THE IMPACT OF INDUSTRY 4.0 ON LOGISTICS HUMAN RESOURCES: AN INSIGHT FROM DOMESTIC LOGISTICS COMPANIES IN IZMIR

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ABSTRACT

THE IMPACT OF INDUSTRY 4.0 ON LOGISTICS HUMAN RESOURCES: AN INSIGHT FROM DOMESTIC LOGISTICS COMPANIES IN IZMIR

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Industry 4.0 covering new digital production systems and new business processes can be defined as automation of production processes as labor-based production processes have been replaced by the machine power. Industry 4.0 era that consists of the development and integration of information technologies has led to many innovations in the logistics management. Also, in this new era, technological progresses and innovations increase the importance of human factor and require different qualities for the human resources. The objective of this study is to determine whether the human resources of domestic logistics companies in İzmir are sufficient for Industry 4.0 era or not and the potential impact of new digital processes on them. For this purpose, a multiple case study was carried out in domestic logistics companies operating in Izmir. Findings show that domestic logistics companies are not ready for Industry 4.0, because their human resources do not have the necessary competences required by Industry 4.0. According to results, in order for the employees to adapt to this new era, they need first to gain competency in data analysis, programming language, and the use of logistics information systems. At this point, domestic logistics companies expect government incentives in order to provide these qualifications to their existing human resources. Also, the results suggest that the adaptation of education system in universities will facilitate the transition to this new era by continuously supplying qualified human resources to labor market.

Keywords: Industry 4.0, Logistics sector, Human Resources, Technological Innovations

ÖZET

ENDÜSTRİ 4.0'IN LOJİSTİK SEKTÖRÜNDEKİ İNSAN KAYNAKLARINA ETKİSİ: İZMİR'DEKİ YEREL LOJİSTİK ŞİRKETLERİ ÜZERİNDEN BİR DEĞERLENDİRME

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Yeni dijital üretim sistemlerini ve iş süreçlerini kapsayan Endüstri 4.0, insan gücüne dayanan üretim süreçlerinin yerini makine gücüne bırakmasıyla üretim süreçlerinin otomasyonlaşması olarak tanımlanabilir. Bilgi teknolojilerinin gelişimi ve entegrasyonu ile meydana gelen Endüstri 4.0 dönemi, lojistik yönetiminde birçok yeniliğe yol açmıştır. Bununla birlikte, bu yeni dönemde teknolojide yaşanan gelişmeler ve yenilikler insan faktörünün önemini arttırmakta ve insan kaynağında farklı nitelikler gerektirmektedir. Bu araştırmanın amacı, İzmir'deki yerli lojistik firmalarının insan kaynaklarının Endüstri 4.0 dönemine hazır olup olmadıklarını ve yeni dijital süreçlerin bu firmaların insan kaynakları üzerindeki potansiyel etkilerini tespit etmektir. Bu amaç doğrultusunda, İzmir'de faaliyet gösteren yerli lojistik firmaları ile çoklu vaka çalışması yapılmıştır. Elde edilen bulgular, yerli lojistik firma çalışanlarının Endüstri 4.0 için gerekli olan niteliklere sahip olmadığını göstermektedir. Edinilen sonuçlara göre, çalışanların bu yeni döneme uyum sağlayabilmeleri için öncelikle veri analizi, programlama dili ve lojistik bilgi sistemlerinin kullanımı becerilerine sahip olmaları gerekmektedir. Bu noktada, yerli lojistik firmaları mevcut insan kaynağını bu yönde geliştirebilmek için devlet desteğine ihtiyaç duyduklarını belirtmişlerdir. Ayrıca, işgücü piyasasına sürekli nitelikli insan kaynağının sağlanabilmesi için üniversitelerin eğitim sisteminin Endüstri 4.0'ın gereksinimlerine göre yeniden yapılandırılması gerekliliği vurgulanmıştır.

Anahtar Kelimeler: Endüstri 4.0, Lojistik Sektörü, İnsan Kaynakları, Teknolojik Yenilikler

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

API : Application Programming Interface
CPS : Cyber-Physical System
EDI : Electronic Data Interchange
ERP : Enterprise Resource Planning
ETA : Estimated Time of Arrival
EU : European Union
GDP : Gross Domestic Product
GPS : Global Positioning Systems
IoS : Internet of Services
IoT : Internet of Things
M2H : Machine to Human
M2M : Machine to Machine
RFID : Radio Frequency Identification
SAP : Systems Analysis and Program Development
TMS : Transportation Management System
US : United States
WMS : Warehouse Management System

CHAPTER 1. INTRODUCTION

Throughout the history, some important radical changes have occurred in the organizations of the production systems. These changes (i.e. innovations), which have significantly affected societies, are called as industrial revolutions. The first industrial revolution (1.0) occurred with mechanical production systems that used water and steam power, the second industrial revolution (2.0) emerged with electric power and also mass production was enabled in this era, and the third industrial revolution (3.0) enabled further automation of production with the use of electronics and the development of IT (Eldem, 2017). Nowadays, a new industrial revolution called as Industry 4.0, based on Cyber-Physical systems, Internet of Things, and Internet of Services, is on the agenda (Hompel and Kerner, 2015).

The term "Industry 4.0" has gained significant popularity in recent years. It was first mentioned during a trade fair in Germany in 2011 (Barreto et al., 2017). Industry 4.0 includes systems that enable real-time communication and connectivity between people, machines, and products (Rüßmann et al., 2015, p. 8). It leads to a new transformation and perspective in production. It is stated that this transformation will increase productivity, affect the economy positively, develop the industry, and change the labour profile. Also, it is claimed that all these factors will affect the competitiveness of enterprises (Boston Consulting Group, 2019).

> *"Industry 4.0 is a transformation that makes it possible to gather and analyze data across machines, enabling faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs."* (Boston Consulting Group, 2019).

Industry 4.0 is of great importance for businesses not to lose their competitive advantages; therefore they should quickly adapt to this new era. The integration of new technologies and the use of modern production techniques play an important role in competitiveness (Zawadzki and Żywicki, 2016). Adapting instantly to the changing needs of the consumer in order not to lose competitiveness and automation systems

which are in constant communication and coordination with each other describe the characteristic structures of this era (Stock and Seliger, 2016).

Ermolaeva (2016) emphasizes that the fourth industrial revolution will direct existing business processes to digitalization and replace manual operations by digital computer structures (Ermolaeva, 2016). The innovations introduced by Industry 4.0 are explained under nine building blocks of Industry 4.0, which are Autonomous Robots, Additive Manufacturing, Augmented Reality, Simulation, System Integration, Industrial Internet, Cloud Computing, Cyber-security, and Big Data (Rüßmann et al., 2015).

When taking into consideration the chronological development of four industrial revolutions, it can be seen that logistics processes have been affected in parallel with each industrial revolution (Timm and Lorig, 2015). Logistics 1.0 refers to mechanization of transportation, logistics 2.0 consists of automatic transport systems such as automated storage and sorting, the period in which computer and information technologies enable the management of logistics systems is called as logistics 3.0 (Domingo, 2016). Lastly, the fourth industrial revolution brings along the term "Logistics 4.0" (Timm and Lorig, 2015). Under the influence of Industry 4.0, physical logistics processes have started to be transformed into software-based applications, an increase in computing and communication skills has been observed, and sharing information with all stakeholders has become quite easy (Hompel and Kerner, 2015).

According to Rüßmann et al. (2015), Industry 4.0 enables the integration of production and logistics processes with information technologies. During the production and logistics processes, there is a simultaneous communication between people, machines, parts, and products. In this way, all networks are standardized, and the information is accessible for each production and logistics actor. By the help of new information and communication technologies, it is possible to collect, analyze, and interpret data for use in logistics processes. As a result, production and distribution processes will be able to respond to all expected or unexpected changes flexibly (Rüßmann et al., 2015).

In the Logistics 4.0 concept that emerged with the new industrial revolution, supply chain will become a larger network because customers will be involved in the

production with the concept of 3D production, and all relevant stakeholders (customers and suppliers) in the chain will easily access this network. Also, through the established network, all orders will be managed in real-time (Schwab, 2017).

One of the most important features of Industry 4.0 is the autonomous robots. The transportation of goods within the factory will be provided automatically by the routes programmed and autonomous forklifts (Domingo, 2016). In order for them to be autonomous coded and to cooperate with people, employees must be ready and sufficient to cooperate with machines. Therefore, the concept of M2H will come to the forefront in this era. It means there will be a change in the way human resources work, so new branches of professions and new qualifications will emerge (Sener and Elevli, 2017).

The effects of innovations and inventions on people and employment in each revolution have been the subject of discussion. Also, in the new era, some authors think that Industry 4.0 will affect employment negatively, while the others argue that it will affect employment positively (Rutkowsky et al., 2015; Schwab, 2017).

The communication of robots and machines with each other plays a major role in the Industry 4.0 strategy. Unmanned production processes in the new generation production facilities called "smart factory" will be realized with the communication of the machines in the process called M2M (Öztemel and Gürsev, 2018). While this process aims to reduce costs and increase efficiency, it may also create some problems. The most important one seems that employees can lose their jobs because robots and machines can replace people (Schwab, 2017).

The other viewpoint argues that Industry 4.0 will give people different roles and tasks by creating new business models such as robot coordinator, programmer, repairman, industrial data analyst, industrial software programmer, production technologies specialist, etc. Therefore, it is claimed that the demand for qualified labour will increase (Rutkowsky et al., 2015; Sener and Elevli, 2017). Also, for employees in the future, instead of working under the harsh conditions, forcing the limits of body strength, the main working elements will be to follow their own practices in self-organized processes and to develop production strategies. Since there will be many

integrated systems, the number of people who will work for their control and monitoring will increase (Sener and Elevli, 2017). It is also supported by Ermolaeva (2016) that revolutions and innovations have not reduced employment so far (Ermolaeva, 2016).

> "*Previous waves of technological transformation did not reduce overall employment although number of manufacturing jobs decreased, new jobs emerged and the demand for new skills grew.*" (Ermolaeva, 2016, p. 3).

The fourth industrial revolution has been implemented recently, and new qualifications emerge to be sought in the employees of the company that can adapt to the change of revolution. In the new era, processes such as explaining the changes in the ways of doing business to human resources, adapting and motivating the operation teams to this new system are required. Also, a new human resource that can be integrated with these new systems will be necessary. Unlike the last century, the most important factor in the success of institutions in today's competitive conditions is the skilled workforce (Rüßmann et al., 2015). For the successful implementation of new technologies and business processes, the human resources that will control and implement these processes are very important. The quality and efficiency of human resources directly affect the success of business processes (Sezer and Ak, 2017).

Companies that would like to apply new technologies and business processes successfully need to attach importance to the qualities of human resources (Roos et al., 1997). When looking at the job advertisements of the logistics companies (e.g. Amazon, DHL, etc.) which are thought to implement new technologies and business processes of Industry 4.0 best, it is observed that they are looking for the following three groups of qualifications in their human resources;

- **Use of data analysis** which are Oracle, Hadoop, Unix, Vlookup, Mahout, Pivot Tables, R, Access.
- **Use of information systems for logistics** which are SAP, ERP, WMS, TMS.
- **Knowledge of programming language** which are SQL, MYSQL, VBA, Phyton, Perl, Ruby, Java.

The aim of this study is to investigate whether human resources of domestic logistics companies in İzmir are sufficient to implement applications of new technologies of Industry 4.0. It also aims to reveal its impact on the human resources of domestic logistics companies. This study seeks for the answer of question how the human resources of domestic logistics companies should be transformed. The extent to which the employees of domestic logistics companies are ready for Industry 4.0 is investigated. The main research questions are as follows:

- Do employees of the domestic logistics firms in İzmir currently have the qualifications required by Industry 4.0?
- Do managers of domestic logistics firms think that their employees should have qualifications required by globally leading logistics firms?
- Do domestic logistics companies need a new human resources during the period of Industry 4.0?
- Do managers of domestic logistics firms think that people working in the logistics sector can be trained to adapt to Industry 4.0, and what is the advice on how to train them?

In order to find the answers to these research questions above, interviews were conducted with the CEOs/managers of domestic logistics companies in Izmir. The answers of these questions will enable domestic logistics companies to realize their shortcomings in their human resources. This study also guides logistics company managers for selecting and training their employees. In addition, the findings of this study will give the idea of how logistics companies' human resources should change. It also guides the current workers in logistics companies for which skills and qualifications they need to gain and strengthen at the beginning of the Industry 4.0 era.

CHAPTER 2. INDUSTRY 4.0

2.1. The First Three Industrial Revolutions Throughout the History

The industrial revolutions, which have occurred at different times, are seen as the basis of many innovation movements and transformations in the world. Industrial revolution means the transition from small-scale production and economy based on agriculture and handicraft to large-scale production and economy based on industry (Jensen, 1993). Another definition is that industrial revolution is the transition from production type based on manpower to production type based on machine and technological power (Rojko, 2017). Changes in the mode of production also affected the role of people in production, and it caused people to undertake different tasks (José et al., 2013). Each industrial revolution improved technology some more and the continuous development of technology also led to the changing of the qualifications of employees according to the technology used at that time (Kaya, 2014). The industrial revolution, which has led to socio-economic and cultural changes in the world, has taken place four times up to the present (Butter et al., 2014). The developments of the industrial revolutions are shown in Figure 1 below.

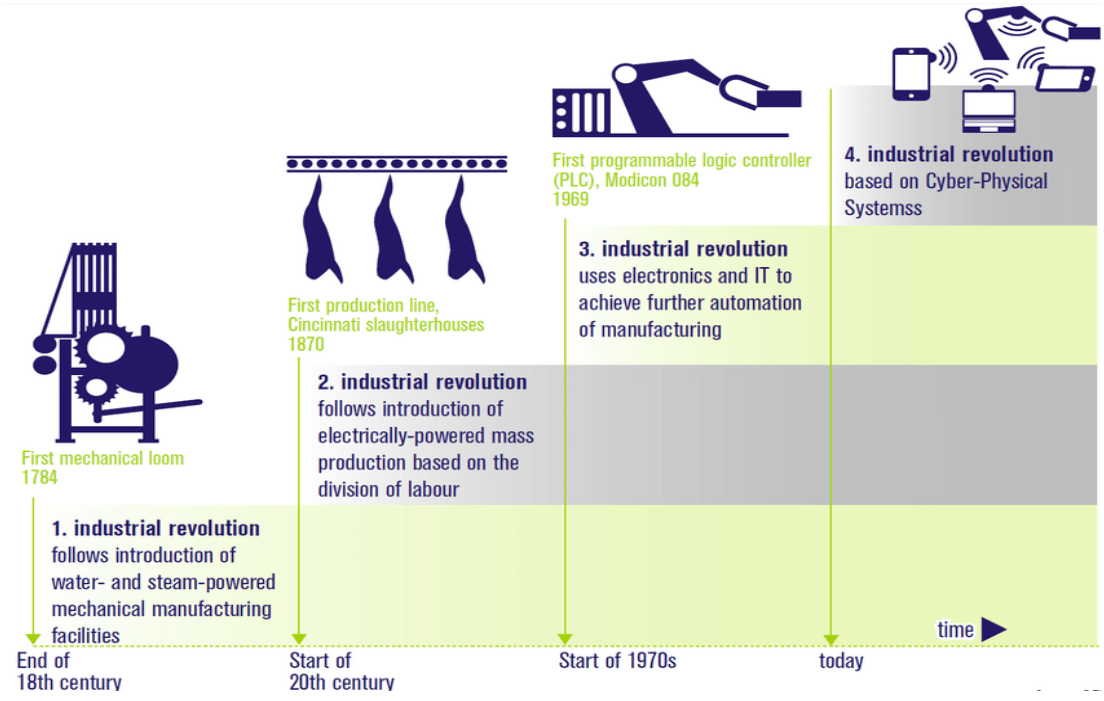

Figure 1. Industrial Revolutions (Source: Butter et al., 2014)

The first industrial revolution, which affected the period between 1760-1830, began to show its effect with the mechanization of the weaving looms in England. Before the start of the first industrial revolution, the economic structure was largely dependent on agriculture and handicraft. Also, some production types such as weaving and carpentry took place on handlooms (Cipolla, 1965). Through the invention of the steam machine in England, which had an external combustion engine that converts the heat energy existent in the steam into mechanical energy, the power of steam and water was transferred to production and manual production was replaced by mechanical production (Cipolla, 1965). In this period, factories started to be established through the transition to mechanization. The inclusion of machinery to production also increased iron, steel, and textile production, therefore it led capital stock in countries. At the same time, railway networks were developed during this period, thus the products started to be transported to distant points and trade developed (Jovane et al., 2008). The first industrial revolution also had social consequences as well as economic consequences. The most important one of these was the emergence of the bourgeoisie and the working class. In addition to this, socialism gained importance, which protected the rights of the working class (Debray, 2007).

