such as the internet, the internet of things, social networks and cloud computing. This data needs to be processed quickly as it becomes more diverse, more complex and less structured. However, traditional data analysis may not be able to handle such large amounts of data. This has created a new and complex area of advancement, surpassing traditional technologies and computing capabilities such as relational databases and scale-up infrastructures (Park et al., 2015).

Literally, big data encompasses huge amounts of data, so it is difficult to collect, store and analyze. However, big data is not only a large amount of data, but also a concept that offers the opportunity to find useful information on existing data (Fisher at al., 2012).

2.2 Cloud Technologies

According to the National Institute of Standards and Technology (NIST), cloud computing is a model that provides ubiquitous on-demand network access to a common pool of configurable computing resources such as networks, servers, storage, applications, and services with minimal management effort or service provider interaction (Mell,2011). In short, people who use the cloud system will be able to access the data they want whenever they want if they have a device (smartphone, tablet computer, laptop or desktop computer, etc.) that will enable them to use a network or internet connection that provides this service.

2.3 Cyber - Physical System

Cyber-Physical System (CPS), which effectively combines cyber and physical components, detect their changes, respond to them, learn and adapt themselves using modern sensor, computing and network technologies. The cybernetic beginning of the Cyber-Physical System is the integration of computer hardware and software technologies and qualitative new actors surrounding them (Alguliyev et al., 2018).

2.4 Internet of Things

The Internet of Things (IoT) is recognized as an ecosystem that includes smart objects equipped with sensors, networking and processing technologies that integrate and work together to provide an environment where smart services are delivered to end users. It is a computing technology that transforms common objects into interconnected devices wherever there is an Internet connection. The internet of things is a concept for deploying billions of smart objects that can sense the surrounding environment, transmit the obtained data, process it, and then give feedback to the environment (Asghari et al., 2019; Kiran, 2019; Sisinni et al., 2018). It is possible to come across internet of things (IoT) applications in many areas such as production, health, environment, smart cities, marketing.

2.5 Virtual Reality and 3D Technologies

Virtual reality; It refers to technologies that replicate a real environment or recreate an imaginary world with a computer in at least three dimensions and use it to provide an experience that includes real sounds, images and other sensations. Virtual reality and augmented reality technology are used in production, vocational training (aviation, military, medicine, etc.), education and in studies related to the evaluation of models designed in many fields. Today, employees are trained with virtual reality devices to accurately convey factory operations (Zhu et al., 2019; Raja & Priya, 2021; Firu et al., 2021).

2.6 Cyber security

Advancement in technology also leads to higher cyber threats that require the development of new preventive measures and is of great concern. Billions of data are produced and stored on the Internet. It will be inevitable for this data to be exposed to a cyber attack at any time. In the new digital age, protection against possible cyber attacks has become an important issue as a result of the massive development of the information and communication technology (ICT) industry (Sarker et al., 2020; Craigen et al., 2014; Rainie et al., 2014; Von et al., 2013).

2.7 Learning Robots – Cobots

The concept of robot can be defined as a machine that resembles a human form and is programmed to perform many traditional tasks done by humans. On the other hand, cobots, are a type of robot designed to do many complex tasks in cooperation with the human factor and robots in order to achieve high productivity (Clarke, 2019; Peshkin et al, 2001).

Although traditional robots can do a single task with high speed and precision, easier and less costly, they also includes technical limitations that require an experienced programmer, a long time and a heavy amount of coding. These limitations of traditional robots can be overcome with artificial intelligence (AI) equipped robots controlled by algorithms and programs. At this point, Robots that among the superior technologies of industry 4.0 have emerged from the combination of machine learning and artificial intelligence. Robots, which are part of traditional industrial production, are increasingly equipped with more intense artificial intelligence and show themselves in tasks that human intelligence can handle. Although they are smarter than traditional robots, it cannot be said that all artificial intelligence robots are smart. Some robots are coded just to close the jar lid or insert a screw. These robots cannot be expected to perform complex tasks (Liu et al, 2020; Kragic et al, 2018; Gray & Wegner, 2012).

The first industrial robot was produced in 1961 at Unimation, the first robot company founded by Devol and Joseph Engelberger in 1956 (Gasparetto & Scalera, 2019). The robot consisted of a mechanical arm mounted on a rail and equipped with a gripper. Later, Devol and Engelberger's vision for robotic automation became a reality and millions of arm-type robots were built. Many items we buy today are assembled by a robot (Corke, 2017).

