

Development of Logistics Management and Relationship with Industry

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Abstract: Today, the internet is in contact with everything in the world. Since it is impossible to think of production and logistics separately, Industry 4.0 is expected to redefine business processes in the logistics sector. The main purpose of the study; It is to reveal the innovations it will bring to the logistics sector by examining the Industry 4.0 revolution in detail, which contributes to the development of the logistics management. This study, which was prepared as a conceptual framework, was supported by a survey study to raise awareness about the effects of Industry 4.0 on the logistics sector and to reveal a new perspective in terms of theory and practice. In the last 15 years, the transportation/transportation activities in the sector have been carried out with a more scientific and contemporary perspective, increasing the impact of logistics on transportation systems day by day and has started to play an important role in the development of Turkish foreign trade. The purpose of the study in your hand; The logistics sector, which has been developing rapidly, "Does the logistics performance of Turkey in the last 15 years, which has developed with the contribution of industry 4.0, digitalization and the internet, differ according to the descriptive characteristics of the participants and businesses?" and "How does Industry 4.0, digitalization and internet contribute to Turkey's logistics performance in the last 15 years? It is to reveal it by evaluating it with ANOVA analysis for searching the answers of the problem in the form.

Keywords: Digital Industrial Revolution, Industry 4.0, Logistics 4.0, Logistics, Internet

Introduction

Logistics is a nested and sequential set of processes to bring the final product to the desired point. When it comes to general services and vehicles, the first thing that comes to mind is the transportation, stacking and distribution of the final product. Today, logistics services take their share from the increase in technology. However, meeting future logistics demands will depend on the development of new methods rather than the efficient implementation of existing logistics processes. With the advancement of technology and globalization, there have been innovations in the definitions of logistics. In addition to the existing definitions, since information communication is web-based, the definition of logistics e-logistics has been added (Hieber, 2002:13).

When we look at the historical development of logistics, it can be said that humanity may have started with an instinctive drive to get from one place to another. When this need was blended with the economic events of goods or services, the first traces of logistics emerged. Moving these goods and services to markets where they are less valuable and more valuable has also followed the traces of the first global transportation such as Spice and Silk Road. Transportation, which is one of the basic building blocks of trade and economy, has taken its current form with its increasing needs and developing technology elements.

Logistics management, on the other hand, determines the quality determinants according to customer expectations and demands and manages the process of transferring products, people and data in a fast, economical, safe and environmentally friendly way. The ultimate goal of logistics management is the realization of all transfers in the markets of goods and services. However, its main purpose is to provide the other party with the desired quantity, the desired date and the desired quality.

The expected effects of Logistics 4.0 in the near future will have an impact on all logistics activities. According to the general definition and scope, the main process map of logistics management can be summarized according to the most common usage. Logistics management is an integrated process that includes efficient and optimum management of all functions of a business that needs movement and warehousing. The responsibility of the logistics service provider to the service buyer is to provide the required inputs at the desired time, in the desired quantity and in the desired quality. The logistics service, which keeps these basic expectations to a minimum, has a critical importance in this highly competitive sector. On the other hand, innovative approaches that can meet the expectations of service users with minimum cost are among the new elements that make a

difference for service providers. In today's global world, logistics expectations now include not only essential services but also ancillary services and functions affected by logistics. Logistics services available at every stage of the supply chain are of great importance as they are greatly affected by the speed and quality of the supply chain (Babacan, 2003: 10-14).

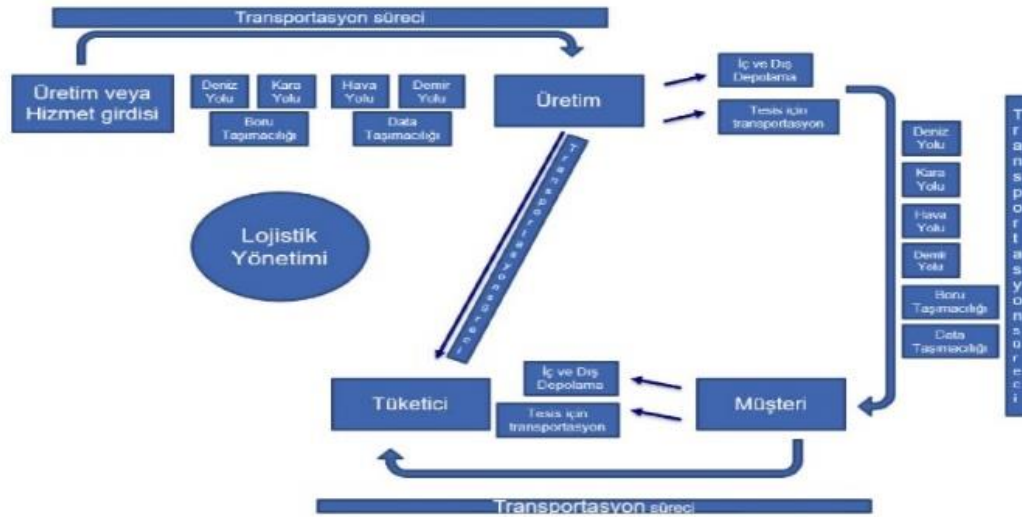


Figure 1. Main Processes in Logistics Management

If we talk about the purpose and importance of logistics management, it is quality, price, time and service to maintain profitability and value creation in businesses. Another important purpose of logistics management; is to ensure that products, raw materials, auxiliary products and auxiliaries or a service agent are delivered, when necessary, under appropriate conditions, when necessary and at the lowest cost. The effective and correct use of logistics management not only provides an improvement in the markets of goods and services, but also provides a global power to the country as a fundamental power (Karayalcin, 1986: 32). Almost every field of human activity is associated with logistics. Logistics; It has been an important determinant in the economy of every country as it affects efficiency, transportation processes, energy resources and costs.

Basic Principles and Main Activities of Logistics Management

Standardization, economy, competence, flexibility, ease of use and simplicity, traceability, coordination and planning are among the basic principles of logistics management. Companies want to deliver the products and services demanded by the customers to their buyers at the desired place, time and quality. The main activities of logistics for this customer need are as follows: Customer Service, Transportation and Traffic Management, Warehouse / Warehouse Management, Inventory Management, Demand Management, Usage.

Classification of the Logistics Process

Logistics processes have undergone changes due to the diversification and differentiation of customer needs and sectorial expectations over the years. 1PL (First Party Logistics) First party logistics; It is the model in which the company carries out its basic logistics activities with its own vehicles (<https://eta.borusanlojistik.com/blog/22>). 2PL (Second Party Logistics) 1PL is a model of companies directly supplied by companies (Lee, 2013;258). 3PL (Third Party Logistics) Third party logistics companies; It refers to sophisticated and more complex process chains based on first- and second-party logistics service delivery models. It is the model of companies that need logistics services to process processes with their own sub-service providers (Çalış, 2003,145). 4PL (Fourth Party Logistics) Occurred in regions where third party logistics companies were unable to fully influence the available service options. In the third-party models that focus on classic transportation and warehousing, the fourth-party logistics model was introduced to meet the more complex and highly anticipated logistics requirements of companies. The ultimate goal is to provide a complete supply chain service by integrating large and specialized activities (Bade, 2000).

Development of Logistic Management

The dynamics of the logistics industry, which provides the instinct to change consumer demands and respond quickly to consumer demands, has led to more innovations in logistics activities. Development processes such as industrial revolutions, which are one of the important stages of human history, have brought innovations to logistics processes and management.

Logistics 1.0, Logistics processes have been one of the sharpest innovations in the use of engine power during the industrial revolutions that began with the power of steam and mobility by James Watt, and most importantly brought that power to mechanization, often using a steam engine for rail transport, hampering road transport :35).

Logistics 2.0, In the light of industrial and technological developments, the use of high-strength materials such as steel and aluminum in production vehicles continued to pave the way for their use in logistics vehicles. By integrating electricity, coal and oil-based power sources into transportation processes, road transportation continued, while rail and ship transportation increased its share. Container shipping is one of the most important innovations in this period (Galindo, 2016:43).