The second industrial revolution, which was at the beginning of the 20th century, emerged with changes in the use of raw material and energy sources. Electricity, petroleum, and chemical substance were used in the production as an energy source. During this period, the use of internal combustion engines based on oil became widespread (Mokyr, 1998). At the same time, Henry Ford introduced mass production line system in the automotive industry aided by the discovery and development of electric power and it accelerated industrialization (Bauernhansl et al., 2014). The development of steel production instead of iron, which prevailed in the First Industrial Revolution, improved rail transport and trade further. In addition, other developments such as telephone, radio, typewriter, and newsprint shaped communication in this era (Mokyr, 1998).

The third industrial revolution dominated the period from the 1970's to the present. After World War II, the development of electronics, information, and communication technologies ensured automation in production (Greenwood, 1997). By virtue of the development of programmable logic controller (PLCs), automation in production

started to be advanced (Sundmaeker et al., 2010). *"The first three industrial revolutions can be summarised, in respective order, as the results of mechanisation, electricity and lastly information technology"* (Du Plessis, 2017, p. 9). Intelligent robots that started to be produced in this era brought automation to a very important point (Rifkin, 2011). One of the most important other subjects in this era was the rapid depletion of the world's resources, therefore the notion of sustainability became a current issue. In the third industrial revolution, renewable energy sources such as solar and wind gained importance due to the problems and environmental concerns in non-renewable resources (Mathews, 2013).

The fourth industrial revolution was first introduced at Hannover Exhibition in Germany in 2011. Then, it appeared in the report "Recommendations for implementing the strategic initiative Industry 4.0" prepared by Kagermann, Wahlster, and Helbig in 2013 and presented to the German government (Kagermann et al., 2013). In this report, Kagermann et al. (2013) introduced the concept and system of Industry 4.0 and determined the strategies to be made for the future. The main idea of this revolution, called Industry 4.0, is the implementation of the IoT and CPS systems in the production (Weyer et al., 2015) This revolution will be explained in details in the next section.

2.2. The Fourth Industrial Revolution

The fourth industrial revolution, called Industry 4.0, started as a technology project supported by the German Government and provided the transition from the traditional production method to the new production model based on Cyber-Physical systems. In the simplest terms, cyber-physical systems provide a connection between the virtual world and the real world with the help of actuators and sensors (Rudtsch et al., 2014). The purposes of the project are to increase production efficiency and provide the integration of customers to the production process (Qin et al., 2016).

The features of Industry 4.0 are to realize real-time communication and connection between producers, customers, and products and to develop a digitalized intelligent manufacturing model according to flexible customer demands. The basic of this intelligent manufacturing model is the transformation of the product from a single type to customized. In this model, customers can participate in production fully, not partly

(Fırat and Fırat, 2017b). In this new era, consumers can design the products as they wish on the internet platforms. Then, the products designed by consumers are easily produced with 3D production (Schwab, 2017).

The fourth industrial revolution includes a structure that will completely change the relationship between production and consumption. This new era is described by the production systems which meet the changing needs of the consumer and the automation systems keeping in communication with each other (Alçın, 2016). Also, Mrugalska and Wyrwicka (2017) describe the concept of Industry 4.0 as the integration of physical machines, sensors, and software to better control and plan production. Industry 4.0 focuses on optimization of value chains because of autonomous control and dynamic production. It covers the design and implementation of products, services, flexible logistics, and production systems (Mrugalska and Wyrwicka, 2017).

Can and Kıymaz (2016) claim that the fourth industrial revolution aims that all parts in production work in cooperation with each other. In this new era, the integration of digital data, software, and information technologies come into prominence (Can and Kıymaz, 2016). According to Qin et al. (2016), Industry 4.0 creates a strong network of communication between various companies, factories, suppliers, logistics providers, and customers. This network enables real-time communication and connectivity between them (Qin et al., 2016).

Industry 4.0 will provide an intelligent system which has autonomous systems such as self-configuration, self-monitoring, and self-healing. Also, Industry 4.0 gives people a very active role in the production. The role of people in production is to provide software and control these intelligent systems. Although this intelligent system has the ability to control itself, people will be needed because every control system needs another control mechanism in order to solve problems and work in a balanced way. Thus, a new type of advanced production and industrial processes based on machine-human cooperation will emerge. As a result, it will enable unprecedented operational efficiency and increase productivity (Thames and Schaefer, 2016).

Industry 4.0 which is known as a digital industry is a transformation that allows faster, more flexible, and more efficient processes in production. In addition, real-time communication between machines, which is a part of this transformation, makes data collection and analysis easier. Rapid access to data and analysis leads to the development of the decision-making mechanism (Gilchrist, 2016).

Tjahjono et al. (2017) state that the fourth industrial revolution, dominated by cyber-physical systems, can be described as an intelligent ecosystem that includes sensors and operators connected to the internet and can identify all devices used to exchange information and data with each other. This makes it possible to access all kinds of information in real-time and reveals a production facility capable of communicating with each other and self-regulating (Tjahjono et al., 2017).

Öztemel and Gürsev (2018) mention that Industry 4.0 highlights topics such as production flexibility, computer-aided design, and production in smart factories, which are implemented by fully automated systems independent of human power. All units of the production work in real-time and constant communication with each other. This enables faster, better quality, and more efficient industrial digital conversion with intelligent machine-machine interactions. Furthermore, this concept makes it possible to produce more and more various products with less manpower (Öztemel and Gürsev, 2018).

At the same time, according to Gorecky et al. (2014), through the Industry 4.0, a mechanism for machines was created that reminded of the way the human brain works. It was called as artificial intelligence. By means of this mechanism, machines able to make decisions as people do and manage themselves. The self-management and self-control of machines depend on how people program them. This situation shows that people and machines should work in cooperation and emphasizes the importance of the human-machine concept in the new era (Gorecky et al., 2014).

Wang et al., (2016) mention that smart factories are one of the most important innovations in Industry 4.0. The Smart Factory concept, which has emerged as a result of developing automation technology, has a very progressive and advanced function. These factories are equipped with automation systems that increase productivity,

monitor production instantly, and interfere remotely when certain problems arise. Through the software incorporated into automation systems, malfunctions in the factories are detected in a short time and the steps to be taken for maintenance and repair are also determined. The fact that all these details can be planned in the smart factory system ensures continuity in efficiency structure (Wang et al., 2016, p. 167).

According to Wan et al. (2015), the main aim of Industry 4.0 is to create smart factories with self-managing production processes. Smart factories are defined as a highly intelligent organism to enable the integration of the virtual world and the physical world. It significantly increases the use of resources, reduces the storage and distribution cycle of customized products, and enables production to be realized simultaneously with customer demands (Wan et al., 2015, p. 136). The reason for reducing the storage of products is the concept of just-in-time production, which is one of the features of Industry 4.0. The concept of just-in-time production means that desired products by customers can be produced instantly in smart factories. Thus, the products do not have to be stocked and the enterprises reduce the stock costs (Kovács and Kot, 2016).

2.3. The Components of Industry 4.0

The concept of Industry 4.0 consists of the three main components which are Internet of Things, Internet of Services, and Cyber-physical Systems (Bartodziej, 2017, p. 35).

2.3.1. Internet of Things

Lee and Lee (2015) define the Internet of Things as a concept rather than a kind of technology. This new concept refers to machines and devices capable of interacting with each other on internet (Lee and Lee, 2015). In this context, the data generated by any object is transferred to other systems via a network (Berger, 2014). Another definition according to Erturan and Ergün (2017) is that the network systems, which are set up by physical devices, machines, vehicles, and various electronic equipment to enable data communication, constitute the Internet of Things (Erturan and Ergin, 2017).

The concept of the Internet of Things was first expressed by Ashton during a presentation to a private company in 1999 (Ashton, 2009). Ashton (2009) states that

the internet consists of data input made by people to computers. It recognizes information obtained from people. However, people's knowledge and accuracy of data are limited. Therefore, it is emphasized that the internet should collect information not only from people but also from objects. The concept of the Internet of Things made it possible. In this way, human-based errors reduce and real-time communication between objects becomes reality (Ashton, 2009).

Some important examples of the technologies based on the Internet of Things are RFID tags, sensors, triggers, smart phones. RFID basically consists of a tag and a reader. Data and energy transfer is provided by electromagnetic waves without any contact between the tag and the reader. The electromagnetic waves emitted by the reader meet the antenna and activate the circuits in the tag. The tag detects and modulates the waves and then reports them back to the reader, and the reader transforms these waves into digital data. RFID tags enable the storage and transmission of information such as electronic product code. This technology enables real-time communication between supplier, distributor, and retailer in each stage of the supply chain (Şekkeli and Bakan, 2018).

The Internet of Things is defined as the communication between devices and machines without need for human interference and data input. In addition, the decision-making mechanisms of machines are realized without human interference by means of the data collected (Lee and Lee, 2015).

The Internet of Things is not limited to RFID tags, sensors, triggers, and smartphones. Also, there are many uses of technologies based on the Internet of Things in our daily life. It refers to the communication of numerous devices with each other. Some examples of this communication in our daily life are as follows: (Aktaş et al., 2014).

- The refrigerator will re-order from the supermarket when the product in the refrigerator is over.
- Sensors sense traffic congestion or empty parking places and transmit it to the driver via a message.
- Open roads are detected with sensors during natural disasters.

- The patient or doctor is alerted by portable devices that continuously measure blood pressure or insulin levels in case of danger.

One of the fields where the technologies based on the Internet of Things are widely used is the logistics sector. Logistics companies need to have an effective internal audit structure in order to conduct their operations quickly and regularly. Logistics companies utilize sensors and monitoring devices in their warehouses and vehicles to monitor the flow of goods and services. Data obtained by sensors and devices can be displayed and controlled instantly. For example, UPS company uses these technologies to instantly monitor 60,000 vehicles in the USA (Dai and Ge, 2015).

2.3.2. Internet of Services

The service sector has started to grow rapidly with the development of the industry. Due to the rapid growth of this sector, the need for development and diversification of service forms has emerged. In order to meet the increasing service needs, services were integrated into information technologies and started to be managed over the internet. The new services integrated with the information technologies are called " Internet of Services ". This concept is defined as web-based software components that provide services accessible through the internet (Bartodziej, 2017, p. 54). Technological developments in the service sector trigger the creation of new design, distribution channels, and completely new business models in service delivery. These innovations make it easier to provide services (Bartodziej, 2017).

Cardoso et al. (2009) define that the Internet of Services is as a substructure that uses the internet to offer and sell universal services such as health, communication, and banking services for consumers. The Internet of Services provides consumers a business network that includes detailed services such as research, development, design, production, marketing, sales, and distribution over the internet. Through this business network, organizations such as companies, wholesalers, and suppliers can work collaboratively to serve consumers, thus they can create superior value (Cardoso et al., 2009).

2.3.3. Cyber-Physical Systems

The concept of cyber-physical system (CPS) was first used by Lee to emphasize the increasing importance of computer systems connected to the physical world (Lee, 2006). Rudtsch et al. (2014) state that the systems that connect the physical world and the virtual world via the internet are called Cyber-Physical Systems. These systems use sensors, actuators, and information and communication technologies to establish a connection between the physical world and the virtual world (Rudtsch et al., 2014).

According to Barreto et al. (2017), Cyber-physical systems form intelligent systems that ever-changing data are interconnected in a virtual cloud system. In addition, these systems can be monitored, coordinated, controlled and integrated by the computer. In cyber-physical systems, it is possible to create a virtual copy of the physical world and manage remotely production processes (Barreto et al., 2017).

This concept reveals intelligent factories (cyber-physical production system). This system not only develops automation technology in production but also improves decision-making processes and monitors all production processes. Through this system, the production process can be controlled locally by sensor systems instead of central control systems. Therefore, this system can control itself, monitors the processes, and interferences in the event of any failure. In other words, this shows that human intervention in the production process has reduced or even has disappeared (Rudtsch et al., 2014).

Another definition according to Fırat and Fırat (2017b), Cyber-physical systems connect the mechanical and electronic components via information technologies, enable each component to communicate, and maintain continuity within a network system. This technology was first introduced in 1999 as RFID technology. RFID is an electronic device with small circuits containing a small chip and antenna and is a method used for recognizing objects using radiofrequency (Fırat and Fırat, 2017b).

Also, the concept of "digital twin" has emerged with cyber-physical systems. In a simple way, a digital twin can be defined as a virtual presentation of a physical product. For example, before a factory is physically established, all necessary feasibility studies can be performed by simulations. Also, any changes planned to be applied to the

product are first tried on the "digital twin" and the improvements are performed in the virtual environment firstly (Uhlemann et al., 2017).

There are five basic stages of cyber-physical systems. These are as follows; (Bartodziej, 2017).

- Ensuring the combination of physical and virtual worlds
- Creating a dynamically adaptable system
- Establishing autonomous systems that can be adapted to change
- Collaborating with dispersed control systems
- Establishing more comprehensive human-system cooperation

2.4. Nine Building Blocks of Industry 4.0

The integration of three components (IoT, IoS, CPS) of Industry 4.0 enables the use of nine basic technologies. Industry 4.0 refers to devices that work more efficiently by interacting with each other in real-time through these three components (Rüßmann et al., 2015). An innovative network system that is more transparent and interconnected is used throughout the whole process from material to design, from marketing to transportation (Lasi et al., 2014). The 4th Industrial Revolution, which will take place in almost every part of our lives in the near future, consists of nine building (technologies) blocks. These are Autonomous Robots, Additive Manufacturing, Augmented Reality, Simulation, System Integration, Industrial Internet, Cloud Computing, Cyber-security, and Big Data (Rüßmann et al., 2015). The building blocks of Industry 4.0 are shown in Figure 2 below.

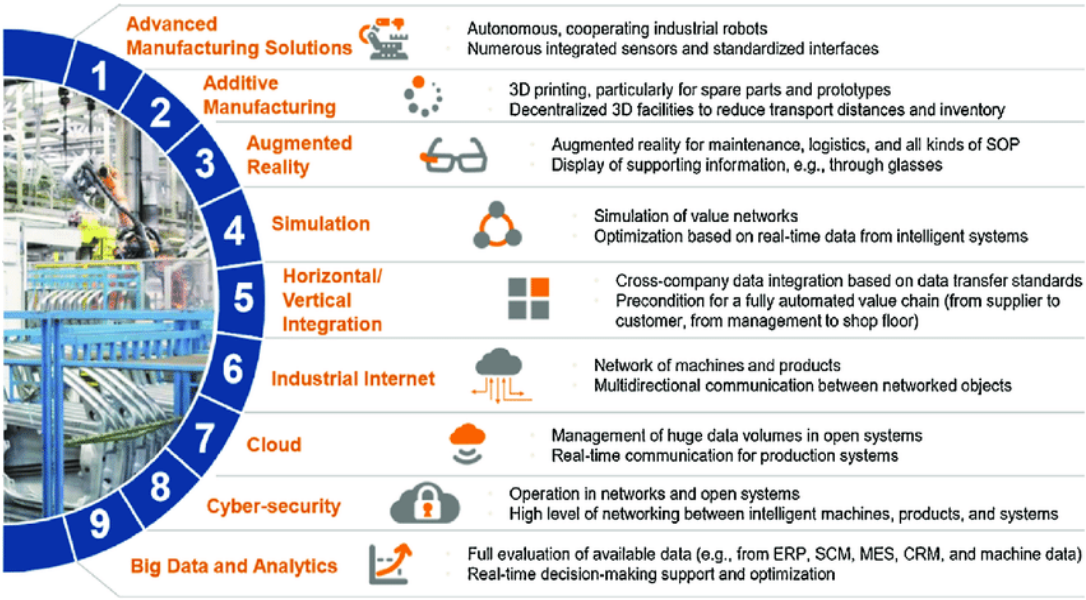

Figure 2. Nine Building Blocks of Industry 4.0 (Source: Bortolini et al., 2018)

2.4.1. Autonomous Robots

One of the most important building blocks of Industry 4.0 is autonomous robots. They are safe, flexible, multidimensional and focus on cooperation to perform the duty imposed (Rüßmann et al., 2015). They are more efficient and more economical in working areas when compared to people. As technology evolves, more efficient robots are produced, and these intelligent robots do not only do simple things in a limited space but also do everything human can (WEF, 2017). In Industry 4.0, people will collaborate with robots and use intelligent sensors to be in communication. Robots will be used in production, logistics, and office management, and they can be controlled from distant. When there are any problems in the factories, the employees are texted by robots so the problems can be seen remotely. The factory can continue to work without breaks by offering instant solutions (Berger, 2014). In addition, robots can communicate not only with humans but also among themselves via a network. By means of the constant communication between them, they can perform the operations without human intervention, direct the production, and solve any problems with their own decision-making mechanisms (Rüßmann et al., 2015).