Our life has turned into a physical and intelligent environment, with sensors, actuators (a kind of engine powered by an energy source), computational units, which are perfectly placed in everyday objects, and which are constantly and invisibly interconnected through a network. Much research on the classical robotic platform has focused on sensing its environment and storing data in the database for future use. Thus, the robots will be equipped with many expensive sensors and some complex algorithms, and will be operational based on a huge database for decision making. As a result of these developments, it will be possible for service robots to enter our daily lives and save us from daily work (Baeg et al., 2007).

2.8 Artificial Intelligence and Dark Factories

To implement Industry 4.0, three key features must be taken into account: horizontal integration, vertical integration, and connected manufacturing systems through value-added networks, and digital integration of engineering. Smart factory, which represents vertical integration, aims to improve the intelligence of machines by skillfully combining artificial intelligence (AI) technology, as well as cloud computing, the internet of things (IoT) and big data technology to deeply integrate information technologies into automation (Lui et al., 2015; Wang et al., 2017; Shafiq et al., 2018).

Dark Production, or in other words, the Dark Factory, is a computer-controlled production center where the manufacturing process is carried out with a machine that does not require any human being to run it. Automation and robotics are making production more advanced, replacing humans as part of processes. Automation is defined as the force behind rationalizing production processes to increase competitiveness and efficiency (Wadhwa, 2012).

The Dark Factory first came to the fore in the early 1980s, and the first Dark Factory examples began to appear in Japan in the 1980s (Shirley et al., 1995). In 1982, General Motors opened a dark factory in the US state of Michigan with the idea of the factory of the future. The aim of General Motors was to be free from production risks and bureaucracy with automation and robots. However, the factory was closed in 1992 before it could reach the status of a dark factory. FANUC company, founded in 1956 by Dr. Seiuemon Inaba in Japan, pioneering the concept of numerical control (NC), has become the most successful and well-known dark factory. This company that running dark factory with NC machine tools and robots, was the first company to be at the forefront of the manufacturing revolution worldwide. It operates a complex of 22 factories with robots, producing 22,000 to 23,000 computer numerical control machines per month, and its robots can remain unsupervised for up to 30 days at a time (Enterpriseiotinsights, Accessed: 29.04.2020). In the years following its establishment, FANUC has become the world's leading manufacturer of factory automation, pioneering many firsts with its 4.9 million CNC controls and 810,000 robots installed worldwide (Fanuc, Accessed: 25.07.2022). Robot manufacturers such as FANUC, KUKA, ABB and YASKAWA all produce robots between 10,000 and 30,000 in more than 30 countries each year. However, today, the models expressed as smart factories are semi-automated models that include human-machine (robot) cooperation (Hentout et al., 2019; Sztipanovits et al., 2019).

Table 1. Advantages and Disadvantages of Full Automation and Artificial Intelligence in Production

Advantages	**Disadvantages**
Production and production process management will become practical. Despite longer working times (24 hours), fewer defective parts will be produced. Machines that are costly in the first place are cheaper to manufacture. It can increase the methods and efficiency of companies in the field of production. With cyber-physical systems and other arguments, the potential to increase efficiency in the production process is enormous. It will enable flexible production systems and the supply chain will become smarter. Energy and infrastructure costs will decrease. Since the production will continue at night, especially energy costs will be saved. Less human resources will be needed. They can be used in more productive works by shifting labor power to areas such as R&D. An increase in income and profit will be achieved. Since the speed to be achieved in production will be faster than the traditional production method, it will increase the competitiveness.	Industry 4.0 introduces some new technological challenges in the process that allows people to gradually adapt and increase the level of digitization. In the current technological environment, the main challenge is to intelligently combine and integrate multiple data sources and reason to reduce situational awareness. As it relies on levels of technical complexity, integration and automation far beyond traditional manufacturing processes, it will create new vulnerabilities. This is where shared concerns about security requirements, policy, and compliance matter. Also, capturing machine-generated data, understanding it, transforming it into valuable information, and adopting such technologies and implementing them for the first time can be very costly. There is also the opinion that production will create a disadvantage in terms of employment as well as the security risk. However, while this disadvantage mostly affects the blue-collar labor factor, it is also believed that it will increase the need for more educated and qualified labor force.

The full automation and smart manufacturing model offers several advantages and disadvantages (Brousell et al., 2014; Shafiq et al., 2015; McKinsey, 2016; Kusiak, 2017; Fonseca, 2018; Tuptuk&Hailes, 2018; Fatorachian & Kazemi, 2018; Fragapane et al., 2020). As given in Table 1, each innovation will have advantages as well as disadvantages. Eliminating the disadvantages of automation and smart production over time will bring a new breath to production.