Logistics 3.0, the development of software-assisted production technologies and the management of logistics processes with software-supported technological activities emerge in this period. Examples of software-based logistics management systems such as WMS (Warehouse Management Systems) and TMS (Transport Management Systems) have begun to be applied manually and are the pioneers of many databases used today (Galindo, 2016:58).

Logistics 4.0, the concept of Logistics 4.0, was brought to life with the integration of innovation, software and applications in the logistics sector and entered the literature in today's logistics sector. Logistics 4.0 is a concept for smart services and smart products. The innovative approach to describe innovative, software-based products and emerging services is called "smart logistics". It is a system that can increase the flexibility and easy adaptation of businesses and provides advantages for companies to take action for this added value (Lin and Jones, 2009: 542). Logistics 4.0 leverages communication technologies to further improve supply chain functions and inter-company coordination. Thanks to intelligent and digital network systems, people, machines, plants, logistics and production communicate directly with each other. It provides timely production optimization by integrating logistics into the supply chain as early as possible. To better understand the historical development of Logistics 4.0, it will be necessary to analyze the Industrial Revolutions correctly. In other words, the logistics development process consists of four stages like the industrial development process (Galindo, 2016: 25-30).

The first industrial revolution (Industry 1.0) Logistics 1.0 begins with the discovery of steam engine power. The greatest inventor of this period was James Watt. Thanks to the mechanization in agriculture, production efficiency has increased. Factories with a new workplace for people began to be established. Transportation and production activities have gained a new dimension with the use of animal power and hand tools (Wang, 2016: 69). Second industrial revolution (Industry 2.0) Logistics 2.0 is defined as evolution as a result of new technological developments. At the same time, this period is the transition to the industrial engineering period. The biggest technological developments of this period are the use of electrical energy in industry and mass production lines. Third industrial revolution (Industry 3.0) The biggest technological advancement in Logistics 3.0 is the transistor and programmable logic controller. Innovations such as giant machines, machine tools and CNC are controlled by a programmable logic controller (Galindo, 2016: 25). Some of the new technologies in the fourth industrial revolution (Industry 4.0) Logistics 4.0 are; autonomous vehicles, additive (3D Printer) production, unmanned aerial vehicles (UAV), drone use, smart objects, cloud computing, big data, autonomous robots (Ötleş and Özyurt, 2016).

Current Situation of the Logistic Industry in the World and in Turkey ***Current Situation in the World***

From a global perspective, it can be said that technological developments and effects in each sector group cause a rapid increase in the logistics sector. The demands of fast logistics solutions brought by globalization increase the competition in the logistics sector and add value with the knowledge gained over the years (Erdal, 2005: 16). The logistics sector, which serves to increase the production of goods and services, which is an important criterion in the development of countries, is an important criterion in the competition of countries. Countries that

have superiority in logistics transfer lines due to natural and geographical reasons are becoming more prominent especially in the competition of the logistics sector (Erdal, 2005: 13).

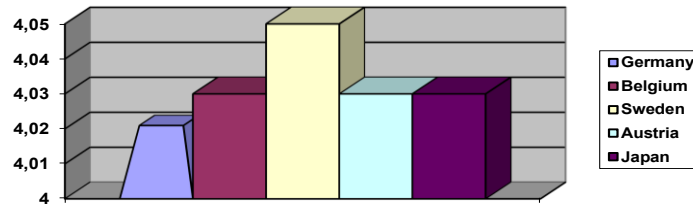


Figure 2. Top 5 Countries According to the World Bank Logistic Sector Index Criteria (2018)

Considering the logistics sector index criteria prepared according to the World Bank data, Germany ranks first with the giant industry. It is a leader in the logistics industry, active in innovative and all new industrial approaches (Lee, 2015: 365). The digital and innovative service examples of Logistics 4.0 brought not only general traceability in the supply chain, but also many operational innovations and made most processes autonomous. Every process where autonomy can be achieved can be easily monitored and improved, and process performance measurements can be made more meaningful. In order to achieve this, an in-depth analysis of the existing processes should be made and the main causes of time loss and errors should be well defined (Orhan, 2003: 45)

Current Situation in Turkey

The Logistics Performance Index, launched by the World Bank in 2007, is defined as an index that measures the ability of countries to trade. This index is used to determine the development levels of countries (Demirbilek et al., 2018: 12). Logistics Performance Index; According to the 2018 data in Chart 1, Turkey ranks 47th among 160 countries.

Chart 1. Comparison of Logistic Performance Index by Years

Year	Range	LPI Point	Custom0	Infrastru cture	International Logistic	Quality of Logistic Affairs	Tracking of Shipment	On-Time Delivery of Shipment
2007	30	3.15	3	2.94	3.07	3.29	3.27	3.38
2010	39	3.22	2.82	3.06	3.15	3.23	3.09	3.94
2012	27	3.51	3.16	3.62	3.36	3.52	3.54	3.87
2014	30	3.5	3.23	3.53	3.18	3.64	3.77	3.68
2016	34	3.42	3.18	3.49	3.41	3.31	3.39	3.75
2018	47	3.15	2.71	3.21	3.06	3.05	3.23	3.63

Source: www.lojistikcilerinsesi.biz, 2019

Noting the progress made in 2012 in Turkey, it ranked 12th in 2010 and rose to 27th, but this trend cannot continue. In this period, the highest score was achieved with the delivery of shipments with 3.63, but it decreased compared to the previous year. Tracking and traceability of shipments was the second highest score with 3.23. It is also possible to conclude that we need to improve the logistics services we provide to other countries based on customs criteria and LPI scores. Companies that change rapidly for the logistics sector in Turkey are also affected by this change in the world (Öztemel and Gürsev, 2018: 158).

Relationship of Logistic and Industry and Benefits of Logistic 4.0

Definition of Industry

In the 1st article of the Industrial Registry Law No. 6948, which entered into force as of 1957; It is stated that "Places that continuously and mass-produce by changing/processing the quality, shape or composition of a

substance with the help of forces such as machinery, workbenches or tools or by manual labor partially or completely, and places where minerals are mined and processed are Industrial enterprises, the works done here are considered Industrial works" (TC Official Newspaper, 1957)

Transformation of Logistic with the Experienced Industrial Revolutions

"It is clear that logistics activities have a significant impact on the competitiveness of the Industry, and the development and transformation of the Industry in parallel with the Industrial revolutions experienced due to their interaction with each other creates a similar transformation effect on the logistics sector" (Çiçekli, 2018). In order to better understand this situation, it is necessary to examine how each emerging Industrial revolution changes logistics activities and processes.

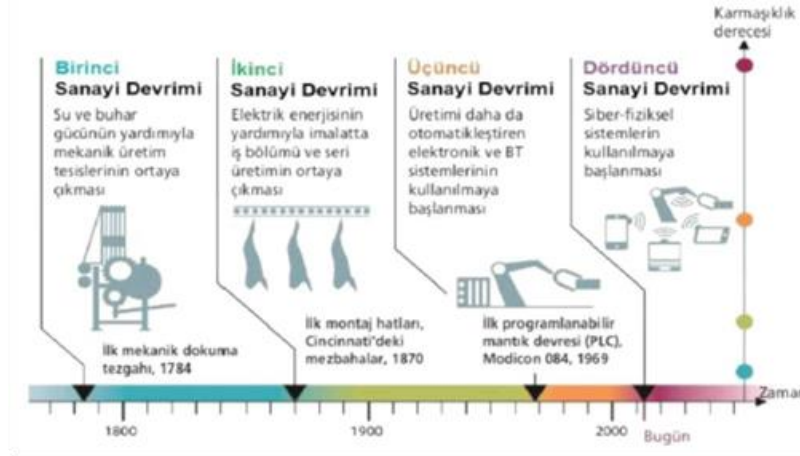


Figure 3. Shaping the Industry (Genç 2018: 237)

First Industrial Revolution and Logistics 1.0: Before the Industrial Revolution, consumer products such as textiles and food produced by villagers at home or by artisans in small workshops in cities were both very expensive and insufficient to meet the demands of consumers. However, with the development of the steam engine and its use in textiles and in obtaining metal from iron, there were great changes in production and the first textile factories were established in England. England has started to sell cheap and high quality textile products to the whole world and has thus become an important economic power (Akbulut, 2011: 1-3). Following the steam engine, with the development of steam ships, steam trains and railways since the second half of the 19th century, there has been a significant increase in the carrying capacity, and now machines have been used instead of animal power for the transportation of people and goods (Çiçekli, 2018; Galindo, 2016: 25-27).