Autonomous robots are able to carry out the duties programmed in any environment without motivation and extra power. They are only obliged to perform the duty assigned to them continously, therefore they increase automation and become

indispensable (Fırat and Fırat, 2017a). It also has had a positive effect on employment because new jobs have emerged such as robot coordinator, programmer, and repairman. In the new era, people and robots work in cooperation. While people do control and follow-up production, robots do physically exhausting jobs and manual works (Fırat and Fırat, 2017a).

2.4.2. Additive Manufacturing

Additive manufacturing model is another important building block of Industry 4.0. It includes machines that model an imagined part in a computer environment and quickly convert it into physical objects with 3D printing. First, computer designs objects using 3D model software (CAD), after that the 3D printers convert these objects into a physical model step by step. Additive manufacturing provides great flexibility in design. The main idea of this model is that the products which cannot be produced, or which are difficult to produce because of the complicated parts are easily produced in a short time. Companies can be more flexible and customer-oriented by utilizing 3D printers. Through this technology, customers can participate in production via a digital platform and design their own products as they wish (Stock and Seliger, 2016).

It becomes possible that localized production can be made close to consumption points by 3D printing, thus it eliminates the need for some supply chain stages such as retailers and distribution centers. This production model will reduce the logistical difficulties of the companies by enabling them to reach readily each region and market (Sasson and Johnson, 2016).

2.4.3. Augmented Reality

Paelke (2014) states that augmented reality is the integration of digital data such as sounds, photos, videos, or graphics into the physical environment in real-time. In order to benefit from this technology, devices that identify augmented reality such as smart glasses, smartphone or tablet are required (Paelke, 2014).

Eldem (2017) describes that augmented reality is a technology that combines computer-generated data such as audio, video, and graphics in the real-world environment. By means of augmented reality, industrial designers are able to

experience their designs and studies before completing their products. It also saves time in works performed at the factories and prevents mistakes. For example, when installing a machine, the smart glasses can be used to display the erection sequence of the parts (Eldem, 2017).

According to Rüßmann et al. (2015), augmented reality systems are still start-up phase. However, in the future, it will be a major part of the companies' support systems. They also state that companies can use augmented reality to provide real-time information to employees and improve the decision-making process (Rüßmann et al., 2015, p. 5).

2.4.4. Simulation

Simulations will become an integral part of factory operations by the fourth industrial revolution. Simulation is a computer-based imitation of a real-life system or process. The simulation uses real-time data to project the physical world into a virtual model, including machines, products, and people. This system allows the product to be tested in the virtual world before changing in the physical world. It allows companies to reduce installation and implementation times as well as trial and error costs. Mistakes and errors of products are noticed, and corrections are firstly tested in the simulation so that more efficient and quality goods are produced (Rüßmann et al., 2015).

> "*For example, Siemens and a German machine-tool vendor developed a virtual machine that can simulate the machining of parts using data from the physical machine. This lowers the setup time for the actual machining process by as much as 80 percent.*" (Rüßmann et al., 2015, p. 3).

2.4.5. System Integration

Horizontal integration provides the synchronous operation of the software of all companies in the supply chain. This integration encompasses everything from raw material procurement to design, production, marketing, shipment and builds integrated systems (Eldem, 2017).

Vertical integration is to provide continuous communication and flow in the technological infrastructure required for all processes. For example, the integration of

units such as sensors, valves, motors, control panels, production management systems, enterprise resource planning software, and business intelligence applications in the production is considered within this scope. Vertical integration of these objects is extremely important in order to create a flexible and rearranged production system. Also, vertical integration creates a self-regulating system with intelligent machines (Soylu, 2018).

Through the Industry 4.0 revolution in which horizontal and vertical integration take place, the systems can quickly adapt to a change in production processes. Also, when a problem occurs, the problem can be solved quickly. In addition, it is possible for enterprises to have a more flexible structure and necessary changes can be realized by a simple interface. Both integrations are done wirelessly in the cloud system (Zhou et al., 2015).

2.4.6. Industrial Internet

The Internet of Things (IoT), also called Industrial Internet, forms the basis of smart factories, smart products, and smart services. It describes the processes to collect, reproduce, and organize data from different sources over a global network (Alçın, 2016).

According to Banger (2016), the Internet of Things refers to a system that allows sensors embedded in objects in the physical world to connect to the internet through wireless or wired connections. The sensors are data collection devices in the global network. The Internet of Things develops the concept of intelligent production that can perceive and connect to each other (Banger, 2016).

In addition, machines and robots connected to a network via the internet have the ability to communicate with each other in real-time by means of the Internet of Things concept. Thereby, self-managed smart factories are established, and production becomes faster, higher quality, and more efficient. This communication is extremely important for full automation in smart factories and enables collaboration. Furthermore, the communication of machines and robots with each other improve their decision-making skills. They can make their own decisions with the information they

collect and play an active role in each stage of production by virtue of their integrated communication capabilities. (Bi et al., 2014).

2.4.7. Cloud Computing

According to Lee et al. (2014), cloud computing means a server that makes every kind of documents and files needed accessible from anywhere. All information, documents, and data required by companies are collected in a server and they are always accessible via the internet. In this way, companies have a more flexible structure. Also, these servers eliminate material requirements such as hard drives (Lee et al., 2014). Google Drive, Box.com, Microsoft Cloud can be given the best examples of cloud computing.

Zhou et al. (2015) state that the basis of the fourth industrial revolution consists of big data generated by objects connected to the internet. Smart factories established in this era and full automation in production are provided by the data obtained and the flow of these data between objects. Cloud computing enables the archiving and rapid transfer of continuously increasing data. Cloud computing is of great importance in this era because cloud computing makes it easy and quick to access the required data from millions of stored data (Zhou et al., 2015).

Seyrek (2011) defines that Cloud Computing allows users to easily access the information they need on the internet at any time. Users store important information on internet-based networks instead of storing them on computers or hard disk. In this way, necessary information can be accessed from anywhere and at any time (Seyrek, 2011).

Thames and Schaefer (2016) state that one of the major features of the cloud system is that it reduces the workload of personal computers and stores data that cannot be stored in the computer memory. Users can run applications on these servers without installing them to the computer. Also, users connected to the cloud network can exchange real-time information between themselves (Thames and Schaefer, 2016).

2.4.8. Cyber-Security

Cyber-security is known as the security of computer and information technology. It is defined as the protection of computer hardware, software or information. Storing all

kinds of information and data on internet-based servers has created negative situations such as hackers, data theft, and industrial espionage. In the fourth industrial revolution, companies believe that cyber-security threat will increase because information technologies have a great place in this era. In the Industry 4.0 environment, it is important that reaching critical data is only possible for authorized persons. For example, in a production facility, only authorized persons should access critical data. All precautions should be taken to ensure that the information entered into the devices at the factory comes from reliable sources (Eldem, 2017).

Sundmaeker et al. (2010) state that as the number of online companies increases, cyber-security is becoming more and more important. Also, as the amount and the importance of data uploaded to networks increases, cyber-security threats are also increasing in parallel with it. Therefore, taking cyber-security precautions in this era is the most important issue (Sundmaeker et al., 2010). According to Gasser (1988), the protection of information systems against theft or damage to hardware and software is cyber-security (Gasser, 1988).

According to Boston Consulting Group (2019), cyber threats will increase with the connection and communication features that emerge with Industry 4.0. Therefore, industrial systems need to be protected from these threats. To ensure this security, the method of accessing data, identity security, and communication systems of machines and users must be protected primarily (Boston Consulting Groups, 2019).

2.4.9. Big Data

Through the advancement of technology and the increasing use of internet, the importance of information and data in digital media has increased to a great extent today (Witkowski, 2017). According to Witkowski (2017), big data, in its most general definition, are huge data sets that contain all kinds of information and data used daily. In this context, big data typically consists of various channels, including sensors, devices, video/audio, networks, transactional applications, and social media feeds (Barreto et al., 2017).

According to Russom (2011), it is possible to access a wide variety of information from digital media. Big Data is a form of meaningful and processable of all these data obtained from different sources. For example, people perform many transactions on the internet in daily life such as communication, searching, purchasing, and sharing. All these transactions are classified according to their structure and generate big data. Also, big data mean collecting, storing, and analyzing large amounts of data from different sources to increase added-value (Russom, 2011). With such a large amount of data being stored on secure systems, analyzed, and converted into meaningful information, companies start to gain valuable information. While errors can be foreseen and precautions can be taken, opportunities can be realized in advance and action can be taken quickly (Eldem, 2017).

According to Witkowski (2017), big data provides to be made an accurate analysis and helps users move in line with these analyzes. It provides convenience in decision-making due to the reliability of the results obtained in the analysis. Providing instant access to all kinds of information and making accurate decisions is crucial for the operation of Industry 4.0. Big data consists of five dimensions which are volume, variety, velocity, value, and verification (Witkowski, 2017).

Velocity refers to the speed of data. Every millisecond, minions of data are generated based on events and interactions around the world with devices such as heart monitors, televisions, RFID scanners, and traffic monitors. Variety means that the variety of data has expanded as much as the number of sources generating data. Each data is generated from different sources and different technologies such as e-mails, audio players, video recorders, etc. Each device recording the data works in a different format and pattern. Volume refers to the amount of data. The amount of data is increasing day by day. Value means that it needs to add value to the organization during the decision-making process after processing, storing, and analyzing large data. Verification means that big data consists of millions of data and must be checked for safety during data flow. This dimension refers to whether the data is reliable or not (Witkowski, 2017).

CHAPTER 3. THE EVOLUTION OF LOGISTICS

The word “Logistics” was first used in the Armed Forces and it is known that it was used by Chauncey B. Baker in 1905 to describe a military function in the form of transport, supply, maintenance, and renovation of materials and personnel (Agrawal, 2003). At the present time, it is not possible to make a single definition of logistics when considering the historical developments of its. The ever-evolving technology has continuously been affecting logistics activities and has led to many definitions (Farahani and Rezapour, 2011).

Logistics, in its most general definition, covers transportation, warehousing, customs procedure, packaging, and distribution processes from the procurement of the raw material until the product reaches the user (Christopher, 2016). Also, logistics is defined as providing products and services at the desired place and desired time (Çekerol and Kurnaz, 2011).

According to Buurman (2002), logistics is the service of planning, implementing, transporting, warehousing, and controlling the movement of all kinds of products, services, and information flow within the supply chain from the point of origin to the point of consumption in order to meet the requirements of the customers (Buurman, 2002). Likewise, Lambert and Stock (1993) state that logistics management is the business of planning and managing the flow and storage of products, services, and information to meet the needs of customers (Lambert and Stock, 1993). In addition, Fleischmann et al. (1997) emphasizes that another important activity is reverse logistics. In the simplest form, reverse logistics can be explained as the return of the products to the vendors. Reverse logistic may be necessary due to many product-related conditions or other problems. For example, a product can be returned for repair, the products can be sent back for refund, and the product can be returned to correct the error made at a stage of production (Fleischmann et al., 1997).

Similarly, according to Ballou (2006), logistics is the activity of the planning, managing, and controlling all activities to provide raw materials, auxiliary materials,

services, and products required for production according to customer demands. It is stated by Ballou that logistics activities include customer service, planning, demand forecasting, delivery, product control, parts and service support, purchasing, packaging, back order, exchange, transportation, and storage (Ballou, 2006).

Çevik and Kaya (2010) also claim that the concept of logistics is taking the product from the point where it is produced, keeping it in warehouses, stocking it, delivering the product to the desired places and at the desired time and performing all these processes in a planned way, in the fastest way, and efficiently (Çevik and Kaya, 2010).

According to Porter (2000), in recent years, the importance of logistics management concept has increased with globalization. It is clear that effective logistics management has some effects on companies such as cost reduction, increasing production and productivity, and meeting the customer satisfaction. These effects enable companies to increase their market shares and increase their competitiveness in the global environment (Porter, 2000).

As the technology develops day by day, logistics activities are also developing (Timm and Lorig, 2015). In order to understand clearly the relationship between industry and logistics, "The Value Chain Analysis" developed by Michael Porter is an important resource. This analysis has been carried out to analyze the value of activities in an enterprise and how these activities affect the competitive advantage of the enterprise. It divides the business into strategically interrelated activities from the procurement of raw materials to the final consumer and classifies these activities into two groups, namely basic and support activities (Kuyucak and Şengür, 2009). In this context, some basic activities creating value for business are inbound logistics including activities related to procurement and storage of input to be used in the production activities of the enterprises and outbound logistics consists of the processes related to the collection, stocking, and distribution of the products produced by the producers (Ülgen, 2013, p. 123). From this point of view, it is clear that logistics, which is one of the basic activities of companies, has a significant effect on the competitiveness and development of the industry.

In recent years, rapid technological developments in each sector have caused important changes in the economic and political structures of the countries. Correspondingly, companies that can improve logistics productivity by using new technologies will be more successful in the market. Today, the technology used in enterprises affects logistic activities extremely. The sustainability of logistics efficiency in the near future will hinge on the development of new methods and technologies rather than the efficient implementation of existing logistics processes (Bowersox and Closs, 1996). However, Ceran and Alagöz (2007) state that adapting to developing technology can be a problem for companies in terms of cost. Therefore, it can be preferred that the logistics activities of the companies are outsourced from an external company, thus enterprises can focus on their main activities, reduce costs, and provide customer satisfaction. This situation has increased the importance of logistics providers recently (Ceran and Alagöz, 2007).

All logistics activities (transportation, warehousing, planning, etc.) from the procurement of raw material to the final consumer develop in parallel with the technology. It is thought that logistic activities, which are increasing day by day in order to increase operational performance and meet customer expectations in the best way, will be affected significantly by Industry 4.0 approach (Schlüter et al., 2017).

Rodrigue et al. (2016) claim that globalization and advances in technology affect the operation of logistics, service techniques and methods. The spread of the door-to-door delivery service concept leads to the implementation of logistics activities in an integrated manner and with advanced technology applications (Rodrigue et al., 2016).

Also, according to Tanyaş (2015), technological developments affect the way of doing business of logistics and increase the importance of a qualified workforce as well (Tanyaş, 2015). As technology evolves, people are given different roles and tasks. The jobs that depend on people's muscle force are being replaced by the technology-based workforce (Rutkowski et al., 2015).

3.1. Major Logistics Activities

According to Lambert et al. (1998), based on many different definitions, all logistics activities are customer service, planning, inventory management, distribution,

handling, order processing, packaging, parts and service support, facility and warehouse selection, purchasing, warehousing, reverse logistics, transportation (Lambert et al., 1998).

According to Barreto et al. (2017), although there are many logistics activities, these activities can be reduced to three major departments which are warehousing, transportation, and supply chain planning when technological applications in logistics are examined. In addition, according to Transport and Logistics Sector Report (2018), Turkish logistics companies use information technologies mostly in transportation, warehousing, and planning and information sharing systems. This also led to this study to select these logistics departments as major (Transport and Logistics Sector Report, 2018). In this section, these departments are just introduced, and Logistics 4.0 applications will be exemplified in the following sections.

3.1.1 Warehouse and Inventory Management Activities

Warehouses are confined space where raw materials, semi-finished, and finished products are stored. Also, warehouses are known as distribution centers determined by strategic decisions (Lambert et al., 1998).

According to Hamdan and Rogers (2008), main logistics activities can be classified as taking delivery of products, checking products, counting products, providing the placement of products, packaging, transferring products to the desired location by transportation (Hamdan and Rogers, 2008).

According to Dadzie and Johnston (1991), warehouses occupy an important place in the series of activities from material supply to product delivery. Therefore, the warehouse is in a substantial position between the seller and the buyer. In addition, storage of raw material used in production and product ready-to-use provide continuity in production for companies and also help companies release timely products to the market, therefore, it provides competitive advantage to companies in the market (Dadzie and Johnston, 1991).

Myerson (2012) states that warehouse operation means taking the delivery of the products coming from a certain point, keeping it for a certain time, and preparing it to be sent to a certain destination. While warehouses are perceived as the places where only products are stored in traditional management approach, in today's supply chain management approach, they are seen as sales support places (Myerson, 2012). Amazon warehouses can be given as examples of this. Products can be ordered online from warehouses and the product is delivered by autonomous processes without human intervention. This means that it is enough to order online from the warehouses in order to get the products (O'Connor, 2013).

Nowadays, manual operations in warehouses are limited as much as possible and management based on automation is used. As a result of the automation, labor costs are reduced, process speeds are increased, error rates are reduced, optimization is provided, and new software and automatic identification systems such as barcode and RFID are used (Böse et al., 2009).

According to Kobu (2005), inventory activity is the possession of material and product availability in order to keep production at the desired level and perform delivery, sales, and production. In other words, the materials held by the company to meet the demand of customers call as inventory, and also inventories are measured in terms of the amount and monetary value of objects considered as inventories (Kobu, 2005).