In order to implement the dark factory model, multidimensional problems that need to be solved such as the technical dimension, the architectural dimension, the planning dimension, the human dimension, the safety and security dimension must be resolved (Zuehlke, 2010).

3. THE PLACE OF INDUSTRY 4.0 ARGUMENTS IN OUR LIVES

The Industry 4.0 era requires manufacturers to continuously improve their production efficiency and quality in order to provide competitive advantage, while providing rapid responses to ever-changing consumer demands in production. For this purpose, mass production to meet the ever-changing demand is ensured by automation with high efficiency, continuity and repeatability.

The adaptation of the human factor to this phenomenon of high speed and repeatability in the production process requires physical strength, endurance, speed, etc. limited in terms of these limitations can result in reduced productivity and quality. All of these bring the issue of automation and the labor factor, that is, the human being, to the agenda in production. The collaboration of robots and humans to complete production tasks has resulted in the Human-Robot Collaboration (HRC) discipline of robotics (Zaatari et al., 2019; Huang, et al., 2019). Human-Robot Collaboration (HRC) is defined as application scenarios where a collaborative robot (cobot) and a human use the same workspace and interact to perform collaborative tasks (Hentout, et al., 2019; Krüger et al, 2009; Nagesh et al.,1999).The main task of human-robot cooperation is to ensure the safety of the human factor (Liu & Wang, 2020). However, robots designed for assembly line workers have been observed to increase safety, quality and productivity while reducing ergonomic concerns due to physical and cognitive loading in the workplace (Cherubini et al., 2016; Vargas et al., 2019).

Looking at its examples in the world, The first example of a dark factory is a factory established in China that produces mobile phone modules. It has been observed that a robot arm used in the factory can do the work of 6-8 workers alone, the number of workers working in the factory was 650 before the system was installed, and this number decreased to 60 with the use of the robot arm. It has been observed that the rate of defective parts in the final product output decreased from 25% to 5% with the active installation and operation of the system in the factory (Turkey's Industry 4.0 Platform, Accessed: 05.05.2020). Another example, Audi carries out its production in the main plant in Ingolstadt in cooperation between man and machine. Together with KLARA (a robot that applies adhesives with the aid of a robot), CFRP roofs are being installed for the Audi RS 5 Coupe without a protective fence between a human and a robot. Similar systems have also been integrated into the body shop in Ingolstadt and Brussels, and in engine assembly production in Györ (Automotiveit, Accessed: 11.04.2020). Universal Robots, the world's leading robot manufacturer, sold its first collaborative industrial robot or cobot in 2008. Currently, the company has sold more than 50,000 cobots which are used in several thousand production environments day by day around the world (Universal Robots, Accessed: 12.04.2020). In Turkey, AKINROBOTICS, established within the Akınsoft software company in Turkey, is the world's first humanoid robot factory that makes mass production. AKINROBOTICS carries out technological studies that will facilitate daily life in the field of robot technologies that will be used in the service sector and produce industrial robot arms (Akin Robotics, Accessed: 2.5.2020).

4. WILL MACHINERY EXPECTED TO REPLACE LABOR AFFECT EMPLOYMENT NEGATIVELY?

Scientists and business people are warning of mass unemployment due to the rise of smart technology, artificial intelligence, robotics and algorithms. Considering the unmanned mission of technological transformation, it means that this situation will negatively affect the employment of the labor factor and technological unemployment will increase. However, the disadvantaged position of labor in an environment with a high level of automation should be evaluated in terms of the characteristics of the current labor market. The jobs of the future undergoing technological transformation require more technological knowledge and human skills. Although technological developments leave production to artificial intelligence, robots and smart machines, human intelligence is still needed behind these technological wonders. In all production and service units built on full automation, there will always be a need for technicians and engineers working in the background of the flawless operation of that technology. Although this situation shows that unskilled labor power will lose the war against technology, it shows that there is always hope for qualified labor power.

With Industry 4.0, new training opportunities can be considered as a win-win strategy for both employers and employees. While their workforce learns essential skills for future industrial jobs and increases their earning potential throughout their careers; boring, dirty and dangerous tasks will be automated. According to the World Development Report (2019); The fulfillment of tasks traditionally performed by humans by robots powered by artificial intelligence poses a risk for the labor factor. However, although the number of robots operating around the world is increasing rapidly, there is an increase in overall labor demand. In the report, it was mentioned that technological advances lead to direct employment creation in the technology sector (WORLD BANK GROUP, 2018).