Second Industrial Revolution and Logistics 2.0: Technical advances in the second half of the 19th century; The development of industries based on inventions such as motor, light bulb, telegraph, radio and telephone has changed the economic system in the world. This new period, in which the first electrically powered assembly line started to be used in the slaughterhouses in Cincinnati, USA, and the most common energy source was coal, is called the Second Industrial Revolution period (1850-1975) (Günay, 2002: 8-14).

Third Industrial Revolution and Logistics 3.0: The development of the computer and electronics industry has started a new Industrial process with nuclear energy. This period, in which production became automated and the first programmable simple robots began to be used in manufacturing, is called the Third Industrial Revolution period (1975-2011) (Çiçekli, 2018; Galindo, 2016: 29-31).

The Fourth Industrial Revolution and Logistics 4.0: Europe, one of the pioneers of the industrial sector, is facing challenges such as insufficient natural resources, rising energy prices, the aging of the workforce, as well as the rise of the Chinese and Asian economies and the tremendous acceleration of technological changes. In particular, the global economic crisis in 2008 caused a serious economic recession and loss of workforce in Europe, so a new industry was created to ensure sustainable and stable economic growth in Europe and to return the industrial production, which was shifting to East Asia, to Europe. The idea of adopting the policy understanding (reindustrialization) has emerged (Erol, Schumacher & Sihni, 2016: 1).

The concept of "Industry 4.0", which is defined as the inclusion of digital information technologies in all processes of production and the life cycle of the product (design, production, logistics, etc.), was first used in Germany in 2011. In fact, it is no coincidence that this concept first emerged in Germany. Because Germany, one of the first countries that comes to mind when it comes to industry, ranks first in the Industrial Performance Index (CIP) developed by the United Nations Industrial Development Organization (UNIDO) to measure the industrial performance of countries.

Industry 4.0, also expressed by different countries as "Industry 4.0, 4th Industrial Revolution, Internet of Things, Industrial Internet, Internet+, Society 5.0, Industry 2025, Future Manufacturing/Manufacturing 2030, Smart Manufacturing/Manufacturing or Smart Factory" It is based on the concept of cyber-physical systems, which means the integration of processes. These systems, which offer virtual and physical worlds together, are formed by the combination of internet and services and create a networked world where smart objects can communicate with each other, thus making the internet of things possible. When the real and virtual worlds come together, many innovative applications can be made. For example; Cell phones, which were used only for phone functions in the past, have turned into a multi-functional device from internet use to different applications today. Therefore, as a result of integrating production processes with the integration of cyber-physical systems into production systems, "Smart Factory" type production, which provides significant quality, time, resource and cost advantages, will be possible (MÜSİAD, 2017: 51-70).

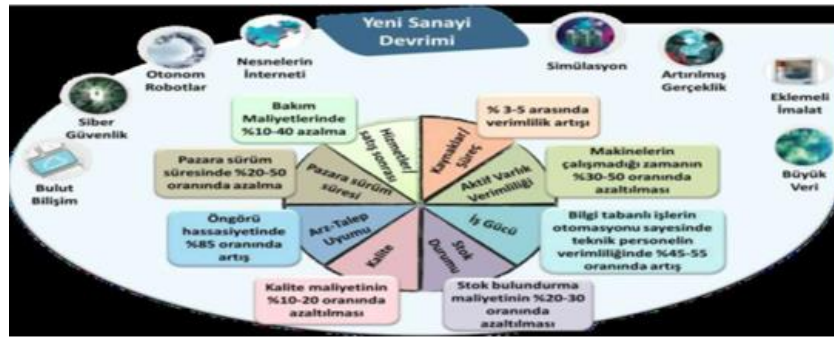


Figure 4. Digital Technologies and Earnings at Industry 4.0 (TÜBİTAK 2016)

The basis of Industry 4.0 is the "Internet of Things (IoT)". Every object (material, machine, product, etc.) will have an identity, connecting with any object from anywhere, at any time, in this system that can cooperate with each other and people, and connects all objects, suppliers and customers with a network can be established. In a study of the Gartner company; It is thought that interconnected objects will be used especially in "manufacturing, transportation, defense, agriculture, logistics, banking and health" (MUSIAD, 2017: 51-69).

When we look at the sectoral effects of Industry 4.0, it is stated that software and telecommunication are the sectors that will be affected the most, and that "machinery, electrical devices, chemistry, automobile, agriculture, health and logistics" are among the sectors that will be positively affected by this change that is expected to be seen.

Significant changes are expected in the logistics sector as a result of the concept of Logistics 4.0, Reindustrialization efforts to create new production methods (Industry 4.0). Because the logistics industry in Germany, which uses the concept of Industry 4.0 for the first time and ranks first in LPI, is the 3rd largest industry and there are German logistics companies (DHL, Kuehne+Nagel, DB Schenker, etc.) that are leaders at the global level.

In order for logistics companies to compete today, they need to improve themselves in terms of efficiency, effectiveness, service delivery, innovative technologies, speed and punctuality, and transform with planned strategies. While mechanization took place with the emergence of electricity and information technologies, Industry 4.0, where the demand for personalized products and services increased significantly after the first three Industrial revolutions and everything could be interconnected; It also requires supply chain processes (supply and shipping logistics) to adapt itself to this change. The two main elements in this change, which is defined as Logistics 4.0; it is labor saving in cargo transportation and transportation time (Çiçekli, 2018; Galindo, 2016: 32)

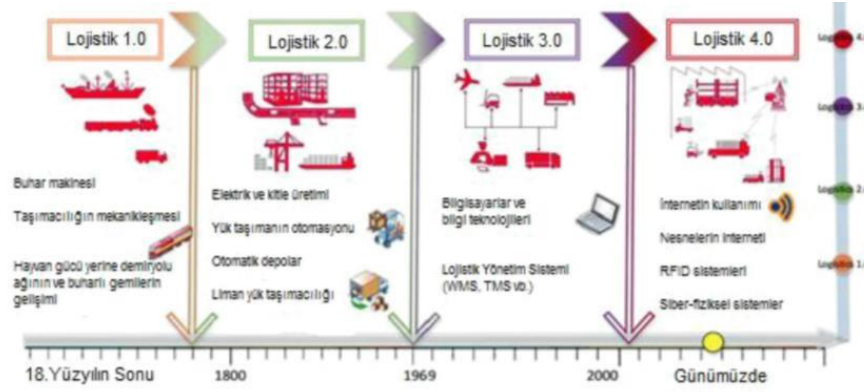


Figure 5. Revelation of Logistic (Galindo, 2016)

Logistics 4.0, which is also defined as “Future Logistics, Digital Logistics or Smart Logistics”; The fully automated and integrated use of digital information technologies that make up Industry 4.0 in the logistics sector can also be defined as smart and digital logistics applications based on cyber-physical systems, that is, the logistics sector fully adapts to the new Industrial revolution. As seen in the literature review, scientific and academic studies on Logistics 4.0, which is currently a new concept, have started to emerge since 2015.