The purpose of inventory management is to ensure the continuity of goods and services flows and to ensure the balance of demand and stock. Business profitability is highly dependent on the effectiveness of inventory management, and business profitability can be increased by reducing inventory costs or increasing sales (Kilic et al., 2018). Also, stock keeping has negative effects on companies as well as positive effects. Overstocking can damage companies in terms of cost in some situations such as failure to sell products, deterioration of products waiting in stock. Therefore, reducing stocks is one of the most important factors in reducing the costs of companies (Bokor, 2005). For this reason, companies give importance to Just-in-Time production. This production model is based on the optimum use of all resources. This production system aims to produce the required product at the required time and thus it does not need to stock up (Kovács and Kot, 2016).

3.1.2 Transportation

Transport management is a geographic displacement of goods, products, and people in an economical, fast, and safe way (Allen, 1997). The main purpose of the transportation departments in logistics is to ensure that the product is transported as soon as possible and at the lowest cost. This is achieved through the creation of an infrastructure to ensure coordination between transport systems (Fair and Williams, 1981).

In a narrow sense, transportation means the shipping of an object (goods, products, people) from one place to another. In a broad sense, transportation is the timely delivery of products to the desired regions and centers to meet customer requirements (Batur, 2008). Companies that do not have an advanced transportation system cannot perform their logistics activities efficiently. A good transport system has a significant impact on the efficiency of logistics, on reducing the operating cost, and on improving the service quality. Improvement of transportation systems can be achieved through both public and private sector efforts (Tseng et al., 2005).

In addition, the report of DHL (2016) mentions the importance of route optimization in transportation. Big data, one of the most important building blocks of Industry 4.0, enables real-time information to be accessed quickly, and the shortest and safest route is created based on this information. For example, delivery routes are automatically changed according to current traffic conditions. This route optimization provides both time and cost advantages for the companies (DHL, 2016).

Generally, there are four modes to be used in transportation, which are air, sea, rail, and road (Burckhardt et al., 1998). Air transportation is the most efficient transportation method in terms of speed and time, and it is more suitable for long distances (Çırpın and Kurt, 2016). Also, the speed advantage provided by air transport has an impact on reducing storage costs, which is great advantage for logistics (Yıldıztekin, 2002). However, there are some disadvantages in this mode. The most important one is a very expensive transportation method compared to the other modes. Expenses are quite high such as fuel consumption, terminal requirements, and frequent maintenance of aircraft (IATA, 2004, p. 81).

Sea transport is the optimum solution to minimize the high cost and emission amount, to reduce the traffic density and traffic accidents resulting in death when compared to road transportation (Atar, 2014). Also, sea transportation is safer than other transportation modes (Saygılı, 2014). It is the most economical method because low transportation costs are in question due to low energy consumption. At the same time, it is possible to transport large amounts and big volume of products in this transport way (Baird, 2001). However, for sea transportation, expensive facilities are needed such as ports and piers. In addition, the provision of transport depends on the presence of the port. It cannot be used in all zones (Baird, 2001).

Compared to the road transportation, railway transportation consumes less energy in both freight and passenger transport and costs less (Kılcı, 2017). It is a more preferable method than other methods in terms of environmental pollution (Lambert and Stock, 1993). Also, it is the most efficient mode in terms of cost advantage over long distances (Saygılı, 2014). Some disadvantages include that railway transport takes place in limited areas and it is usually operated by the state (Elbirlik, 2008).

Road transportation is the most preferred method of transportation because the initial investment costs are very low compared to other modes. Mostly, it is chosen for short distances. It is also not like sea and train transport, it is elastic which means it can be used in every geography condition (Kılcı, 2017). However, the limited capacity can be considered as a disadvantage and long distances can cause problems in terms of time (Elbirlik, 2008). Road transport has the biggest share among air pollution, sound and visual pollution, fatal and injured accident statistics (Atar, 2014).

In addition, Saygılı (2014) mentions about multimodal transportation. The term multimodal is used for activities carried out with the integration of more than one type of transport. Thus, transportation is carried out by providing speed, security, and cost optimization by choosing the appropriate transportation types. The intermodal transportation system, which combines more than one type of transportation by taking advantage of all transportation types, provides many benefits such as reducing cost and maximizing efficiency. It also eliminates the disadvantages of transportation modes (Saygılı, 2014).

Through the development of technology, new transportation methods have become the main topic of conversation. The most important of these is drone delivery. Amazon performs successful tests about it. It is planned to provide easy access to every point that is difficult to reach by road by this delivery model (Bamburry, 2015). However, drone delivery, which is still in the testing phase, can have both cost and technical problems in taking off and landing especially in the urban areas. As a solution to this situation, the idea of leaving the product vertically from the air through the parachute to the customer's address is another innovative approach (Ateş and Önaçan, 2018).

3.1.3. Supply Chain Planning

All management processes for the flow of materials and information between suppliers and customers in the supply chain can be defined as Supply Chain Management. Information technologies developed recently increase the importance of supply chain analysis and make it more efficient (Christopher, 2016).

Logistics is the planning and implementation of all processes from the procurement of the raw material to the final consumer in order to meet the needs of customers in an efficient and cost-effective way (Christopher, 2016). The changes in the market understanding in recent years also have affected the logistics sector. The understanding that the consumer obtains the desired product at any time is developing. This marketing understanding can only be realized by the rapid and reliable implementation of logistics in line with the determined targets. Developments in computer and communication technologies also facilitate this market understanding. Planning competencies in logistics have developed recently as a result of the development of information technologies such as EDI (Electronic Data Interchange), which provides electronic data transfer between companies, and GPS (Global Positioning Systems), which provides container tracking and freight tracking (Ellram et al., 1999). The development of information and communication technology allows companies to make more efficient analyzes and allow them to plan logistics processes accordingly these analyses (Christopher, 2016). Planning and analysis in logistics are so important in some processes such as demand forecasting and demand management (Sheu, 2010).

Demand forecasting is the process of predetermining the goods and services to be demanded in the future and the materials to be used in the production of these goods

and services. Determining future demand for goods and services constitutes the starting point of all estimates and fulfills an important function by providing input to other activities (Croxton et al., 2002).

Demand management aims to meet the demand at the maximum level. It also aims to reduce delay time, expenses, cost, and inventory. At this point, it is easier to estimate the demand through accurate information communication between the supply chains. Demand management can be carried out with an correct analysis of demand and flexible production capability (Croxton et al., 2002).

Planning is the process of making decisions about producing the desired quality products by using the existing resources of the enterprise. The purpose of production planning is to minimize the cost of the activities that are being carried out in the production process and to meet the demands of the consumers by making production on time (Ballou, 2007). In supply chain management, the analysis and planning of all supply chain processes are extremely important for the company's competitive advantage and sustainability (Christopher, 2016).

Planning and analysis in logistics are not limited to those examples above. In addition, route optimization generated by the analysis of the obtained real-time data provides benefits to firms in terms of time and cost (DHL, 2016). Also, site selection for logistics activities is also of great importance. Warehouses and distribution centers are determined as a result of analyzes and plans made according to certain criteria (Bamyacı, 2008). Another important point in logistics planning is warehouse placement. Inefficient warehouse placement causes financial and time losses at the enterprises (Çolak et al., 2016). As an example, in a chemical company, it was aimed to develop warehouse placement. In the first stage, the most used raw materials were determined with the help of multi-criteria ABC analysis. In the second stage, a mathematical model was developed, and raw materials were placed according to the results of ABC analysis to minimize transportations inside the factory. As a result of these analyzes, a new placement layout was created (Çolak et al., 2016).

3.2. The Historical Background of Logistics

When the chronological development of the four industrial revolutions is taken into consideration, it is seen that logistics processes are affected in parallel with each industrial revolution (Timm and Lorig, 2015). In other words, the logistics development process (Figure 3) consists of four stages like the industrial development process (Domingo, 2016).

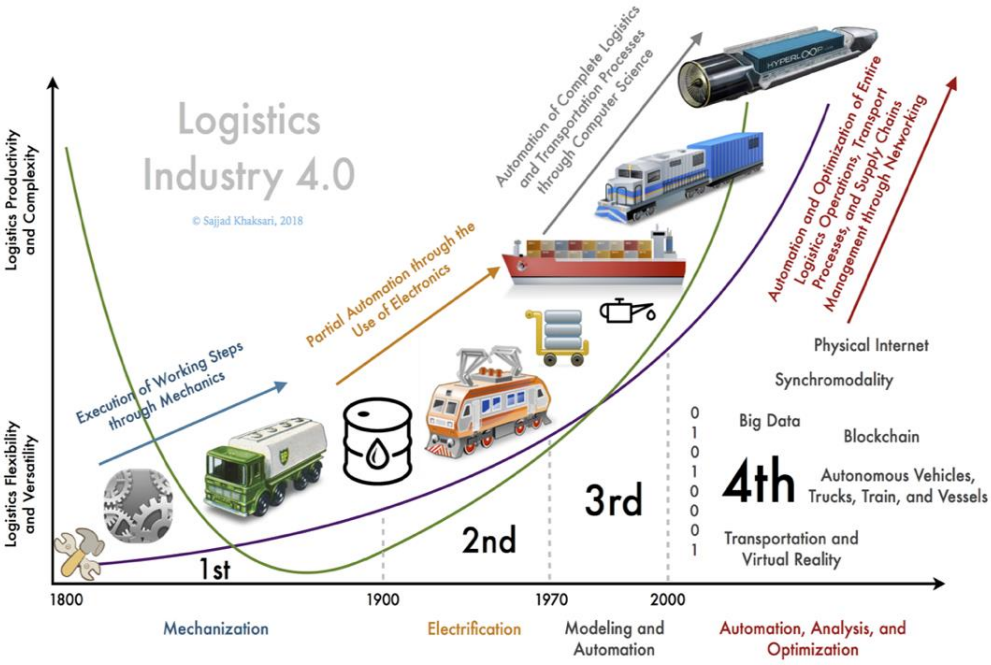

Figure 3. The Historical Development of Logistics (Source: Khaksari, 2018)

After the invention of the steam engine by James Watt, in the second half of the nineteenth century, carrying capacity increased with the development of steamships and railways, and also the use of machinery instead of animal power started to be used to transport goods and people. This development was accepted as the beginning of the mass transport era and this period was known as "mechanization of transport". In this era, also called Logistics 1.0, firms tended to be close to their local suppliers and customers because supply and delivery took too much time. For the same reason, it was very difficult to adapt to changes in demand. This situation led to delays and stock increases. In this era, the warehouse consisted of a simple room. Inbound logistics was carried out with wheelbarrows by people manually while the outbound logistics was carried out by steam trains and ships (Domingo, 2016, pp. 26-31).

The second period (Logistics 2.0) was based on the importance of technological development of steel, copper, and aluminium in machine development. In this period, the incredible development of electricity and oil resources also improved transportation. In addition, automation developed due to the widespread use of electricity, and "cargo handling automation" started to be used. Also, through electrical power, transportation by railways and aircraft became very widespread and automatic warehouses were used. Furthermore, the expansion of the container ship was an important innovation in port transportation. In this period when the supply chain started to be globalized, people used motorized forklifts to transport the goods inside the factory (Domingo, 2016, pp. 26-31).

The third industrial revolution, namely the introduction of manufacturing with computers, caused developing of the system of logistics management (Logistics 3.0). This system was accepted as the beginning of the widely used warehouse management system, transport management system, and information-technology system, and it made significant progress in the control and management of logistics processes. In this period, supply chain management was completely global and also warehouse management was planned and controlled by software. Transport of goods within the factory was provided by automated lines, forklifts used by people, and robots programmed on the route with the latest technology. During this period, transport and delivery processes were planned before production begun (Domingo, 2016, pp. 26-31).

The emergence of Industry 4.0 as a result of the interplay of numerous technological progress with the new generation methods undoubtedly leads to greater changes (Logistics 4.0) in the logistics sector (Timm and Lorig, 2015).

3.3. Logistics 4.0

According to Barreto et al. (2017, 1248), Logistics 4.0 emerged as a result of the use of advanced internet known as digitalization, which provided real-time communication between machines and people (Barreto et al., 2017, p. 1248). In addition, Schumacher et al. (2016) stated that the concept of Logistics 4.0 emerged with the integration of the innovations and applications of cyber systems into the

logistics sector. Nowadays, both virtual and physical structures are needed throughout the entire life cycle from production to distribution to enable companies to quickly adapt to changes due to increasing demand and competition. In order to meet this need, the concept of Industry 4.0, which was first used in Germany in 2011 and defined as the inclusion of information technologies in all processes of manufacturing and product life cycle (design, production, logistics, etc.), emerged. This concept is based on the concept of cyber-physical systems which is the integration of physical processes with computers (Schumacher et al., 2016).

Through new information, communication, and sensor technologies developed in this era, it is possible to collect, analyze, and interpret the data for use in logistics processes. The measurability, efficiency, and sustainability of logistics systems are increasing significantly with the integration of physical processes with computers (Rüßmann et al., 2015).

Industry 4.0 will affect and reshape seven rights of the logistics, which are the right product, in the right amount, in the right form, at the right time, from the right source, in the right way, and at the right price (Özdemir and Özgüner, 2018). The main reason for this is that Industry 4.0 approach is based on real-time communication of all processes with each other (Qin et al., 2016). Also, computerized systems that automatically control processes make it possible to effectively control all logistics processes. In addition, autonomous working driverless vehicles, drone delivery, cloud technology, transfer of processes to digital platforms enable the creation of new business processes and Logistics 4.0. The reliability, agility, and efficiency of logistics processes increase due to the wide availability of information and superior cooperation with the transfer of logistics processes to digital platforms (Özdemir and Özgüner, 2018).

According to Witkowski (2017), Industry 4.0 offers significant opportunities in the logistics sector such as innovation, efficiency, and sustainability. The Industry 4.0 approach, which integrates all systems, will enable the integrated management of all suppliers, warehouses, market shelves or vehicles. Through the smart machines, stock levels, supply chain failures, damaged products, changes in demand will be continuously monitored to ensure the efficiency of all business processes and thus

coordination in the field will be provided. Also, by the help of the integrated operation of the machines with Industry 4.0, it will provide just in time logistics services. For all that, it will be possible to reduce the idle time in all processes of supply chain and to use resources more efficiently (Witkowski, 2017). Also, Industry 4.0 is thought to reduce the need for personnel in operational areas of logistics. On the other hand, it is estimated that logistics processes will increase the need for qualified personnel in software and strategy intensive departments (Rutkowsky et al., 2015).

The use of cyber-physical systems in the monitoring and controlling processes in Logistics 4.0 provides feedback on the organization of physical processes. Radio Frequency Identification (RFID) technology can be given as an example of Cyber-physical systems. It uses radiofrequency to identify and locate products and also send information to a computer to collect and analyze relevant information. They can communicate with other systems and people and also share real-time data information (Barreto et al., 2017).

According to RüBman (2015), Logistics 4.0 transformation starts with the integration between logistics processes and information technologies. In this transformation, there will be simultaneous communication with people, machines, parts, and products at each stage of the supply chain. Thus, all networks in supply chain will be standardized and all information will be accessible. Also, the information will be stored in the cloud to reduce errors and improve accessibility. As a result of all these factors, production and distribution processes will be able to respond flexibly to all expected or unexpected changes (Rüßmann et al., 2015).

Similarly, Domingo (2016) states that, in Logistics 4.0, the supply chain will be a large network and all relevant stakeholders (customers and suppliers) in the supply chain will access this network. An internet platform will be used to manage all orders from customers to suppliers in real-time. In addition, transport of goods within the factory will be provided with fully autonomous forklifts and programmed routes, thus this will enable to reduce warehouse costs and error rates will be almost zero (Domingo, 2016).

Industry 4.0 technologies have many uses in logistics operations. Examples of the use of Industry 4.0 technologies in logistics will be given in the next section. The future

of logistics technology and the supply chain in Logistics 4.0 is shown in Figure 4 below.