5. IS IT POSSIBLE FOR LABOR TO KEEP UP WITH TECHNOLOGICAL TRANSFORMATION?

The World Economic Forum's Future of Jobs Report (2020) stated that as technology adoption increases, 50% of all workers will need to be requalified by 2025. Critical thinking and problem solving are among the skills that employers will highlight in the next five years; New emerging self-management skills such as active learning, resilience, stress tolerance and resilience are added to the list in the report.

At the same time, the report estimates that by 2025, 85 million workers could be displaced due to a shift in the division of labor between humans and machines. On the other hand, the report points out that more jobs (97 million) may emerge, more adapted to the new division of labor between humans, machines and algorithms.

If we look at the top 20 professions of the future listed in the 2020 Future of Jobs Report in Table 2, it is noteworthy that jobs in the labor market will undergo a technology-based transformation. The occupations listed in the report as information engineering, technicians, specialists and support workers for these jobs reveal that the need for jobs and workers in this field will increase. This necessitates a radical change in the labor force. It will not be possible for the labor currently working in the market to keep up with this transformation in the short term, but considering that every transformation is a process, the infrastructure should be prepared to equip the new people who will join the labor force with the right training and to keep up with the technological transformation.

Table 2. Top 20 Occupations with Increasing Demand in the Future in the Future of Jobs Report (2020)

Data Analysts and Data Scientists	Digital Marketing and Strategy Specialist
Artificial Intelligence and Machine Learning Specialist	Process Automation Specialist
Big Data Specialist	Business development specialist
Digital Transformation Specialist	Information Security Analyst
Software and Application Developers	Project supervisor
Internet of Things (IoT) Specialist	Business Services and Management Manager
Database and Network Specialists	Strategic Consultant
Robotics Engineer	Management and Organization Analysts
Fintech Engineer	Organizational Development Specialists
Mechanics and Machine Repairers	Risk Management Specialist

Source: Weforum, Accessed: 15.07.2022

The reality facing the workforce is that workers need to reconsider their understanding of current job skills. The cooperation between the business world and educational institutions will result in favor of the labor force and will contribute to supporting the technological transformation in the production of goods and services. Therefore, the labor force should be educated about the technology it will use today and in the future. Another issue related to technological transformation and the labor market is the role of government policy and labor unions. These authorities need to be able to help reduce the negative consequences of technology as well as take advantage of its benefits. Because considering that the benefits of technological innovation will not spread evenly on the labor factor, the government's labor policies should have the effectiveness of helping workers who are negatively affected by technology.

6. CONCLUSION and RECOMMENDATIONS

Every level of society accepted and digested industry 1.0, the transition from industry 1.0 to 2.0 and then to 3.0. Now, the industry, which is more complex and full of uncertainties, is meeting with 4.0. The Industry 4.0 vision has enabled many industrial countries to invest in production efficiency, low design and less risk. A large part of these investments are the product of smart factories in areas such as big data technologies, artificial intelligence-powered robots, internet of things (IoT), cyber-physical systems (CPS), and Industry 4.0, which accelerates the transition to full automation. Focusing on low cost, efficiency or operational flexibility by countries and manufacturers (companies) and prioritizing the dimension of production technologies will enable Industry 4.0 to enter our lives rapidly. However, Industry 4.0 brings and its requirements should be well analyzed. The disadvantages of the new production models as well as the advantages should be studied and solutions should be produced. The vulnerabilities of new production technologies that have risk and security problems should be studied. The education system should be structured in terms of the new position of the labor factor in the production to be transferred to the full automation process.

No one knows for sure how much the workplace and workforce will change and what role technology will play. In all of this, one caveat should be noted. While it is clear that the industrial revolutions of the past had the result of creating jobs, it is not known whether digital transformation will destroy jobs or create jobs. Since Industry 4.0 is still going through the first stages, the future of employment remains uncertain, but it should not be forgotten that technological developments are making rapid progress. For this reason, necessary measures regarding employment should be planned at the beginning of the road. Industry 4.0, while removing unskilled jobs from the market, could potentially create more jobs as it negatively impacts employment. On the other hand, it could reinvigorate the manufacturing base in many production units as labor costs would be taken out of the equation. Managers, on the other hand, highlight the need for new and more effective approaches to talent development. For this reason, the necessity of developing the knowledge, skills and abilities of the labor force and the education system must be planned in a way that will respond to the effects of this upcoming technological transformation. The weakening abilities of labor in the face of technology should be protected by putting the right regulations and policies into practice at the right time. It is important that formal education systems train people with different skills who will not be replaced by automation in the future and will keep up. Work in this area should continue in the future to ensure that workers, employers and policy makers are prepared for these potential changes.

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