The success of Logistics 4.0, which provides flexibility to businesses and enables them to meet the needs of customers more easily and quickly, depends on the combination of some digital technological applications, and all businesses that want to adapt to this new logistics system must implement the following five components in their logistics processes:

1. Enterprise Resource Planning (ERP): ERP, which is a comprehensive software system that provides coordination between the activities of an enterprise such as purchasing, production, marketing and logistics, can be integrated with customers, production partners and suppliers by connecting with the information systems of other companies, and as a result, efficiency Increase in profit, flexibility, quality, cooperation, communication and customer satisfaction, decrease in costs, cycle times, stocks and error rates can be achieved (Çakır and Beduk, 2013: 84).
2. Warehouse Management System (WMS): The management of warehouses is of great importance in logistics processes, and businesses with an effective warehouse management system gain competitive advantage in the sector by reducing their logistics costs (Özdemir and Özgüner, 2018: 43).
3. Transportation Management System (TMS): The widespread use of Industry 4.0 applications requires the use of systems that provide integration between demand management, distribution center and warehouses in Logistics 4.0. Thanks to these systems with cloud and GPS technology, businesses can instantly track their vehicles and obtain healthy information about their shipments (Özdemir and Özgüner, 2018: 43).
4. Intelligent Transportation System (ITS): These systems, which offer reliable, efficient and effective solutions (road or vehicle data collection, traffic management, navigation, control, communication and information sharing, etc.) in the transportation sector, are used in road, airway, seaway and rail systems. It facilitates the decision-making of managers with the data it collects, especially by utilizing sensor networks, and enables logistics activities to be carried out more flexible and faster (Özdemir and Özgüner, 2018: 44).
5. Information Security Management System (ISMS): The fact that web-based applications such as the internet of things, big data and cloud computing in Industry 4.0 lead to a comprehensive and fast data and information flow has made the security of the said information very important for businesses. (Özdemir and Özgüner, 2018: 44).

It is expected that Industry 4.0 applications will have an impact of approximately 2 trillion dollars in logistics in the next 10 years and offer numerous opportunities (Özdemir and Özgüner, 2018: 44). However, as can be seen from the table below, Logistics 4.0 also has some disadvantages, and it is not easy for companies to adapt to logistics 4.0.

Chart 2. Advantages and Disadvantages of Logistic 4.0 (Szałpka & Stachowiak, 2018)

Advantages of Logistic 4.0	Disadvantages of Logistic 4.0
Integration of real and virtual world	High implementation cost
Real-time communication between all systems	Requirements for advanced information technology equipment
Improving all processes in the supply chain, increasing visibility and flexibility	Rules for the application of process-oriented (Full-time/lean) management methods
Possibility to shorten delivery times for customer satisfaction	The necessity of applying Industry 4.0 technologies
Availability of advanced technologies for analysis of unlimited amounts of data	Issues regarding availability and processing of data
Reduction in the risk of structural or organizational errors in transactions	Low level of awareness among companies regarding this new approach
Possibility to increase the performance of machines and operators and reduce costs	Rules for the integration of the company's subsystems
Opportunity to make autonomous decisions by all system users	Rules for the integration of all stakeholders in the supply chain

Logistic 4.0 Applications and Benefits

All Industry 4.0 applications in the logistics sector fall within the scope of Logistics 4.0. As is known, process efficiency is a very important indicator in logistics. For this reason, all Logistics 4.0 applications try to increase efficiency in some way. This efficiency is achieved as a result of applying Industry 4.0 principles to the basic logistics services of “Storage, Transport, Packaging, Distribution, Loading/Unloading and Information” services. Innovations in these services can only be achieved thanks to technological developments (Horenberg, 2017: 4). It is envisaged that digital and integrated technological applications will be evaluated in the following three main dimensions of logistics.

Chart 3. Areas of Logistic 4.0 and Usage Areas (Szałpka & Stachowiak, 2018)

Lojistik 4.0 Areas	Usage Areas
Administration	Investments, innovation management, integration of value chains
Material Flow	Automation and robotization in warehouse and transportation, internet of things, 3D printing and scanning, advanced materials, augmented reality, smart products
Information flow	Data-driven service, big data (data collection and use), RFID (real-time recognition and positioning systems), software (ERP, WMS, cloud, etc.)

Industry 4.0 Technologies That Create Logistic 4.0

Cyber-Physical Systems and RFID, cyber-physical systems, which are the basic technologies of Industry 4.0, consist of a large physical system formed by smart and connected objects by utilizing information and communication technologies (computer, network and software) and a copy of this system in the virtual environment. It provides the opportunity to predict the changes that may occur in the system (Banger, 2018: 46-47). The Internet of Things, as one of the fundamental technologies of Industry 4.0, enables objects containing embedded software, hardware and sensors (physical devices, machines, vehicles, etc.) to connect to an internet network with wired or wireless connections, integrate and communicate with each other, and thus collect data at every point that provides a system. Object in Industry 4.0; It is defined as “any physical entity that has or may have information and communication software and hardware in it”, and objects with this system are assumed to be connected and intelligent.

Smart objects, which have special information and hardware, detect the developments and changes (mobility, light, temperature, humidity, pressure, etc.) happening in their environment through sensors connected to them. These sensors measure physical or chemical changes and convert them into data, and smart objects make decisions based on these data in an “autonomous” way, in other words, by themselves. Examples of technologies used by smart and connected objects in wireless communication; “Wi-Fi, LTE (Long Term Evolution), NFC (Near Field Communication), Cellular data G3-G4-G5, Bluetooth etc.” (Banger, 2018: 39-40). The International Telecommunication Union (ITU) stated in 2005 that the internet of things consists of four stages (Özsoylu, 2017: 50).

1. Object tagging (identifying objects),
2. Sensor and wireless networks (sensing objects),
3. Embedded systems (thinking of objects),
4. Nanotechnology (reducing the size of objects).

It is thought that an economic value of 11 trillion dollars can be created in 2025 by using the internet of things technology in areas such as “cities, homes, offices and factories, health, retail sector, vehicles and logistics” (Öztürk, 2018).

Additive/Additive Manufacturing, First developed in 1984, materials such as glass, plastic and ceramics are processed with powerful lasers with 3D printers, enabling complex parts to be produced in a high quality and cost-effective manner. In this technology, designs are developed in the form of computer-aided three-dimensional modeling and can be easily produced from a 3D printer without assembly and storage. The technology of using the virtuality on the computer in industry with the 3D printing method by quickly prototyping is called "additive manufacturing". Additive manufacturing, which consists of three stages: modeling, manufacturing and finishing; It removes the constraints of a design with a complex geometric shape and enables fast, easy and low-cost production. (Banger, 2018: 49-153; Horenberg, 2017: 6).

Simulation, which is a digital modeling/design technique that enables the monitoring of the features of a physical system by transferring all the information of a physical system to the virtual environment, is used in many fields, especially in manufacturing and engineering. The main goal of simulation, which has been studied especially since the 1980s with the development of computers; foreseeing the error probabilities of the processes in the virtual environment and taking measures for this. Time and cost savings can be achieved thanks to the precautionary measures regarding the possibility of errors (Çelen, 2017: 10).

Augmented and Virtual Reality, the environment created by computers through imitation is called virtual reality. Augmented reality is; It is an image that is formed as a result of virtualization of the environment we live in the real world with data such as computer-assisted image, sound, video, GPS, and is actually an application that combines the virtual and real world. The said application can change the way of doing business in a positive, fast and safe way with the information and instructions it provides to the employees. It is estimated that the first augmented reality application providing user experience was developed in 1992 at Armstrong Laboratories of the US Air Force. Display devices with augmented reality technology such as helmets, smart glasses, handheld devices, monitors and screens mounted on the head of the employee enrich a live and real world image with virtual images and information (image overlay) to ensure that activities such as design, planning, production and maintenance are performed at once and without errors. It allows it to be done in such a way (Banger, 2018: 50-163).

Autonomous/Intelligent Robots and Artificial Intelligence, Autonomous term; It is used for intelligent and connected systems that can collect and analyze data from the environment, monitor their own situation, decide and apply themselves, thanks to the artificial intelligence provided by the software and hardware it has. The prime example of these systems is robots with artificial intelligence that can be programmed by computers. Today, the robots in question; It is widely used in fields such as production, research, assembly, packaging, distribution and health. Thanks to robot technology, also known as robotic technology, even extremely dangerous and even impossible applications can be easily performed by autonomous robots. Electronic autonomous robots named "Elmer and Elsie", first developed by William Gray Walter at a neurology institute in Bristol, England, around 1948-1949, could go to the charging station themselves when their battery power was low. Although they inspired many robotic researchers in the future, their very slow movement has led to these robots being called "tortoises". The robot named "Unimate" operating on the basis of numerical programming was developed by George Devol for the first time in 1954, the first palletizing robot was developed by Fuji Yusoki Kogyo company in 1963, while the first robot with six electromechanical drive axes was patented by the German company Kuka in 1973. Although it differs according to the sector in which it is used and the activities it performs, a fully autonomous robot is expected to have the following features (Banger, 2018: 45-74):

- a. Ability to work alone and take care of themselves without human support,
- b. To be able to perform the movements of human organs such as hands and arms to a certain extent, to exhibit human characteristics (communication, thinking, decision etc.) with artificial intelligence,
- c. To be able to collect information and data about its own structure and environment and to learn something from this information.