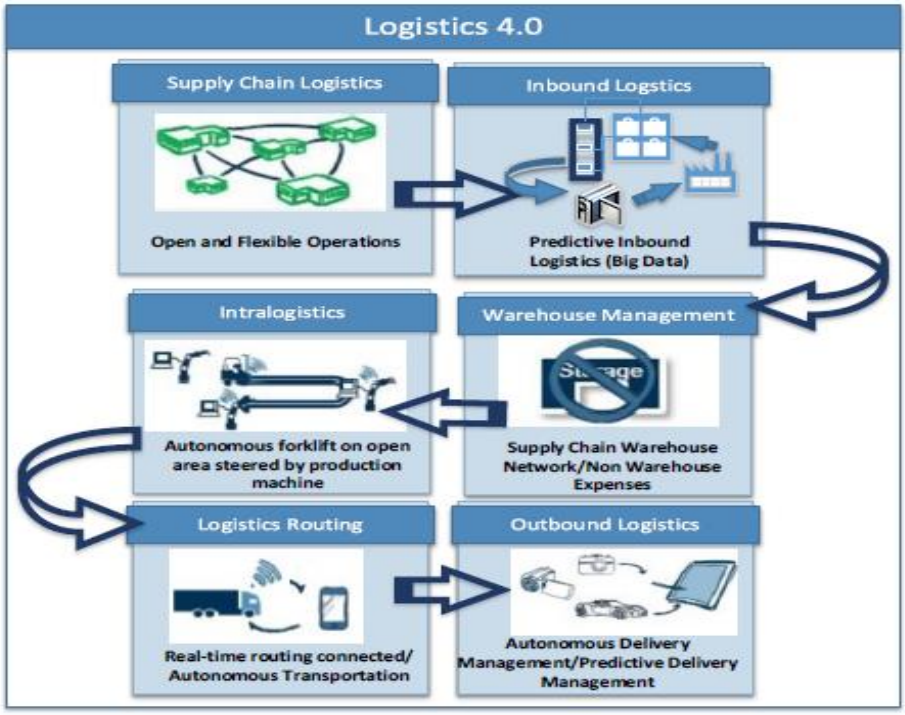

Figure 4. Supply Chain in Logistics 4.0 (Source: Domingo, 2016, p. 35)

3.4. Applications of Industry 4.0 Technologies in Logistics

This section explains how new technologies of Industry 4.0 are implemented in logistics operations and so how they lead to the emergence of Logistics 4.0. Applications of building blocks (technologies) of Industry 4.0 in logistics are explained under the seven technologies (Sorkun, 2020; Timm and Lorig, 2015).

3.4.1. Autonomous Vehicles

The use of autonomous vehicles in logistics operations reaches the highest rank with new technologies of Industry 4.0. Autonomous vehicles are used in many warehousing activities such as collection, loading, transport, and packaging (Nilsson and Darley, 2006; Schuldt, 2012). Recently popular autonomous logistics consists of self-driving vehicles and unmanned air vehicles. The "Auto Pallet Mover" developed by Jungheinri Ch AG company is used for picking up products from the shelves throughout the warehouse using laser navigation technology. Its control system

ensures vehicle coordination, safe traffic flow, and optimization without collision and accident (DHL, 2016).

Also, through the acquisition of Kiva Systems by Amazon in 2012, "Kiva robots" came into use in Amazon's warehouses. At present, thousands of Kiva robots in Amazon warehouses autonomously do a lot of work that manpower needs to do. Kiva robots, which do not depend on anything, act independently, and perform all their tasks. In terms of labor productivity, these robots are available in each distribution center of Amazon's right now (Domingo, 2016).

In addition, the developed robot technology is also active in transportation and delivery. These robots can deliver multiple packages like people. They can move at human speed, detect obstacles, adjust acceleration, stop actions, and cross the street safely. The GPS and video camera in front of the robot reduce threats such as theft during delivery. Optimized routing ensures fuel efficiency, and thus deliveries can be made cheaper. In addition, German transport company DHL has been testing the drone-like "Parcelcopter 4.0" for so long. The company tries to make it a general delivery method by testing aircraft transport, as Amazon and UPS do (DHL, 2016).

Another example of technological developments in transportation is "Future Truck" project of Mercedes Company. This project aims to use autopilot on intercity highways. In this way, the company aims to make the process more efficient by minimizing the possibility of accidents caused by drivers (Ateş and Önaçan, 2018).

In InventAIRy project, the placement and management of the products in the warehouse are carried out automatically and independently by the drones. These drones analyze the interior of the warehouse with sensors and three-dimensional cameras, analyze external areas with GPS, read the barcodes optically, and transmit stock information in real-time (Fraunhofer, 2014). Another example of the use of drone technology is the Amazon Prime Air developed by Amazon Company. Drones are planned to be used in the last mile delivery in the near future by this technology (Flämig, 2016).

According to Muzır (2019), the developing technologies in the field of logistics are parallel to Industry 4.0. The autonomous system gets into act actively in the transportation sector. The Norwegian chemical company called Yara announces that it will produce the world's first autonomous and battery-powered ship by 2020. It is aimed to minimize the mistakes and costs caused by people with driverless trucks and ships (Muzır, 2019).

Another example of autonomous logistics is seen at Alibaba company. The products loaded from the warehouse to the trucks are realized by robots. The robots can also decide order and sequence of products to load. At this point, the task of developing software that will provide autonomy are assigned to the people (Önden, 2018).

3.4.2. 3D Printing Technology

The importance of 3D printers in the logistics sector increases in the Logistics 4.0 period (Ertek, 2012). It includes machines that model an imagined part in a computer environment and quickly convert it into physical objects with 3D printing (Stock and Seliger, 2016). According to Korkmaz (2014), it is considered that 3D Printer technology makes production multi-centered, increases the potential of small enterprises, decreases warehouse needs and logistics costs and thus reorganize production relations (Korkmaz, 2014). Through the 3D printing, it becomes possible that localized production can be made close to consumption points, thus it eliminates the need for some supply chain stages such as retailers and distribution centers. This production model will reduce the logistical difficulties of the firms and enable them to reach each region and market readily (Sasson and Johnson, 2016).

In addition, the proximity of resources used with 3D printing technology is expected to reduce transport and storage costs (DHL, 2016). Amazon obtained patent of the 3D printer delivery truck, which was developed to deliver products to customers faster. When the shopper orders a product from Amazon, the truck closest to the customer produces the product in a short while with 3D printer and the product is delivered to the customer without the need for storage. It is foreseen that these truck technologies will significantly reduce the storage and transportation costs in logistics (DHL, 2016). It is also thought that this technology will eliminate some departments in logistics such as transport, storage, handling, and distribution (Troselj, 2014). Akben (2017) stated

that the lack of some logistical activities would result in many investments in this sector to be idle and employment could not be provided as much as before (Akben, 2017).

Another application of 3D printing technology is seen in Kazzata company. Kazzata company adopts the concept of a virtual warehouse and stores the 3D CAD drawing of the spare parts in a secure software database and if required, the part can be printed by the nearest 3D printers (Reeves and Mendis, 2015).

3.4.3. Augmented Reality

Augmented reality technology for machine-human interaction and cooperation in logistics is of prime importance, especially through smart glasses (Knapp AG, 2018). Currently, augmented reality in logistics is used to improve warehouse operations, transport planning, and last-mile delivery (DHL, 2014). The use of augmented reality technology in warehouse operations saves time and reduces costs by determining optimal order picking path and sequence (Glockner et al., 2014). As a logistics company, Knapp AG has developed a product selection technology (KiSoft Vision) using augmented reality (Knapp AG, 2018). This technology enables an accurate product to be found in a short time, reduces the error rates in the warehouse by up to 40% (Baur and Wee, 2015).

Similarly, Miman et al. (2014) state that augmented reality is used extensively in some logistics activities such as storage, transport, and order preparation. More recently, logistics companies have focused on two systems, namely “pick-by-voice” and "pick-by-light”. In the pick-by-voice system, the person working performs the operation by listening to the voice commands given from the computer through the headset. Another system, pick-by-light system, is made by directing the employee with the lights placed on the warehouse shelves. In these systems, it is aimed to reduce the time spent searching for the products in the order list and to increase the motivation of the employee. Also, employees are visually guided through the system consisting of a specially prepared spectacle frame and screen to reach the product on the shelves (Miman et al., 2014).

The use of augmented reality technology in transportation as well as in warehouse has made a great contribution to logistics. Augmented reality technology determines how each object should be placed in the vehicle and determines the exact point of delivery (Sorkun, 2020).

3.4.4. Simulation

Simulation is a very important technology for the design of production and logistics systems. Through simulation technology, designs can be tested in any scenario and problematic situations that can occur in real life can be determined. The problems identified during the design phase can be eliminated and more efficient processes are provided. The model, established with simulation technology, is then integrated into ERP and other IT infrastructures to form the digital twin of the facility. All kinds of operations, revisions, improvements, and investments in the factories can be pre-tested by the digital twin and can be protected from expensive and time-consuming errors (Çakaloz, 2008).

The simulation serves to develop a computational model of a warehouse to be designed in the software environment and to calculate the performance of the existing system and its alternatives. For the development of any system, it is often not possible to test ideas while the system is already running. In these cases, possible results can be seen by using simulation technology. Simulations, which are mainly used in warehouse processes, are extremely efficient in measuring warehouse capacities and in arranging warehouses (Ertek, 2012).

According to Wyland et al. (2000), Simulation models give a range of results rather than a single result. These results allow statistical accuracy to be increased and more reliable and predictable systems to be installed. It is foreseen to what extent changes in demand will affect stock, labor, transportation costs, and warehouse fields by means of the simulation technology (Wyland et al., 2000).

3.4.5. Industrial Internet

Industrial Internet also called Internet of Things identifies all objects throughout the supply chain so that it makes the supply chain transparent by providing information

about objects. This feature can be used efficiently in transportation, maintenance, security, safety, stock, warehouse, and quality control processes. The status of the products during delivery can be monitored with the obtained real-time information by RFID technology, one of the IoT technologies, and it helps planning the delivery efficiently (Andersson and Jonsson, 2018). Agheera, an IoT platform for logistics, enables logistics providers and customers to monitor all assets in real-time from different devices, therefore increases the transparency and reliability of logistics operations and helps to protect assets against theft and damage (DHL, 2016). The information collected by sensors, GPS, and RFID enable the vehicles to be tracked instantly. They optimize transport times and transport routes. The image and location of the vehicle can be visually forwarded to logistics providers through Google Maps and API smartphone (Lee et al., 2009). In addition, real-time information obtained through IoT technologies can be used in route optimization such as guidance of vehicles according to traffic and weather conditions (Hannan et al., 2018). Georgakopoulos et al. (2016) state that all phases of the supply chain can be monitored transparently by IoT. In this way, when problems occur at any stage of the supply chain, reasons can easily be identified (Georgakopoulos et al., 2016).

According to the DHL report, the "Internet of Things" concept connects each step of the supply chain and it also has a major impact on operational efficiency in the logistics sector. Interconnected pallets and objects in the warehouse enable smarter warehouse management (Tike, 2015). The speed of the forklift used to transport products in the warehouse can be controlled by sensors and the risk of accidents can be minimized (Lee, 2016). In transportation, monitoring and tracking can be done faster, accurately, predictably, and safely. Also, fleet management and maintenance schedules can be made automatically through interconnected vehicles (Tike, 2015).

3.4.6. Cloud Technology

Cloud technology enables efficient and effective information flow between supply chains and allows collaboration and integration throughout the supply chain. Also, Cloud technology enables each company to privatize IT solutions for logistics problems (Daniluk and Holtkamp, 2015). Moreover, the IT infrastructure set up through cloud computing enables the development of autonomous control in logistics, which is one of the important components of Logistics 4.0 (Schuldt et al., 2010).

According to Muzır (2018), in the logistics sector, where many processes such as transportation, storage, distribution, and finance are managed simultaneously, cloud computing provides cost advantage and enables all these processes to be conducted in an organized way (Muzır, 2018).

Schuldt et al. (2010) state that cloud technology is exploited to integrate many systems in logistics. Logistics providers are usually interested in many different processes such as warehousing, stocking, transportation, supplying, and distribution (Schuldt et al., 2010). The entire supply chain can be coordinated like a control tower by offering a single integrated image by the cloud applications. In addition, cloud technology provides precise information to firms about global stock levels and shipping locations and assets. The developed cloud-based logistics platform called "Transporeon" includes features such as the assignment of orders, loading time interval, follow-up processes, and it facilitates transparency and communication between all processes and also it reduces waiting times and leisure trips. More than 1,000 loaders, 55,000 carriers and 150,000 users from 100 countries are currently connected to the platform (DHL, 2016).

In addition, Gomez et al. (2015) give some examples of cloud computing applications in logistics; in Hamburg port, information about weather conditions and accidents can be transmitted to users in real-time and also providers can attain the prices, offers, and route information with the container portals set up on the cloud technology instantly (Gomez et al., 2015).

3.4.7. Big Data

Big data analysis come into use in many logistics and supply chain activities such as strategic resource utilization, supply chain network design, demand planning, procurement, and inventory (Brinch et al., 2018; Tiwari et al., 2018). Big data analysis collects data from many different kinds of sources such as GPS, ERP, RFID, barcode scanners, social media, and mobile devices and makes these data into a meaningful form (Hofmann, 2017).

Also, Big data technologies provide many benefits in logistics such as route optimization, predictive network and capacity planning, address verification, real-time analysis. Big data also enables customers to track their products instantly and know the exact time of arrival of the product (DHL, 2013).

Some applications of big data in logistics; intelligent correlation of transport data flows (shipping information, weather, traffic, etc.) can provide time scheduling of tasks, optimization of loading order, and Estimated Time of Arrival (ETA). In addition, the big data logical analysis platform developed by LogiNext, a startup company, helps logistics companies to increase route optimization and monitor their resources in real-time. This platform has some ability such as determining the location of delivery, time-preferred delivery scheduling for each order, giving estimated-delay warning, and real-time ETA updates (DHL, 2016). Also, DHL Company has developed a truck called "SmartTruck". It makes daily route planning with shipment information using big data technology and reduces driving distances with a dynamic route system that consider the current order and traffic situation (DHL, 2013). Also, UPS company uses Big data to help cargo delivery drivers find the most convenient route (Sanders, 2016). Moreover, Mishra and Singh (2018) express how to reduce waste in the supply chain using Twitter data (Mishra and Singh, 2018).

CHAPTER 4. HUMAN CAPITAL AND DIGITALIZATION

4.1. The Importance of Human Resource Competencies

The aim of each company in the market is to gain a competitive. The most important factor in achieving it is human resources because businesses can achieve success if they use their employees' competencies and benefit from them (Biçer and Düztepe, 2003). Competence can be defined as observable behaviours involving distinctive knowledge, skills, and attitudes in achieving excellent performance (Biçer and Düztepe, 2003). According to Lucia and Lepsinger (1999), competence is a group of knowledge, skills, and characteristics linked to the performance of a person in the workplace, measured by accepted standards, affecting a significant part of person's role and responsibilities in the workplace, and it can be improved by means of training and education (Lucia and Lepsinger, 1999).

Human resources, regarded as a cost element by the "Fordist-Taylorist" paradigm until the 1980s, gained strategic importance along with globalization, competition carried to the international arena, developing technologies, changing production and management models. It means that human resources become an important factor in the productivity and performance of companies (Lipietz, 1997).

In recent years, human capital, which is defined as intellectual capital, has appeared to be prominent in competing and making a difference for enterprises (Pena, 2002). Also, in 1991, Stewart (1991) presented the most accepted definition of this concept, which began to become more popular in the 90's. According to Stewart (1991), intellectual capital is defined as everything that employees know, that gives the business a competitive advantage in the market (Stewart, 1991). It is emphasized that intellectual capital in the information society is the only and unique factor that will provide a competitive advantage to businesses, and companies that cannot manage their intellectual capital are doomed to die (Roos et al., 1997).

Especially in companies where technology is used intensively, employees create great values with the intellectual capital they add to the institution. It is envisaged that the most important strategies which enterprises implement in this century are not to lose the qualified people within them and to bring qualified people from other enterprises into their own structure (Seçkin, 1999). Businesses such as Motorola, Microsoft, and IBM, who have realized the importance of intellectual capital, have attached importance to the quality of their employees. The world's most famous software company called Microsoft is worth $ 450 billion and the value of physical assets is only $ 10 billion. What makes this business value is the value of the human capital of company (Seçkin, 1999). Human capital is the most important asset in the organization because people are considered as the source of organizational innovation and creativity.

4.2. The Effect of Technological Innovations on Human Resources

According to Rutkowsky et al. (2015) and Schwab (2017), there is no doubt that the new technology-based production paradigm, which emerges with Industry 4.0, will lead to significant changes in human resources. On the one hand, many new occupational groups and jobs will emerge; on the other hand, many occupational groups will move towards the dusty shelves of history, and the contents and processes of most of them will change. The impact of continuously developing technological innovations on human resources is evaluated from two perspectives (Rutkowsky et al., 2015; Schwab, 2017).

The first view argues that new technological developments, especially emerging with the Industry 4.0, increase automation and robot usage, and these developments may cause people to lose their jobs and it will affect negatively employment (Schwab, 2017). Similarly, Pfeiffer (2016) emphasizes that the works will be automated with the application of new digital technologies in Industry 4.0 era. The author states that these new technological applications may eliminate the need for human labor (Pfeiffer, 2016).

Also, Taş (2018) states that one of the most important concerns about employment is that in the future, robots can replace humans and unemployment may increase (Taş,

2018). However, this view has never been supported in any industrial revolution until today, so economists are not concerned about this issue. It is thought that new technologies will increase employment because new technologies will lead to new products and services (Kazdağlı, 2015).