Although robots have been used for a long time in the industry to perform many complex tasks, autonomous robots with less cost and greater capabilities are now preferred in manufacturing. The EU is the global leader in the use of robots for automation in manufacturing, and 2/3 of the countries that exceed the average number of industrial robots per employee are EU members. The Robotic Industry shows the fastest growth in China, and thousands of new robots are introduced to the market every year around the world. As of 2019, the number of industrial robots used in the world is estimated to reach 2.6 million, and the majority of these robots are used in the automotive, machinery, electrical-electronics, chemistry and food sectors (Firat and Firat, 2017: 217-218).

In Big Data, Industry 4.0, data collected through sensors from many different sources (suppliers, production systems, customers, etc.) at the same time must be recorded in a warehouse for processing by smart objects. These huge chunks of data are called "big data". Since databases and filing systems such as SAP, Oracle, SQL, which are currently widely used, are insufficient for big data, big data systems consisting of analytics developed with special software are required for this. Thanks to these systems, large data piles are stored, sorted, analyzed and thus qualified data is provided for strategic decisions. The amount/volume of data, the speed of data processing, the diversity of data, and the accuracy and reliability of data emerge as the distinguishing features of big data (Banger, 2018: 41-84).

Cloud Computing is a system that enables users to access information and software via a shared network at any time and place with their internet-connected devices (computer, tablet, etc.). While in traditional systems, people can only access the software and information they use by logging into their own computer, in cloud computing, all users can access a server computer on the internet, thus reducing the IT investment needs of businesses (pay as you use). In Industry 4.0, large chunks of data are stored on the cloud platform. Although the history of cloud computing, which eliminates the necessity of installing software and hardware on different computers as in traditional methods, dates back to the 1960s, the first applications started in the 1990s. Basic features of cloud computing; It can be listed as access to a wide network with a large number of users, accessibility from anywhere and from any location, management with less capital and easy maintenance, flexibility, convenience, speed, quality, reliability (Banger, 2018: 42-101).

Cyber Security, Industry 4.0, and the fact that all objects are connected to the internet, that is to a network, undoubtedly brings some malicious attacks and security problems. Cyber security; It aims to protect data and information, prevent unauthorized and unauthorized persons from accessing the resource, and covers two stages: ensuring the security of interconnected smart objects and protecting the entire system together with the network where the data is stored (Banger, 2018: 45).

Implementation of Logistic 4.0 around the World

Thanks to the internet platform to be used in Logistics 4.0, where the supply chain will be a large network and all stakeholders (customers and suppliers) in the chain will have access to this network, all orders will be managed simultaneously. The programmed routes of fully autonomous forklifts to be used in the transportation of materials within the factory will be determined "according to the estimated supply logistics in the light of the information received from the internet platform used by all stakeholders". In this way, in order to deliver the final product at the planned delivery time, warehouse costs will be minimal or zero, as customer and supplier orders will be processed at the same time in the supply of materials needed in production (Çiçekli, 2018; Galindo, 2016: 35-36). Currently, many applications are seen in Logistics 4.0 as follows.

Autonomous Logistic Implementations

The concept of autonomous logistics, which consists of self-driving vehicles and unmanned aerial vehicles, has been very popular in recent years. The auto pallet mover, designed by Jungheinrich, can pick up the goods from the shelves in the warehouse with the laser navigation technology it uses. The special control system it contains; It provides vehicle coordination for a safe traffic flow and optimization without collision and accident. Developing the automation kit called "Movebox", which has features such as barcode scanning, pallet detection

and stacking, autonomous stopping and slowing down, Baylo transforms ordinary electric forklifts into self-driving vehicles (DHL, 2014a: 23).



Figure 6. Autonomous Logistic Implementations (DHL 2014a: 21-23 ve DHL2016a: 2)

Internet of Things Implementations

Together with Vodafone, Continental established the IoT platform “ContiConnect”, which allows companies to monitor the condition of their commercial vehicles' tires. Sensors placed on the tires; It transmits data about pressure, temperature and tire condition to the platform, and if any of the data reaches a critical value, the platform sends a warning to predefined recipients to prevent damage from occurring. Although the system is currently only used in the USA, Canada, Malaysia and Thailand, many more countries, including Germany, are expected to be included in the system by the end of this year. Moreover, other tire manufacturers, including Goodyear and Pirelli, are working on similar systems (Hannovermesse, 2018).

3D Printer Implementations

3D printers are a technology that is used extensively in the production of medical devices, especially in the health sector, and aircraft parts in the aviation sector. With the production of spare parts in 3D printers according to demand, transportation and stock costs and delivery times are expected to decrease. Amazon has developed a patented 3D printer delivery truck to deliver faster delivery to its customers. Thus, when a shopper orders a product from Amazon, the product can be printed on the 3D printer of the truck closest to the delivery location and delivered to the customer without storage (Çiçekli, 2018; DHL, 2016a: 34).

Robotic & Automotion Implementations

After Amazon bought Kiva Systems in 2012, it started to use robots named "Kiva" in its warehouses. These robots, which can do the work of the workers autonomously, are used in every distribution center of Amazon in order to provide labor productivity (Çiçekli, 2018; Galindo, 2016: 32-33). Fetch Robotics has developed a robot that is used to select materials from shelves in warehouses. (DHL, 2016b: 25).



Figure 7. Autonomous Robot Implementations (DHL, 2016bDHL, 2018Boston)

Big Data Implemntations

In the logistics sector, big data technology can provide “intelligent correlation of data flows, full-time scheduling of tasks, optimization of loading order and Estimated Time of Arrival-ETA,” such as shipment, air, traffic information, especially in transportation. Big Data Logic Analysis Platform designed by a startup company called LogiNext; It supports cargo companies in increasing route optimization and monitoring their resources in real-time. In terms of capacity, it has features such as “delivery location clustering, time-preferred delivery planning for each order, estimated delay alerts and real-time ETA updates” (Çiçekli, 2018; DHL, 2016a: 36).

Cloud Logistic Implementations

Logistics providers in general; It handles many different transactions between multiple parties using different transport management systems and different warehouses. “With cloud applications, the entire supply chain can be coordinated, like a control tower, by presenting a single integrated image,” which can provide businesses with accurate information about shipping locations, stock status and assets on a global scale. Transporeon, a cloud-based logistics platform with 1,000 loaders, 55,000 shippers and 150,000 users from 100 countries; “It provides transparent communication between all parties thanks to its features such as assigning orders, loading time intervals, and tracking-tracking, reducing waiting times and empty trips” (Çiçekli, 2018; DHL, 2016a: 38).

RFID Implementations

RFID technology provides a serious convenience in stock tracking and counting in warehouses thanks to the tags attached to the materials and pallets in the logistics industry (Çiçekli, 2018; The intelligent container, 2019).

Advantages and Disadvantages of Logistic 4.0 Implementations

Many companies are not yet fully aware of the potential of Logistics 4.0. In a study conducted by EPG, a completely independent consultancy company, involving 200 logistics companies from all sectors, the difficulties faced by companies are examined. According to the results of the study, while the rate of those who need Logistics 4.0 systems at a medium or higher level is over 75%, the rate of those who do not need these systems at a low level or at all is below 25% (EPG, 2018: 1).