The second view, technological innovations that have emerged since the first industrial revolution increase employment in the long run because technological innovations assign people new roles and create new jobs (Rutkowsky et al., 2015). The most mentioned innovations in the Industry 4.0 era are automation and robot usage. These innovations contribute positively to productivity, competitiveness, and the emergence of new jobs. This is explained as follows by the International Federation of Robotics in its report on "The Impact of Robots on Productivity, Employment, and Jobs" (International Federation of Robotics, 2017).

Robot usage increase productivity and competitiveness;

- Robots allow companies maintain or become competitive.
- The biggest threat to employment is not automation but it is the inability to remain competitive.
- Increased productivity through automation may lead to increased demand and the creation of new business opportunities.

Automation creates new jobs and provides wage increases;

- Robots have a positive impact on labor demand; Automation provided more than 10 million jobs in the EU 27 between 1999 and 2010.
- Robots did not reduce workers' working hours and also led to an increase in wages because skilled labor has increased.

Robots increase the capacity of the workforce because robots and people will work in cooperation;

- Robots change labor, but not jobs. The automation of processes within a job does not lead to the reduction of workers in the workplace. For example, the introduction of ATMs in the US did not lead to a reduction in the number of bank employees.

- Robots improve work quality and create new high-income business types. At BMW in the US, robots install insulated doors, a process that requires physical force for workers. However, only the final controls are carried out by people, there has been no job loss in this process, and it has achieved 50% increase in productivity.
- The demand for customized products leads to the use of robots that can collaborate with people.

In addition, Ermolaeva conducted a study named "Industry 4.0 and HR in Logistics" in 2017. In this study, he mentions that in the Industry 4.0 era, there will be important changes in the way industrial workers conduct their jobs and a completely new field of work will be constituted. Moreover, the study emphasizes that robots will be used to help people, but people will not be abandoned. The author states that physical works will be performed by robots and people will be needed in qualified works (Ermolaeva, 2017).

Similarly, Sener and Elevli (2017) emphasize that developing technologies, especially with Industry 4.0, increase human-machine interaction and lead to changes in the way human resources work. They argue that, in this new era, new branches of professions will emerge and new technology-based qualifications will be needed in these new business areas. According to them, Industry 4.0 is a revolution in creating added value by automating unskilled jobs and specializing in skilled works (Sener and Elevlı, 2017).

According to German researchers, some of the new branches of professions created by Industry 4.0 are industrial software programmers, information systems and Internet of Things solution manager, industrial data analyst, robot coordinator, programmer, and repairer, production technologies specialist, and product designers and manufactures (Sener and Elevli, 2017).

Also, Duncan (1995) emphasizes the effects of technological developments on human resources. He states that enterprises that are obliged to adapt to changing and transforming environmental conditions as a result of the continuous developing of technology enter the reconstruction process in their corporate identities. Accordingly,

nowadays, businesses have to get out of a static structure and need to adopt a dynamic and continuous learning organization. He states that all these changes create an important employment gap in the information technology field in the services sector and lead to the creation of new business opportunities. Therefore, he emphasizes the importance of qualified human resources based on information technologies in the new era (Duncan, 1995). Similarly, Cressey and Williams (1990), who is frequently referred to in the literature in this field, published a book named "New Technology and the Role of Employee Involvement". In this book, the author emphasizes that technological innovations change the role and responsibility of people and increase employment by increasing the qualified workforce (Cressey and Williams, 1990).

Ruiner et al. (2013), who aimed to investigate the effects of technological developments on the quality of the workforce, argued that developing technologies led to the emergence of new professional groups by changing business structures. Also, it is emphasized that unemployment is an inevitable ending for employees who cannot be integrated into developing technology (Aktuğ and Kiracı, 2014; Ruiner et al., 2013).

4.3. The Logistics Sector in Turkey

Logistics is one of Turkey's most important sectors because Turkey is a strategic country in respect of geographical location. Also, logistics is considered as one of the most important sectors in reaching the export target of 500 billion dollars in 2023 (Bayramoğlu, 2014, pp. 138-139). It is geographically in the middle of Central Asia, the Caucasus, Commonwealth of Independent States, North Africa region where almost half of the world trade take place (Erkan, 2014). Therefore, Erkan (2014) argues that Turkey has the potential to be a logistical base due to its geographical position.

Also, Afatoğlu (2013) claims that Turkey has an important potential in logistics because of the potential of manpower, convenient geographical position, and cost-efficiency. There are almost three thousand logistics firms operating in Turkey. Logistics sector's share in GDP is 15 percent and it employs over 500,000 people (Afatoğlu, 2013). However, there are some situations that affect negatively the logistics sector in Turkey. Lack of professional talent needs, lack of financial

sufficiency, and inappropriate entry to the profession affects the sector adversely. The number of trained and qualified employees is quite low in the sector (Tutar et al., 2009). Also, Turkey Transport and Logistics Sector Report published in 2018 supports the findings of Tutar et al. (2009).

According to Transport and Logistics Sector Report (2018), it is emphasized that Turkey's logistics infrastructure is inadequate and advised that Turkey needs to develop infrastructure for sustainable logistics. Furthermore, this report reveals the biggest problems in the sector. One of the biggest problems of Turkish logistics companies is that employees do not have the necessary qualifications to work in this sector and cannot adapt to technology. Also, 85 percent of 106 logistics companies' managers, which contribute to the preparation of this report, do not consider the training level of their employees as sufficient (Transport and Logistics Sector Report, 2018).

According to Ersoy (2006a), it would not be wrong to state that the Turkish logistics sector is in a process of rapid growth and change. However, it cannot be said that this growth is very healthy and planned. In industrial countries, logistic investments are established according to a specific plan and infrastructure is significant extremely (Ersoy, 2006a). However, there are some difficulties in the logistics sector in Turkey. In Turkey, the biggest challenges for the logistics sector are that lack of investments of technology, communication and information systems, transportation is heavily dependent on the road, and railway transportation is monopolized, it is difficult to find qualified workforce in logistics, and logistics enterprises have insufficient infrastructure investments. (Babacan, 2003; Çekerol and Nalçakan, 2011; Ersoy, 2006b; Ersoy, 2006a). Also, Tanyaş (2015) states that logistics education at universities in Turkey has been provided for 10 years. For this reason, most of the people working in the sector consist of untrained employees and come from other professions (Tanyaş, 2015).

Ersoy (2006a) state that the logistics sector has undergone a major change especially in recent years by the increasing globalization. Companies now demand that their products not only be transported between two points, but also be stored, customs

cleared, transported, packaged, and distributed. This increases the importance of logistics services recently (Ersoy, 2006a).

For the Turkish economy, providing logistics activities to reach an advanced level and approach world standards may cause two important cases. First, Turkey will have a monopoly on providing logistics services around the region because of its geographical location. Secondly, it will benefit domestic producers and exporters and will reduce the time and cost of Turkish products' access to foreign markets, thus affecting export demand positively (Çevik and Kaya, 2010).

4.4. Human Resources in Turkish Logistics Companies

When the employment aspect is evaluated, the logistics is one of the sectors which provide the highest employment in Turkey's economy. According to main indicators of Turkish Statistical Institute in 2011, the number of employees in transportation, storage and communication services in Turkey was 1,052,250.

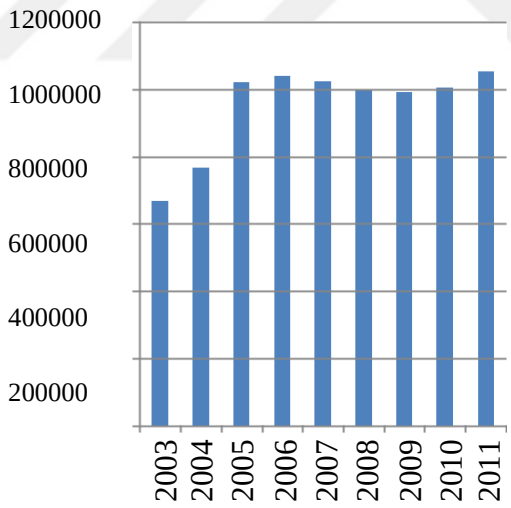

Figure 5. Number of Employees in Transportation, Storage and Communication Services in Turkey (Source: Turkish Statistical Institute, Annual Business Statistics, 2011)

The logistics sector, as mentioned earlier, is a wide range of services. The fact that the sector is a labor-intensive sector and the continuous use of automation and information systems requires specialization. However, when the logistics sector in Turkey is evaluated, it is observed that these specialties are not fulfilled fully (Koban and Keser,

2013) because the low level of training of employees in Turkish logistics companies makes it difficult to specialize in automation and information systems (Quattro Business Consulting, 2008). The training level of the employees in the Turkish Logistics sector is shown in Figure 6 below

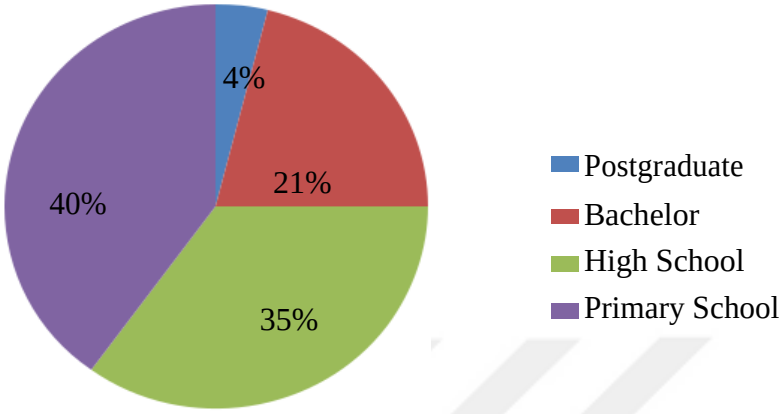

Figure 6. Training Profile of Employees in Turkish Logistics Sector (Source: Quattro Business Consulting, 2008).

Campa (2014) states that the use of technology predominantly creates demand for skilled labor and therefore workers who have low skilled cannot be employed (Campa, 2014). When Turkish logistics companies are evaluated in the opinion of Campa, it is clear that existing human resources of Turkish logistics companies cannot continue to provide employment in this era because Transport and Logistics Sector Report (2018) states that one of the biggest problems of Turkish logistics companies is that most of the employees do not have the necessary qualifications for the logistics sector, and cannot adapt to the technology. It is emphasized that the majority of employees in the logistics sector in Turkey are unskilled workers (Transport and Logistics Sector Report, 2018).

Doğru and Meçik (2018), who investigated the effects of Industry 4.0 on the labor market in Turkey, reached similar conclusions. In this study, it is emphasized that Industry 4.0 is primarily a human-oriented transformation. However, lack of knowledge and unqualified employees is seen as the biggest problem. It has been observed that the current qualifications of employees are not sufficient for Industry 4.0. It is stated that the qualified labor force is limited in the market in Turkey. In addition, it is emphasized by this study that one of the most important issues for this

transformation is education. Giving importance to vocational and technical education is extremely important for adaptation to this new era (Doğru and Meçik, 2018).

According to Transport and Logistics Sector Report (2018), the biggest problems of the existing human resources of Turkish Logistics companies are that they do not have necessary qualifications to work in the sector, do not have training in logistics sector, do not have knowledge of foreign language, and they are inability to adapt to new technologies and systems (Transport and Logistics Sector Report, 2018).

Transport and Logistics Sector Report (2018) states that only 15% of the 106 logistics companies find the training level of their employees adequate. Also, according to the report, a large part of the Turkish logistics sector works in the field. The number of employees who work in the office is quite low. This situation shows that works based on physical power are intense. According to the survey results in this report, the biggest problem of the existing Turkish logistics companies is the lack of qualified workforce (Transport and Logistics Sector Report, 2018).

Küçüksolak (2006) states that the basis of the qualified and specialized workforce is education infrastructure (Küçüksolak, 2006, p. 31). According to Koban and Keser (2013), in the logistics sector in Turkey, it is expressed that education is not regarded adequately. In 2011, only two state universities in Turkey had logistics departments, while today the number is increasing, however, it is still not enough. In terms of the logistics sector, which has great potential in Turkey, the improvement of undergraduate education in logistics will provide skilled labor to be employed and thus it will increase the efficiency and competitiveness of the sector (Koban and Keser, 2013).

Turkey starts to become a logistics base between Europe, Asia, and Africa. For this to happen successfully, the logistics sector needs to reach world standards. That is why the logistics sector needs a large number of trained and qualified work force. Also, the sector is expected to employ more than 1.5 million people in 2023 and the need for qualified human resources in an escalating competition environment is increasing day by day (Erkan, 2014). Employees who do not have qualifications in parallel with developing technology will not be able to serve in the sector. Therefore, human

resources' qualifications and adaptation are very important in the new era (Aktuğ and Kiracı, 2014).

CHAPTER 5. METHODOLOGY

The purpose of this chapter is to define the research methodology and design of this study, describe the sample selection, explain the method used for collecting the data, and provide an explanation of the method used for data analysis.

The question of whether human resources of domestic logistics companies in İzmir were sufficient for Logistics 4.0 was the starting point of this study. In order to find an answer to this question, the four domestic logistics companies in Izmir were examined, and then the necessary qualifications required by Logistics 4.0 were sought in the human resources of these case domestic logistics companies. These necessary qualifications were found in job advertisements of the companies which were thought to implement Industry 4.0 best (Amazon, DHL, Bosch, Ocado, Siemens, Wayfair). Job advertisements found for the study are attached.

The job advertisements of the job positions – warehouse/stock, transportation, and supply chain managers/analysts were examined in the companies that were thought to be the best implementers of Industry 4.0. These job positions examined in this study were chosen according to the classifications of Barreto et al. (2017) which emphasized that Industry 4.0 firstly affected warehouse, transportation, and supply chain planning departments in the logistics sector. Barreto et al. (2017) state that developments and changes in these departments lead to the emergence of Logistic 4.0 because the new technological applications mentioned in Industry 4.0 are implemented mainly in these departments (Barreto et al., 2017). For this reason, the job positions of these departments were examined in this study.

In order to find the qualifications required by Logistics 4.0, job advertisements of Siemens, Amazon, DHL, Ocado, Bosch, and Wayfair companies were examined. Although some of these companies - Bosch, Siemens, and Wayfair - are not logistics companies, this research has examined their job advertisements because it is known that they perform their logistics operations according to the requirements of Industry 4.0 because of the following reasons.

Firstly, it has considered adequate to look at the job advertisements of Siemens company, because Siemens is one of the companies that wants to lead Industry 4.0 and develops their applications according to the requirements of Industry 4.0. It is emphasized that this company adapts to this new system by horizontal/vertical integration, cybersecurity, virtual reality, Internet of Things and many innovations in robots, which are some building blocks of Industry 4.0. This company declares that they want to pioneer Industry 4.0 (Boğaziçi Yazılım, 2018). Amazon and DHL are other companies considered appropriate to look at job advertisements because Amazon is one of the pioneers of this era by developing many robot technologies and drone technologies in transportation. Also, it is emphasized that DHL is close to this era due to the technologies it uses to digitize the supply chain (Büyüközkan and Göçer, 2018). Ocado company is another company job advertisements of which have been searched because this company highly uses robot technology, which is very important building block for Industry 4.0. Robot teams of Ocado company connect to the system via a wireless 4G connection to pack and transport goods and also reduce the need for manual operations as much as possible. This company directed its business processes to digitalization. Ocado company is thought to implement the best activities of Industry 4.0 (Telatar, 2017). The reason for looking at job advertisements of Bosch company is that robots called APAS control the entire production and logistics chain. This is one of the most important processes of Industry 4.0. This company is on its way to a successful transition to Industry 4.0 by using new technologies about software and autonomous robots (Sokullu, 2016). Wayfair company sells more than ten million products with corporation 10,000 suppliers. It is an e-commerce company. This company is one of the pioneers of augmented reality. This company also has made the supply chain transparent and give the opportunity to customers to see where the product is at any time. In addition, they have reduced their last-mile delivery costs with the big data concept, which is one of the most important building blocks of Industry 4.0 (Stewart, 2019; Cosgrove, 2019).

The qualifications obtained by job advertisements were divided into three groups according to their functions because each company sought different qualifications with similar functions in their employees. Afterwards, qualifications with the same functions were placed in the same group. These qualifications are as follows;

- **Use of data analysis** which are Oracle, Hadoop, Unix, Vlookup, Mahout, Pivot Tables, R, Access.
- **Use of information systems for logistics** which are SAP, ERP, WMS, TMS.
- **Knowledge of programming language** which are SQL, MYSQL, VBA, Python, Perl, Ruby, Java.