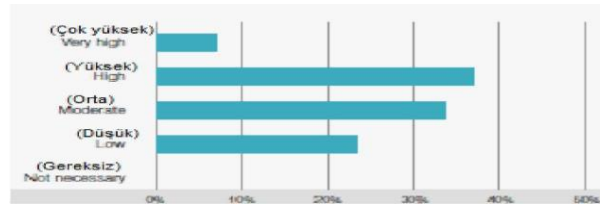


Figure 8. Evaluation of Logistic 4.0 in Warehouse Logistic (EPG, 2018)

With the use of digital technologies, it is foreseen that a significant increase in efficiency will be achieved in the logistics sector thanks to the implementation of full-time logistics in Logistics 4.0, 20-30% reduction in stock keeping costs, and the use of more efficient fuel and energy resources in new vehicles to be developed. (Çiçekli, 2018):

- Increasing efficiency in the logistics operations carried out in warehouses, especially in the processes of selecting and collecting orders, and in the workforce, reducing product losses and risks, providing uninterrupted and accident-free safe service,
- Especially spare parts etc. in logistics operations, reduction of delivery times, stocking and transportation costs in services, fuel savings with resource efficiency, reduction of carbon and greenhouse gas emissions,
- Optimizing (optimizing) planning and use of vehicle routes, loading queues, fleet capacity and other assets in transportation, grouping of delivery locations, reduction of transportation costs and distances, empty rides and waiting times,
- Time-preferred delivery planning, instantaneous estimation of arrival time and optimized tour planning in line with estimated delay warnings,
- Protection of goods and products against theft, damage and some other risks, thanks to constantly traceable, transparent and reliable logistics operations.

Industry 4.0 and Logistic 4.0 Studies in Turkey

According to the "Global Production Cost Index" prepared by the Boston Advisory Group (BCG), taking into account production fees and efficiency, energy costs and exchange rates; Turkey can produce with an average unit cost of 98, Germany 121 and the USA 100. In this case, Turkey can produce 23% cheaper than Germany and 2% cheaper than the USA, thus gaining an advantage in global competition. However, considering Germany's studies and investments in the field of Industry 4.0, there is a risk that Turkey will lose its regional

advantage and global competitiveness in terms of costs in the long run. This is also true for the logistics sector, which is one of the main activities of the industry. (Bulut and Akçacı, 2017: 60).

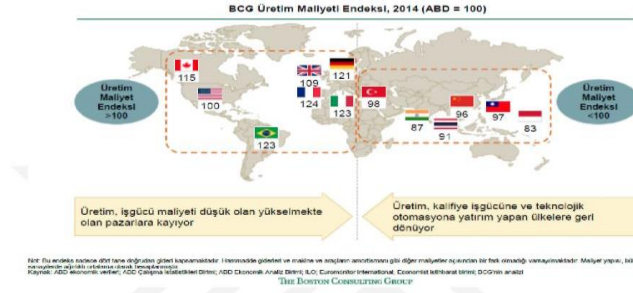


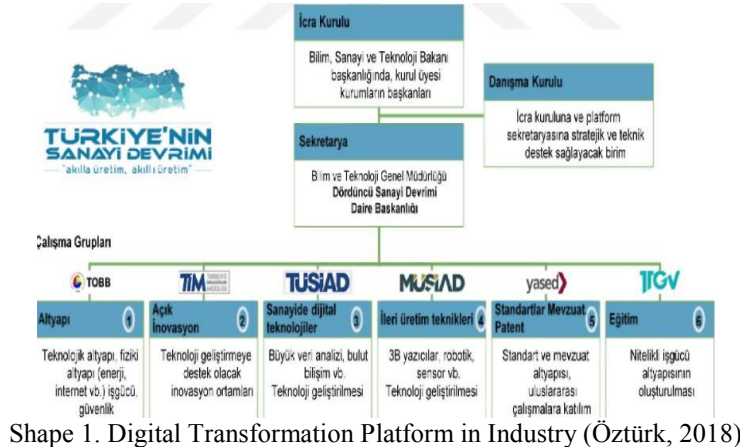
Figure 9. Turkey in the Production Cost Index (Bulut ve Akçacı 2017)

The World Economic Forum (WEF) expects that the digital transformation that will take place in 10 sectors (consumer, automotive, logistics, electricity, telecommunications, aviation, oil, gas, media, mining and chemistry) between 2016-2025 will create more than \$100 trillion in value (TC Bilim, Ministry of Industry and Technology, 2018: 23).



Figure 10: Economic Benefits of Digitalization to Industries (T.C. Bilim, Endüstri ve Teknoloji Bakanlığı 2018: 23)

Realizing the economic opportunities created by digitalization, many countries such as Germany, the USA, China, Japan and South Korea attach great importance to the digital transformation of the manufacturing industry and devote significant resources to digitalization by creating policies and strategies in this area (TC Ministry of Science, Industry and Technology, 2018: 160).). In our country, which understands the importance of Industry 4.0 and digital technologies, studies on the digital transformation of the manufacturing industry were initiated with the decision taken at the 29th meeting of the Supreme Council of Science and Technology on February 17, 2016, and in this context, the Ministry of Science, Industry and Technology " By establishing the Digital Transformation Platform in the Industry, a total of 6 working groups were established in the field of “infrastructure, open innovation, digital technologies, advanced production technologies, standardization, legislation, patents and education” under the roof of the platform (Öztürk, 2018).



Shape 1. Digital Transformation Platform in Industry (Öztürk, 2018)

In the industrial digitalization (maturity) survey conducted by TÜBİTAK within the scope of the "Digital Turkey Roadmap" published in 2018 under the leadership of the Ministry of Science, Industry and Technology, businesses use digital technology in four aspects: "supply management, automation of customer shipments, field and warehouse management and packaging", evaluated the usage levels, and the weighted average of the evaluations varies between 2.34 (packaging) and 2.86 (field and warehouse management) out of 5 (TC Ministry of Science, Industry and Technology, 2018: 82). As a result of the evaluation, it has been seen that businesses are weak in bilateral data sharing with their suppliers, and digital applications are not used enough even though there are stock tracking systems.

Therefore, the level of digitalization in supply chain and logistics management of manufacturing industry enterprises is low. In order to be fully integrated into Logistics 4.0, digitalization should occur throughout the supply chain rather than in a single business (T.R. Ministry of Science, Industry and Technology, 2018: 82-91). Rasih Boztepe, Vice Chairman of the Board of Reysaş Logistics, in an interview with Dünya Newspaper; Emphasizing that "recent developments in the logistics sector will necessitate the creation and development of Logistics 4.0, and its integration with industry and trade", he stated that "within the scope of Industry 4.0, they have started to reconsider their way of doing business and processes for transformation in logistics" (Reysaş, 2018).

Results

In this section, the findings and comments obtained by analyzing the research data with statistical methods are included.

Descriptive Characteristics of Participants

Table 4 shows the age and roles of business owners/managers participating in the research.

Chart 4. Information on Age and Role of Participants in the Business

Descriptive Features	Group	n (86)	f (%)	\bar{x}
Age	20-29	48	55.8	35.6
	30-39	10	11.6	
	40-49	10	11.6	
	50-59	6	7.0	
	60-69	12	14.0	
Role	Member of Board	13	15.1	--
	Senior Manager	13	15.1	
	White Collar Manager	19	22.1	
	Employee	41	47.7	

In the study, the average age of the participants was 35.6%, 55.8% were 20-29 years old, 11.6% were 30-39 years old, 11.6% were 40-49 years old, 7% were 50- It was determined that 59 years old and 14% of them were in the 60-69 age group. 47.7% of the participants are employees. 22.1% are white collar managers, 15.1% are senior managers and 15.1% are members of the board of directors. Information on the enterprises where the participants work is shown in Table 4.2.

32.6% of the companies they work in 1970 and before, 19.8% between 1980-189, 16.3% between 1990-1999, 12.8% between 2000-2009 and % 8.1 of them were established between 2010-2019. Accordingly, it can be said that enterprises have a long-established history. When the number of personnel working in the enterprises is

examined, it is determined that there is a balanced distribution and the enterprise with 151 employees or more constitutes the largest group with 29.1%. This is followed by businesses with 51-100 employees with 26.7%.

Chart 5. Information of Companies where Participants Work

Descriptive Features	Group	n (86)	f (%)	\bar{x}
Establishment of Companies	Before 1970	28	32.6	--
	1970-1979	9	10.5	
	1980-1989	17	19.8	
	1990-1999	14	16.3	
	2000-2009	11	12.8	
	2010-2019	7	8.1	
The Number of Employees at Companies	1-50 people	19	22.1	96.8 people
	51-100 people	23	26.7	
	101-150 people	19	22.1	
	+151 people	25	29.1	
Sector in which Business Operates	Food	31	36.0	--
	Textile	2	2.3	
	Hardware	1	1.2	
	Agricultural Tools	12	14.0	
	Chemical	3	3.5	
	Automotive Spare Part	19	22.1	
	Metal and Steel	10	11.6	
	Others	8	9.3	
Do Companies have Foreign Trade Department?	Yes	81	94.2	--
	No	5	5.8	
The Number of People at Foreign Trade Department	1-3 people	46	54.5	4.4 people
	4-7 people	26	29.3	
	8-11 people	9	10.4	
	+11 people	5	5.8	
How Many Years are Companies doing Foreign Trade Regularly?	Last 5 yıl	10	11.6	16.7 Years
	Last 10 yıl	13	15.1	
	Last 15 yıl	25	29.1	
	Last 20 yıl	13	15.1	
	+20 Years	25	29.1	

Chart 6. Information of Companies where Participants Work (Continued)

Descriptive Features	Group	n (86)	f (%)	\bar{x}
What is The Sales Rate of Foreign Trade Department compared to Domestic Market?	%0-15	9	10.5	%38.15
	%16-30	24	27.9	
	%31-45	29	33.7	
	%46-60	16	18.6	
	%76-90	2	2.3	
	+%91	6	7.0	

When the sector in which the enterprises operate is examined, the largest group is composed of enterprises operating in the food field with 36%, followed by the enterprises operating in the automotive and sub-industry with 22.1%, agricultural tools with 14% and iron-steel sector with 11.6%. A large part of 94.2% of enterprises have a separate foreign trade department. The employees in the foreign trade department are generally 1-3 people 54.5%, 4-7 people 29.3% and 8-11 people 10.4%. In addition, it is seen that the enterprises are mainly engaged in foreign trade activities for 10 years or more. When the ratio of the foreign trade of the enterprises to the domestic sales of the enterprise is examined, it is seen that the foreign trade ratio is 38.15% on average, respectively, 31-45% (33.7%), 16-30% (27.9%), 46-60% (18.6%), 0-15% (10.5%), 91% and above (7.0%), and 76-90% (2.3%). According to these results, it can be stated that the enterprises show a very effective foreign trade performance.

Finding Related to Research Problems and Sub-Problems

Of the research;

1. "Does Turkey's logistics performance in the last 15 years, which has developed with the contribution of Industry 4.0, digitalization and the internet, differ according to the descriptive characteristics of the participants and businesses?"

2. "How does Industry 4.0, digitalization and internet contribute to Turkey's logistics performance in the last 15 years? The results of the statistical analysis carried out to search for the answers to the problem in the form.

The Findings Related to First Sub-Problem

The research, "Does Turkey's logistics performance in the last 15 years, which has developed with the contribution of Industry 4.0, digitalization and the internet, differ according to the descriptive characteristics of the participants and businesses?" As a result of the ANOVA analysis carried out to search for the answers to the first sub-problem, the findings in Table 7 and Table 8 were reached.

Chart 7. Differentiation of Turkey's Logistics Performance in the Last 15 Years by Descriptive Characteristics of Participants

Variable	Group	n	\bar{x}	ss	F	p
Age	20-29	48	3.77	0.412	1.366	0.253
	30-39	10	4.02	0.346		
	40-49	10	3.68	0.448		
	50-59	6	3.94	0.443		
	60-69	12	3.97	0.563		
The Position at Company	Member of Board	13	3.96	0.541	1.435	0.238

Senior Manager	13	3.85	0.483
White Collar Manager	19	3.94	0.365
Employee	41	3.74	0.413

When the data in Table 4.3 are examined, it has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years does not differ according to the ages of the participants and their roles in the enterprise ($p>0.05$).

Chart 8. Differentiation of Turkey's Logistics Performance in the Last 15 Years by Descriptive Characteristics

Variable	Group	n	\bar{x}	ss	F	p
Establishment of Company	Before 1970	28	3.88	0.432	2.148	0.068
	1970-1979	9	3.81	0.358		
	1980-1989	17	3.88	0.478		
	1990-1999	14	3.90	0.283		
	2000-2009	11	3.88	0.495		
	2010-2019	7	3.33	0.451		
The Number of Worker at Company	1-50 People	19	3.70	0.529	1.155	0.332
	51-100 People	23	3.82	0.329		
	101-150 People	19	3.96	0.399		
	+151 People	25	3.84	0.475		
Sector in which Business Operates	Food	31	3.87	0.499	1.170	0.329
	Textile	2	3.42	0.354		
	Hardware	1	3.00	0		
	Agricultural Tools	12	3.90	0.441		
	Chemical	3	3.94	0.096		
	Automotive Spare Part	19	3.88	0.380		
	Metal and Steel	10	3.85	0.372		
	Others	8	3.63	0.415		
The Number of People at Foreign Trade Department	1-3 People	44	3.86	0.396	0.260	0.854
	4-7 People	25	3.90	0.379		
	8-11 People	8	3.75	0.707		
	+11 People	5	3.83	0.312		
How Many Years are Companies doing Foreign Trade Regularly?	Last 5 Years	10	3.47	0.560	2.932	0.026*
	Last 10 Years	13	4.06	0.330		
	Last 15 Years	24	3.83	0.324		
	Last 20 Years	13	3.90	0.370		

	+20 Years	25	3.83	0.503		
What is The Sales Rate of Foreign Trade Department compared to Domestic Market?	%0-15	9	3.33	0.425	2.967	0.017*
	%16-30	24	3.90	0.354		
	%31-45	29	3.91	0.380		
	%46-60	16	3.84	0.556		
	%76-90	2	3.83	0		
	+%91	6	3.86	0.400		

*p<0.05 means statistical significance at the 5% significance level.

When the data in Table 8 are examined, it has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years does not differ according to the establishment date of the enterprise, the number of personnel working in the enterprise, the sector in which the enterprise operates and the number of personnel working in the foreign trade department. (p>0.05).

Turkey's logistics performance in the last 15 years, which has developed with the contribution of Industry 4.0, digitalization and the internet, differs according to how many years foreign trade has been carried out in the enterprise and the ratio of foreign trade to domestic sales. With the post-hoc (LSD) analysis, it has been determined that the average scores of the enterprises that have been doing foreign trade for the last 5 years are significantly lower than those that have been doing foreign trade for more. Similarly, it has been determined that the average scores of the enterprises with the ratio of foreign trade to domestic sales of 0-15% are significantly lower than the enterprises with higher foreign trade ratio.

“The result of the independent sample t test, which examines the differentiation of the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years according to whether there is a foreign trade department in the enterprise or not, is given in Table 4.5.

Chart 9. Differentiation of Turkey's Logistics Performance in the Last 15 Years According to Being a Foreign Trade Department in the Enterprise

Variable	Group	n	\bar{x}	ss	t	p
Whether Company has Foreign Trade Department or Not	Yes	81	3.87	0.414	3.990	0.012*
	No	5	3.20	0.361		

*p<0.05 means statistical significance at the 5% significance level.

When the data obtained are examined, it has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years differs according to the status of being a foreign trade department in the enterprise (p<0.05). According to this result, the logistics performance of enterprises with a separate foreign trade department is also higher.

Findings Regarding the Second Sub-Problem of the Study

The research, "How is the contribution of Industry 4.0, digitalization and internet to Turkey's logistics performance in the last 15 years?" The results of the correlation analysis carried out to search for answers to the second sub-problem of the form are shown in tables below.