In this study, a qualitative research method has been used for investigation. It is stated that qualitative research aims to explore people's subjective viewpoints on events (Storey, 2007). A multiple case study, one of the qualitative research approach, was used in this study (Creswell, 2007). It intensely focuses on understanding the dynamics of an existing event or story (Eisenhardt, 1989, p. 534). In this context, four domestic logistics companies in Izmir have been identified as cases of this study. In addition, quantitative research is difficult and elusive for this type of research because Industry 4.0 has not been fully implemented yet. It is difficult to reach the data required by numerical techniques because Industry 4.0 has just been implemented recently. Therefore, the expert opinions and viewpoints about the research questions have been considered in this study, because the qualitative research method is more appropriate to find the answers of the questions "Why", "How", and "In what way" (Storey, 2007). Likewise, this study aims to find the answers to the questions about whether human resources of domestic logistics companies in Izmir are ready for Industry 4.0, how they can be prepared, and in what way there will be a transformation in the human resources of logistics companies. That is why qualitative research method has been chosen for this research.

The methods of collecting data in qualitative research are observation, interview, and document. The most commonly used method in the qualitative research is an interview, because it is a powerful method used to reveal people's perspectives, experiences, emotions, and perceptions (Yıldırım, 1999). The interview method has been used in this study to reveal the opinions and perspectives of interviewees.

There are three types of interviews which are unstructured, semi-structured, and structured (Kvale and Brinkmann, 2009). In the unstructured interview, the researcher starts the interview with a specific topic. There are no predetermined questions and the exact direction of the interview cannot be predicted (Yildirim and Simsek, 2008).

Questions take shape spontaneously during the interview. Interview questions and topics can vary by the flow of interviews (Kvale and Brinkmann, 2009). The purpose of this interview technique is to prepare questions for later interviews. Thus, unstructured interviews are often conducted at the beginning of qualitative research (Merriam, 2013).

The structured interview consists of a series of questions and each individual is asked in the same manner and order. Structure and order of questions cannot be changed during the interview. The flexibility given to the interviewer with the other two approaches is quite limited in this method. This method reduces the subjectivity of the study and can be used in cases where too many interviewees participate (Yildirim and Simsek, 2008). In qualitative research, the structured technique is most commonly used to obtain demographic information from participants (Merriam, 2013).

In this research, open-ended questions were asked because the aim was to obtain the in-depth opinions and suggestions of representatives of the companies examined about research questions (Merriam, 2013). Therefore, the data in this study were collected through the semi-structured interviews made five CEOs/managers of four domestic logistics companies operating in Izmir. The questions to be asked in this interview were formed by the data obtained from job advertisements. This interview can take place partly as a conversation and it is a flexible interview model that provides great freedom of movement to the researchers and interviewees (Barriball and While, 1994). This type of interview has a list of questions or topics to be discussed during the interview. The questions do not have to be asked in a specific order. The sentence structure and order of the questions can be changed during the interview (Yildirim and Simsek, 2008). Also, if necessary, the researcher has the right to ask additional questions to obtain detailed information about the questions. The aim is to make a discovery about a subject and the researcher can interpret the answers according to the research objective (Kvale and Brinkmann, 2009).

5.1. Sample Selection

In qualitative research, the sample selection is one of the most important steps. The sample model used in this qualitative research is called “purposive sample". The reason for choosing a purposive sample in this study is to collect in-depth information

about the subject, event or status of the research for a specific purpose, contrary to quantitative sampling approaches developed based on probability theory (Maxwell, 2012).

There are some different types of purposive sample selection. Some of the most commonly used types are maximum variation/heterogeneous purposive sampling, homogeneous purposive sampling, typical case sampling, critical case sampling, and total population sampling (Merriam, 2013).

Homogeneous purposive sampling method requires the collection of information on the research problem by identifying a typical case from a large number of situations in the universe, and samples are selected with specific criteria (Büyüköztürk et al., 2015).

In this study, homogeneous type was selected from the purposive sampling types because Industry 4.0 has been evaluated and the analysis is limited to only in the logistics sector, which is typical case, although it affects many situations and sectors. The companies included in this study have been selected according to specific criteria. These criteria are that they must be domestic companies, show logistics activities, and have certain departments which are supply chain analysis, transportation, and warehouse/stock.

5.2. Data Collection

Due to their request to remain anonymous, companies will not be presented by their names. The case companies selected according to the criteria above are coded as A, B, C, D. The interviews with each company's CEOs/managers lasted about an hour. The interviews were recorded and transcribed by the interviewer. The interviews made with the case companies are attached. Also, Industry 4.0 was introduced to interviewees before the interview began. The logistics applications of Industry 4.0 mentioned in the thesis are exemplified to interviewees and argued about them and then the interview started.

In order to get clear and detailed information about research topics, it is primarily preferred to interview with the companies' CEOs. In parallel, the interviews have been

held with the CEOs of A,B,C companies. However, it was said by the secretary that the CEO of Company D was abroad and his work program was so busy. Therefore, supply chain manager and company consultant participated into the meeting as interviewees in the interview with company D. The appointments were taken from each company and the companies were visited to have an interview.

During the interviews, it was asked about whether the case companies' current employees had the qualifications required by the companies which were thought to implement Industry 4.0 best (e.g. Amazon and DHL). Also, the similar questions were asked to these companies' employees through informal meetings to validate the data obtained from CEOs/managers. Based on all, inferences were made about whether the existing human resource was ready and sufficient for the transformation of Industry 4.0.

The job positions - warehouse, transportation, and supply chain managers/analysts - were evaluated separately in these qualifications. However, the interviewees wanted to evaluate them in general because they emphasized that there were no qualifications differences between their employees. They stated that their works were still carried out manually. It is indicated that there is no any systems and automation in their workplace about Industry 4.0, therefore no employee possesses the qualifications mentioned in Industry 4.0. Therefore, they did not require evaluating departments separately. Because of that, a qualification pool was created and presented to interviewees and all departments were evaluated together. The questions prepared for the research are shown in Table 1 below. The first question shown in Table 1 was asked separately for each qualification group, which were "Use of data analysis", "Use of information systems for logistics", and "Knowledge of programming language". It has been found adequate if employees have one qualification from each qualification group formed, because each company is looking for different qualities with the same function. The questions were asked in the following order.

Table 1. Prepared semi-structured interview form for this study

Question 1	Do your managers/analysts of warehouse, transportation, and supply chain departments have the qualifications required by Industry 4.0? (It was asked separately for each qualification group).
Question 2	How do you analyze data?
Question 3	Do you think that your employees should have these qualifications required by digitalized companies? If it is yes, what are you doing for this?, If it is no, what are the reasons? Please explain them.
Question 4	Will your existing human resource be sufficient during the period of Industry 4.0 or will you need a new human resource in this new era? Please explain them.
Question 5	Do you think that your existing human resource can be trained and adapted to this new era? If it is possible, how?, If it is not possible, what are the reasons? Please explain them.

Company A is a logistics company operating in Izmir. It has been performing its activities for 35 years. This company employs about 300 workers and does not operate in production. It operates in the storage and transportation. Also, this company stores construction materials and deliver within the borders of Turkey. This company has two warehouses in different cities in Turkey.

Company B has been operating logistics activities in Izmir since 1967. It is a family company that operates in Turkey and abroad. It does not operate in production and only show storage and transportation activities. It is the company that concentrates on storage. This company has almost 220 workers. This company is one of the companies that attach importance to rail system in transportation. It is a company capable of transporting all products.

Company C is a logistics company operating in Izmir. It has been carrying on its activities for 18 years. It just operates domestically. It can store and transport all kinds of products. It is the only logistics company that can provide transportation to each region in Turkey. This company carries out the majority of transportation by road.

Company D has been operating in Izmir since 1990. It also operates internationally. This company shows activities in design, production, and logistics. The most intense department in logistics activities is transportation. Predominantly textile products are transported. They store and export the products they produce. It is positioned in Turkey's largest 500 industrial companies. This company employs about 1,000 workers. The general features of the companies are presented in Table 2 below.

Table 2. General features of the companies interviewed for this research

	Business Fields	**Number of Employees**	**Scope**	**Transported and Stored Products**
Company A	Storage and Transportation	300	Domestically	Construction Materials
Company B	Storage(mainly) and Transportation	220	Domestically, Internationally	All kinds of product
Company C	Storage and Transportation	120	Domestically	All kinds of product
Company D	Design, Production, Storage, Transportation (Mainly)	1000 (approximate)	Domestically, Internationally	Textile Products

In addition, information about the demographic characteristics of the interviewees are presented in Table 3 below.

Table 3. Demographic characteristics of the interviewees

	Gender	**Age**	**Position**	**Educational level**
Interviewee 1	Male	37	The CEO of the case company A	Bachelor's Degree
Interviewee 2	Male	48	The human resources manager of the company A	High School Degree
Interviewee 3	Male	47	The CEO of the case company B	Bachelor's Degress
Interviewee 4	Male	55	The CEO of the case company C	High School Degree
Interviewee 5	Male	33	The supply chain manager and consultant of the case company D	Bachelor's Degree

5.3. Data Analysis

Another important part of qualitative research is data analysis. In this study, the descriptive analysis method was used to define the subject as precisely and carefully as possible. The descriptive analysis is an often used method for researchers to achieve brief information about different events (Büyüköztürk et al., 2015) Also, it is a type of qualitative data analysis that comprises summarizing and interpreting data obtained from various data collection techniques in accordance with predetermined themes (Yildirim and Simsek, 2008). In this study, the descriptive analysis was chosen to provide a result and brief information to the readers by bringing together the data within the framework of certain concepts and themes (Yildirim and Simsek, 2008).

Also, while the analysis of the research was carried out by the researcher, the findings were examined by another independent researcher and consistency was ensured among these two researchers.

This study was organized according to the 4 stages of descriptive analysis (Yıldırım, 1999);

1. A thematic framework for data analysis was determined with the research questions and interviews.
2. The data was read and processed according to the predetermined themes. In this process, it is important to gather the data in a meaningful and judiciously.
3. At this stage, the data was defined.
4. Last stage, the findings were explained, interpreted, and associated.

Miles and Huberman (1984) proposed the use of matrices, graphs, and tables in the visualization of the explained, interpreted, and associated data (Özdemir, 2010). The data obtained for the purpose of the study are presented in tables in the section of findings.

In the last stage, the data collected in all processes were interpreted and associated to reach a conclusion. Unlike deductive approach, there is no predetermined theory or hypothesis at the beginning of this research. Using a grounded theory and reaching a conclusion by the data obtained during the study determines that this study follows the inductive approach (Strauss, 1987). Grounded theory is a method used to discover concepts, hypotheses, and suggestions by the data obtained (Charmaz and Belgrave, 2007). In this study, in consideration of the grounded theory approach, all required data was collected and analyzed systematically and then it was tried to make inferences from these analyzes (Charmaz and Belgrave, 2007).

CHAPTER 6. FINDINGS

In this chapter, tables are prepared for the research questions and the findings obtained from the interviews about the research questions are presented.

6.1. Qualifications of Domestic Logistics Companies' Human Resources

In this section, interviewees were asked whether their employees had the qualifications required by firms which were thought to implement Industry 4.0 best. In this qualitative research, a table was formed according to the answers received from the interviewees. Table 4 below shows whether the employees of the domestic firms in logistics sector have the qualifications required by digitalized companies.

Table 4. Required qualification groups created for Industry 4.0

	Use of Data Analysis	**Knowledge of Programming Language**	**Using Information Systems for Logistics**
Company A	✘	✘	✘
Company B	✘	✘	✘
Company C	✘	✘	✘
Company D	✘	✘	✓

Company A: The CEO of Company A states that company employees do not have such qualifications about data analysis required by firms which are thought to implement Industry 4.0 best. Logistic data is kept in "Devambar" program and logistics activities are carried out and analyzed only with this program at this company. Through this program, the company can access customer information, issue an invoice, access address information, obtain stock information, etc.

It is expressed by the CEO that the knowledge of programming language is a very distant concept for his employees. There is no required automation at this company to use programming language. He states that, today, even in our industry, automation is scarce, the use it in the logistics sector is unthinkable. It is also stated that the work in the company is mostly carried out by manpower.

Furthermore, the CEO reports that company employees do not have the necessary information systems for logistics and have no idea about these systems. The reason why they do not use these systems is that they do not even know how these systems can contribute to them.

Company B: The CEO of the company B specifies that their workers do not have such qualifications about data analysis required by firms which are thought to best implement Industry 4.0. This company uses some programs such as TınasMix, Atap, and Netsis. All data are managed by these programs.

The CEO states that their employees do not have programming language skills. He informs that the company does not use automation systems yet, that's why these systems are not needed.

Also, it is stated that company workers do not use the information systems required for logistics but only use the programs mentioned above.

Company C: The CEO of Company C states that his employees do not have such qualifications about data analysis required by firms which are thought to best implement Industry 4.0. He emphasizes that employees do not need to use these systems and that the “Deva” program is sufficient for them. He also states that he has never heard of these programs before.

He indicates that employees do not need any programming language knowledge because they just use Deva software and it is stated that this program is enough for them to carry on the business. The employees do not need to know programming languages to use Deva program and also the company does not have automation systems which require programming language.

It is stated that they do not use the information systems required for logistics because they do not have any information about these systems.

Company D: The manager states that employees do not need qualifications required by digitalized companies about data analysis because data analysis is not done in these departments which are mentioned (warehouse/stock, transportation, supply chain analysts/managers), data analysis are made by central planning. It is enough that managers at these departments know basic excel. Also, these qualifications required by digitalized companies are not used in central planning. They use a program close to the ERP system, which is local software and also they can integrate all systems in this native software.

The company employees do not know the programming language required by digitalized companies because they do not require knowledge of programming language in their works. The manager states that their workers in the warehouse and transport departments do not know these systems. They already have a team that creates and maintains the local software that they use in close proximity to the ERP system. This team is doing all the software coding.

The company employees use WMS as the information systems required for logistics and every manager has information about this system. All the activities are carried out with WMS and its own system which is close to ERP.

6.2. Thoughts about Qualifications of Human Resources

In this section, interviewees were asked whether they thought that their employees should have the qualifications required by firms which were thought to implement Industry 4.0 best. In this qualitative research, a table was formed according to the answers received from the interviewee. Table 5 below shows whether interviewees think that employees should have the qualifications required by digitalized companies.

Table 5. Thoughts of managers about their human resources

	Managers who think that employees should have the qualifications required by Industry 4.0	**Managers who do not think that employees should have the qualifications required by Industry 4.0**
Company A		✓
Company B		✓
Company C		✓
Company D	✓	

Company A: The CEO of company A states that he does not think that company employees should have these qualities because he does not have any information about the subject. He also declares that the company has not too many customer potentials, so these qualities are too early for them. He does not know how these systems will contribute to their works. He also believes that it would be very costly to purchase these systems and train their employees. In addition, he states that it is necessary to discuss the advantages and disadvantages of these systems in companies whose potential is not very large. He states that the forklift is a new concept in their lives and emphasizes that they are far behind the standards.

Company B: Manager reports that they are not currently using these systems and cannot answer this because they do not have any information about all of these systems and knowledge.

Company C: The manager does not think that his employees should have these qualities because they should be paid more salary, when they have these qualities. He also does not want to bear the cost of these systems because its potential is not very large. They do not have these systems and they do not need them to carry out their business, so the manager does not expect these qualities from their employees. The profit margin of the transported products is very low, so many firms do not want to

pay storage cost. All of these reasons affect their potential and revenue, and the firm does not think to use systems required by Industry 4.0 because of cost.

Company D: The manager indicates that they are actively using the WMS system. Also, other qualities need to be known by his employees because the knowledge of these analyzes and programs are necessary for autonomous control, and it is necessary to get instant notification when there is trouble. The employees use software close to ERP, which is local software. They integrate all processes with this program, so they know information about these systems.

6.3. Human Resources Preferences

In this section, interviewees were asked whether they would need a new human resource in the digitalization period. In this qualitative research, a table was formed according to the answers received from the interview. Table 6 below shows whether firms will need a new human resource in the digitalization period.

Table 6. Human resources preference of managers in the Industry 4.0 era

	Need human resources	**Not need new human resources**
Company A	✓	
Company B	✓	
Company C	✓	
Company D	✓	

Company A: The CEO of company A states that company employees have a very low level of education, most of them are primary school graduates. Also, it is stated that a person's education is very difficult in terms of time and cost, so he says that he would definitely prefer new human resources.

Company B: The CEO of company B thinks that the firm cannot continue with the existing human resources in the digitalization period and everyone should be changed from managers to their employees. He emphasizes that human resources must be completely changed in order to adapt the firm to this digitalization era.

Company C: The CEO of company C states that the level of education of current employees is very low and they cannot adapt to this system. He informs about that he tried to integrate his workers to the barcode system and the use of I-Pad before but failed. He observed his workers could not adapt to barcode systems and using I-pad, so he believes that they cannot adapt the qualifications required by firms which are thought to best implement Industry 4.0. Therefore, he states that he will definitely prefer new human resources.

Company D: Manager states that they will need new human resources so that the work done will be easier and they will not waste any time to train their employees. But at the same time, he thinks that experience is also very important, so it is necessary to combine these qualities and experiences. He thinks that digitalization cannot overcome some situations, so it is the best option to blend experienced people and employees who possess these qualities.

6.4. Opinions about Human Resources Training

In this section, interviewees were asked whether they thought that people working in this sector could be trained. Also, there is some advice on how to be trained by those who think they can be trained. In this qualitative research, a table was formed according to the answers received from the interview. Table 7 below shows whether interviewees think that people working in this sector can be trained.

Table 7. Managers' opinions about their human resources training

	Employees can be trained	**Employees cannot be trained**
Company A	✓	
Company B	✓	
Company C		✓
Company D		✓

Company A: The CEO of company A states that employees can be trained with state support, not only by a company. It is difficult for the firm to train its employees in terms of cost and time. Seminars and free courses should be provided by the government for all these systems. There should be government incentives in the logistics sector like in agriculture and defence industry. Also, the low level of technological production of Turkey negatively affects the digitalization of firms. In order to prepare employees for the digitalization period, firms must first enter into the digitalization process. The production of machinery and sensors that enable automation are little in Turkey. These tools are taken from outside and they cause extra cost. Turkey should increase its technological manufacturing to adapt digitalization. Logistics is very important in the world trade and in a country. It provides 10% of the world trade, so universities should focus on logistics departments. Programming language and data analysis should be concentrated on at the universities. Graduates of the logistics department must have qualifications about these systems.

Company B: The manager says that they need to transfer someone who knows these systems and the person will give training, introduce the systems, and will enable the systems to be used actively. At the same time, university education is also very important. There is not enough education in universities and there are no differences between graduating employees from universities or non-graduating employees. The firm educate the people from scratch who graduated from universities. Even those who

get training at logistics departments of university are unfamiliar with the sector. Because of that, practical training should be provided more than theory.

Also, as a company, employees can receive compulsory training for these qualifications on certain days of the week within the working hours. Employees can be adapted after a certain period of time with the compulsory training.

Company C: The manager states that he has tried a lot of times to adapt his employees to digitalization. An attempt was made to teach the use of tablets to employees because the employees were asked to follow the whole process. But he emphasizes that he is not successful, and also emphasizes the logistics industry is dependent on the labor force for years and it will continue like that. Also, the barcode system was tried to be implemented in the company, but employees could not adapt to this basic technology. Employees have a very low level of education, so the manager thinks they cannot be trained. Also, he observed that employees could not change the work process that they did in the same way for many years. Employee's education and qualification are not enough to adapt digitalization.

The main point, he thinks that the employees cannot be trained because he has tried it before but he has failed.

Company D: Manager says that it is difficult to educate people who have come to a certain stage and have experienced the work. Also, it is difficult to discourage people from habits. The young generation who are trained with these digital systems and employees who have experience will work together. The young generation will be interested in the digital part of the business and current employees will give their experience, so the firm will have reached a more successful system. He emphasizes that everything is not solved in digital platform, also experience is very important.

Digitalization is very backward concept in our country. Primarily, it must be explained with seminars and conferences why these systems should be implemented in Turkey. For example, Loder logistics association has done serious studies on this issue. They organize conferences with very large companies. They inform people about the status of the logistics. Such organizations should be increased in order to reach a conclusion.

Main point, he emphasizes that they will influence future generations and the employees who have performed their work in the same way for years cannot be trained. Definitely, a new human resource will be needed.

CHAPTER 7. DISCUSSION AND CONCLUSION

The technological changes and applications are accompanied by Industry 4.0 deeply affect the human resources in the logistics sector such as the need for skilled labor (Ermolaeva, 2016). In this study, it is aimed to investigate whether human resources of domestic logistics companies in İzmir are sufficient for Industry 4.0 era or not and the effects of new technological developments of Industry 4.0 on human resources in the domestic logistics companies. In accordance with this purpose, this study bases on the interviews to come to a conclusion. In this section, discussions and conclusions about the research questions of the study are presented.

According to the answer received from the question of whether domestic logistics companies' employees have the qualifications required by firms that are thought to implement Industry 4.0 best, it is explicit that people working in domestic logistics companies in Izmir do not have the necessary qualifications required to adapt to the Industry 4.0 era. The results show that one of the case companies' human resources is capable of just "information system for logistics" which is only one of the three qualifications groups formed in this study. However, the results of the interviews show that the human resources of the remaining three case companies do not have any of the qualifications required by Industry 4.0. Therefore, it is concluded that human resources of domestic logistics companies in Izmir are not sufficient for Industry 4.0. In addition, as a result of the research conducted by Doğru and Meçik (2018) named "The Effects of Industry 4.0 on the Labor Market in Turkey: Firm Prediction", it is emphasized that the existing human resources' qualifications of domestic firms are not adequate for the Industry 4.0 process (Doğru and Meçik, 2018). The findings of Doğru and Meçik's study support the lack of qualifications of existing human resources in Turkish firms, which is one of the results of this study. In addition, the qualifications groups established in this study guide firms and human resources of logistics companies by showing which qualifications employees should have at the beginning of the Industry 4.0 era. Training the existing human resources or future generations in the logistics sector according to these qualifications groups will be useful in adapting to the Industry 4.0 era.

According to the answer received from the question of whether CEOs/Managers of the case companies think that their employees should have the qualifications required by firms which are thought to implement Industry 4.0 best, it is observed that three of the case companies' CEOs/managers do not think that their employees should have these qualifications. As a result of the interview, four factors are obtained as the main reason for this. These are as follows:

- The lack of knowledge of companies' CEOs/managers about the qualifications and systems required by Industry 4.0.
- The lack of knowledge of companies' CEOs/managers about how these systems and qualifications will contribute to themselves.
- The high salary expectation for employees who have the qualifications required by Industry 4.0.
- The automation and digitalization process are not considered necessary for them due to the low customer potential of the company.

However, one of the case companies' CEO/manager states that their employees should have these qualifications. This is because programs such as WMS and ERP are used actively by this company. It is emphasized that employees should have these qualifications in order to use and develop these systems better in the automation and digitalization process.

According to the answer of the question of whether the CEOs/Managers of the case companies will need a new human resource in the digitalization period, all case companies would prefer new human resources in this new era. The most important reason for this is the low level of education of their employees. The Transportation and Logistics Sector Report (2018) supports the findings of this study by stating that the level of education of the employees in the Turkish logistics sector is very low (Transport and Logistics Sector Report, 2018). 75% of the employees in the Turkish logistics sector are primary or secondary school graduates (Quattro Business Consulting, 2008). In the interview, it is emphasized that employees of the Turkish logistics sector cannot be trained due to the very low level of education. Also, Transport and Logistics Sector Report (2018) states that one of the biggest problems

of employees of Turkish logistics companies is that they cannot adapt to new systems and technologies because of the lack of education (Transport and Logistics Sector Report, 2018). Therefore, the current employees of Turkish logistics companies may not be able to continue to work at their job in this era because Aktuğ and Kiracı (2014) state that unemployment is an inevitable ending for employees who cannot be integrated into new technologies and systems (Aktuğ and Kiracı, 2014). In this case, while Industry 4.0 affects employment positively such as creating new business models, it also can cause the existing human resources to become unemployed. In addition, more than one million people working in the logistics sector face the threat of not finding new jobs as substitution because new jobs which are emerged with Industry 4.0 also require skilled labor. Another reason for choosing a new human resource is that it is difficult to educate people in terms of cost and time. Likewise, providing employment to people who have the qualifications required by Industry 4.0 poses a major threat to the existing human resources.

According to the answer of the question of whether CEOs/managers think that people working in this sector can be trained, two of the case companies state that their workers can be trained. According to these two case companies, employees can be trained as follows:

- Employees can be trained with the state support, not only by a company because it is difficult for the firm to train its employees in terms of cost and time.
- There should be government incentives in the logistics sector like in agriculture and defence industry.
- Turkey needs to strengthen its technological production because the low level of technological production of Turkey negatively affects the digitalization of firms. In order to prepare employees for the digitalization period, firms must first enter into the digitalization process.
- Universities should focus on logistics departments. Programming language and data analysis should be concentrated on at the universities. The logistics training at universities in Turkey has been providing for the last 10 years only.

Tanyaş (2015) states that this can be shown as the major reason for the formation of unskilled workers in the logistics sector.

- Practical training should be more dominant than theoretical training. The fact that theoretical knowledge is primary over practices affects the business processes of the companies adversely (Doğru and Meçik, 2018).

However, two of the other cases companies declare that their employees cannot be trained. According to interviewees, the main reasons for this are as follows:

- Very low level of education of employees in the logistics sector is a major obstacle to their training.
- The difficulty of giving up habits is another reason. Employees who have been performing certain business processes for years cannot adapt to other systems.
- Previously, changes in business processes were attempted by case companies such as using a barcode system and I-pad, but employees were not adapted.

The findings of this study show that human resources of domestic logistics companies in Izmir are not ready and sufficient for Industry 4.0 era. More importantly, it is obvious that people employed in the domestic logistics companies will not be able to continue to work because a new human resource will be preferred in this new era. Also, manager profiles that did not trust in human resources were perceived in the answers obtained from the interviews. It was observed that managers finding human resource insufficient tried to solve business processes by simpler and more traditional methods.

One of the most important views of Industry 4.0 on human resources is that it will increase employment because it will create new business models. However, this increased employment will cover the qualified workforce (Rutkowsky et al., 2015). As a result of the interviews, it has been observed that the employees of the domestic logistics companies do not have the necessary qualifications for Industry 4.0 and most of them have unqualified workforce. Besides, it is stated that employees in the logistics sector in Turkey cannot adapt to new technologies and information systems (Transport and Logistics Sector Report, 2018). Based on all these reasons, this study claims that

although Industry 4.0 has positive effects on increasing employment, it constitutes a major threat to existing human resources of domestic logistics companies. It means Industry 4.0 will have a destructive effect on the current employment of domestic logistics sector. In other words, while Industry 4.0 increases qualified employment, it makes the current employment unemployed.

The findings of this study were obtained as a result of interviews that were committed with four logistics companies operating in Izmir. Future research is suggested to investigate whether the same results are achieved if more companies operating in different cities are examined. In the new digital era called Industry 4.0, the business processes will change and also there will be a change in the way human resources work. It is stated that people will work in controlling, programming, and monitoring of the production instead of working under the harsh conditions, forcing the limits of body strength (Rutkowsky et al., 2015; Sener and Elevli, 2017). Especially through increased automation and robotic systems, people will work at qualified jobs such as robot coordinator, programmer, repairman, industrial data analyst, industrial software programmer, production technologies specialist, etc. Also, as stated in this study, changing business processes and new jobs lead to changes in the qualifications required for human resources. However, this study shows that almost all human resources of the domestic logistics companies have unqualified workforce and cannot adapt to new technologies and systems. Also, domestic logistics companies' CEOs/managers do not think that existing human resources can be trained and adapted to Industry 4.0 era, therefore they prefer new human resources. Based on these reasons, the employment-increasing effect of Industry 4.0 becomes disputable in domestic logistics sector whose competitiveness depends on cheap labor and unqualified workforce. In future studies, researching how Industry 4.0 is going to affect employment in Turkish sectors will make an important contribution to the literature.

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APPENDIX

The job postings used in this study are as follows. Due to the limited duration of job postings, no web links were given. Job postings were reviewed in March 2019 and as a criterion, job postings within three months at the latest were taken into consideration.

#	COMPANY NAME	JOB POSITION NAME	REQUIRED QUALIFICATIONS
1	Amazon	Data Warehouse	Oracle, SQL, MYSQL, WMS
2	Amazon	Data Warehouse Specialist	SQL, VBA
3	Amazon	Spare Parts Warehouse Manager	SQL, WMS
4	Amazon	Warehouse Manager	Access, VBA
5	Amazon	Inventory Manager	WMS,SAP, VBA
6	Siemens	Warehouse Manager	Access, ERP, VBA
7	Bosch	Warehouse Operation Manager	SAP, VBA
8	Ocado	Warehouse Planning Analyst	VBA, SQL, SAP
9	Amazon	Instock Manager	VBA, SQL, WMS
10	Bosch	Warehouse Manager	SQL, VBA, WMS, SAP
11	Amazon	Warehouse Specialist	SQL, VBA, Hadoop
12	Amazon	Transportation Planning Analyst	Pivot Tables, Vlooksup, Access, SQL
13	Bosch	Transportation Specialist	VBA, SQL, Access

14	Amazon	Transportation Manager	SQL, R, Python, Pivot Tables
15	Bosch	Transportation Manager	SAP, SQL, Access
16	Amazon	Logistic Specialist (Fulfillment Transportation)	Vlookup, Pivot Table, VBA, SQL
17	DHL	Transportation Solutions Manager	ERP, Access, SQL, TMS
18	Wayfair	Transportation Planner	SQL, Oracle, TMS
19	Amazon	Transportation Specialist Lead	TMS, SQL, Vlookup, Pivot Tables, Access
20	Amazon	Transportation Specialist	SQL, Access, Hadoop, TMS
21	Siemens	Sr. Manager, Transportation	MYSQL, TMS, SAP, Access
22	DHL	Transportation Manager	SQL, SAP, TMS, Vlookup
23	DHL	Sr. Operations Systems Analyst	Vlookup, Pivot Table, VBA, SQL, Oracle
24	Siemens	Supply Chain Manager- Rail Transportation	ERP, SAP, Unix
25	Wayfair	Senior Manager Transportation	SQL, WMS
26	Amazon	Transportation Analyst	SQL, R, Python, TMS
27	Amazon	Supply Chain Analyst	Pivot Tables, Vlooksup, SQL, SAP, Oracle
28	Amazon	Business Analyst (Supply Chain)	SQL, SAP, Python, R
29	Amazon	Senior Financial Analyst	VBA, MYSQL, VBA
30	Amazon	Supply Chain Analyst	SQL, R, Python, Hadoop

31	Amazon	Supply Chain Senior Analyst	SQL, R, VBA, Python, Perl, Ruby, Unix, Mahout, Hadoop
32	Amazon	Business Analyst, Fleet Supply Chain	SQL, Oracle, Java, R, Python
33	DHL	Supply Chain Analyst	SQL, Oracle, TMS
34	Siemens	Analyst, Supply Planning	SAP, Oracle
35	Bosch	Supply Chain Network Analyst	SAP, ERP, Python
36	Bosch	Supply Chain Analyst	SQL, R, VBA, Hadoop, Unix, Oracle, Java
37	Ocado	Supply Chain Analyst	VBA, SQL, SAP, Mahout
38	Siemens	Supply Chain Analyst	SAP, ERP, Oracle
39	DHL	Logistics Analyst	TMS, WMS, SQL, Access
40	Wayfair	Supply Chain Analyst	SAP, ERP, Oracle, PRMS, Pivot Tables
41	DHL	Supply Chain Analyst	Vlookup, Pivot Table, VBA, SQL
42	DHL	Supply Chain Analyst	Vlookup, Pivot Table, VBA, SQL, Oracle, MYSQL
43	DHL	Operations Systems Analyst	TMS, SQL, Vlookup, Pivot Tables, Access, VBA

ETHICAL BOARD APPROVAL

İZMİR EKONOMİ ÜNİVERSİTESİ

SAYI : B.30.2.İEÜ.0.05.05-020-*083* 12.12.2019

KONU : Etik Kurul Kararı hk.

Sayın İsmail Cem Sezer,

"Endüstri 4.0'ın Lojistik Sektöründeki İnsan Kaynakları Üzerindeki Potansiyel Etkisini Keşfetme" başlıklı tezinizin etik uygunluğu konusundaki başvurunuz sonuçlanmıştır. .

Etik Kurulumuz 02.12.2019 tarihinde sizin başvurunuzun da içinde bulunduğu bir gündemle toplanmış ve projenin incelenmesi için bir alt komisyon oluşturmuştur. Projenizin detayları alt komisyon üyelerine gönderilerek görüş istenmiştir. Üyelerden gelen raporlar doğrultusunda Etik Kurul 12.12.2019 tarihinde tekrar toplanmış ve raporları gözden geçirmiştir.

Sonuçta 12.12.2019 tarih ve 104 numaralı Etik Kurul "Endüstri 4.0'ın Lojistik Sektöründeki İnsan Kaynakları Üzerindeki Potansiyel Etkisini Keşfetme" konulu tezinizin etik açıdan uygun olduğuna oy birliği ile karar verilmiştir.

Gereği için bilgilerinize sunarım.

Saygılarımla,

Prof. Dr. Filiz Başkan

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