Chart 10. The Relationship Between the Development of Customs Clearance Processes in Border and Customs Administrations in Turkey (In terms of Speed, Simplicity, Predictability of Formalities, etc.) and Industry 4.0, Digitalization and Internet Usage

Variable	\bar{x}	1	2
1. Development of Customs Clearance Processes in Border Administrations and Customs	3.45	-	0.362*

Administrations in Turkey			
2. Industry 4.0, Digitization and Internet Usage	3.84	0.362*	-

*p<0.05 means statistical significance at the 5% significance level.

According to the correlation analysis, there is a statistically significant relationship between the development of customs clearance processes in border administrations and customs administrations in Turkey (in terms of speed, simplicity, predictability of formalities, etc.) and industry 4.0, digitalization and internet use. Accordingly, industry 4.0, digitalization and internet use positively affect the development of customs clearance processes in border administrations and customs administrations.

Chart 11. The Relationship Between Infrastructure Quality Change (In terms of Ports, Railway, Highway, Information Technologies, etc.) and Industry 4.0, Digitalization and Internet Usage in Turkey Regarding Trade and Transportation

Variable	\bar{x}	1	2
1. Change in the Quality of Infrastructure Related to Trade and Transportation in Turkey	3.48	-	0.109
2. Industry 4.0, Digitization and Internet Usage	4.05	0.109	-

According to the correlation analysis, it has been determined that there is no statistically significant relationship between the change in the quality of infrastructure related to trade and transportation in Turkey (in terms of ports, railways, roads, information technologies, etc.) and industry 4.0, digitalization and internet use.

Chart 12. Relationship Between Ease of Transport (In terms of Road, Sea and Air Transport) and Industry 4.0, Digitalization and Internet Usage in Competitive Firms

Variable	\bar{x}	1	2
1. Ease of Carrying in Competitive Firms	3.71	-	0.067
2. Industry 4.0, Digitization and Internet Usage	3.92	0.067	-

According to the correlation analysis, it has been determined that there is no statistically significant relationship between the ease of transportation in competitive companies (in terms of road, sea and air transportation) and industry 4.0, digitalization and internet use.

Conclusions

When we evaluate the logistics sector in general, it has become one of the important sectors that have developed by reaching high growth figures both in the world and in our country. Developments in information technologies, the acceleration of globalization, new regulations in customs matters, changes in market dynamics, changes in customer demands and the increase in outsourcing make competition in the world market more difficult. The importance of exports in the development of Turkey is an undeniable fact. The healthy development of exports will increase in scale as transportation and logistics applications become widespread in almost all companies. Therefore, both sectors have important responsibilities in this sense. In addition, as a result of the increase in the rate of use of maritime transport in our country in recent years, certain standards have been brought to the ports. In terms of the logistics sector, especially maritime transport brings with it significant advantages compared to both road and rail transport, due to the extremely low capacity and weight limitation. The awareness of added value brought by logistics, which is one of the leading sectors of today's economy world, both on a company and national scale, is increasing rapidly and increasing. Considering the possibilities and requirements that Turkey has, first of all, there is a need for a transportation master plan and a national transportation policy needs to be put forward in line with this plan.

In the research, logistics and industry "Does Turkey's logistics performance in the last 15 years, which has developed with the contribution of industry 4.0, digitalization and the internet, differ according to the

descriptive characteristics of the participants and businesses?" and "How does Industry 4.0, digitalization and internet contribute to Turkey's logistics performance in the last 15 years? It is aimed to reveal this result by making ANOVA analysis for searching the answers of the problem in the form.

It has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years does not differ according to the age of the participants and their roles in the enterprise ($p>0.05$). It has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years does not differ according to the establishment date of the enterprise, the number of personnel working in the enterprise, the sector in which the enterprise operates and the number of personnel working in the foreign trade department ($p>0.05$). Turkey's logistics performance in the last 15 years, which has developed with the contribution of Industry 4.0, digitalization and the internet, differs according to how many years foreign trade has been carried out in the enterprise and the ratio of foreign trade to domestic sales. With the post-hoc (LSD) analysis, it has been determined that the average scores of the enterprises that have been doing foreign trade for the last 5 years are significantly lower than those that have been doing foreign trade for more. Similarly, it has been determined that the average scores of the enterprises with the ratio of foreign trade to domestic sales of 0-15% are significantly lower than the enterprises with higher foreign trade ratio. It has been determined that the logistics performance of Turkey, which has developed with the contribution of Industry 4.0, digitalization and the internet, in the last 15 years differs according to the status of being a foreign trade department in the enterprise ($p<0.05$). According to these results, it can be said that as the duration of foreign trade of the enterprises increases, their logistics performance increases and the ratio of foreign trade to domestic sales increases as their logistics performance increases. Again, the logistics performance of enterprises with a separate foreign trade department is also higher. There is a statistically significant relationship between the development of border administrations and customs clearance processes in Turkey (in terms of speed, simplicity, predictability of formalities, etc.) and industry 4.0, digitalization and internet use. Accordingly, industry 4.0, digitalization and internet use positively affect the development of customs clearance processes in border administrations and customs administrations. It has been determined that there is no statistically significant relationship between the change in the quality of infrastructure related to trade and transportation in Turkey (in terms of ports, railways, roads, information technologies, etc.) and industry 4.0, digitalization and internet use. It has been determined that there is no statistically significant relationship between the ease of transportation in competitive companies (in terms of road, sea and air transportation) and industry 4.0, digitalization and internet use.

References

- Babacan, M.(2003), "Lojistik Sektörünün Ülkemizdeki Gelişimi ve Rekabet Vizyonu, Ege Akademik Bakış, C:3, S:2, İzmir
- Badef (2000), Douglas. Fourth Party Logistics - Breakthrough Performance in Supply Chain Outsourcing, www.ascet.com.
- Bahur Y.,(2006) "Lojistik Faaliyet - CRM Etkileşimi Ve Lojistik Maliyetlerin Kontrolü", İzmir: Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Tezsiz Yüksek Lisans Projesi
- Burmaoğlu,S.,(2010) , ,," Ulusal inovasyon Göstergeleri ile Ulusal Lojistik Performansı Arasındaki İlişki: AB Ülkeleri Üzerine bir araştırma"" , EGE AKADEMİK BAKIŞ ,Cilt:12 ,s:2, ss:193-208.
- Banger, G. (2018). Endüstri 4.0-Ekstra. Ankara: Dorlion Yayınları.
- Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: an overview. *Procedia Manufacturing*, 13, 1245-1252.
- Baur, C. & Wee, D. (2015). Manufacturing's next act. *McKinsey Quarterly*, June 2015.
- Bayraktutan, Y. & Özbilgin, M. (2015). Lojistik Maliyetler ve Lojistik Performans Ölçütleri. *Maliye Araştırmaları Dergisi*, Yıl: 2015, Cilt:1, Sayı:2, 95-112.
- Bulut, E. & Akçaci, T. (2017). Endüstri 4.0 ve İnovasyon Göstergeleri Kapsamında Türkiye Analizi. *ASSAM Uluslararası Hakemli Dergi*, Yıl: 2017, Sayı: 7, 50-72
- Çalış, A.(2003). İhracatta Nakliyat (Incoterms, Taşıma, Sigorta), İGEME-İhracatı Geliştirme Etüd Merkezi
- Çakir, B. Ö., & Bedük, A. (2013). Çalışanların Kurumsal Kaynak Planlaması (ERP) Değerlendirmeleri ve Kurumsallaşma Algıları. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (30), 81-91.
- Çelen, S. (2017). Sanayi 4.0 ve Simülasyon. *International Journal of 3D Printing Technologies And Digital Industry*, 1:1 (2017) 9-26.
- Çiçekli, S. (2018). Sanayi 4.0'ın Lojistik Sektörüne Etkileri. *T.C. Bilim, Sanayi ve Teknoloji Bakanlığı, Verimlilik Genel Müdürlüğü, Anahtar Dergisi*, Nisan 2018, Sayı 352:45-50.

- DHL (2014a). Self-Driving Vehicles in Logistics Report, Publisher: DHL Customer Solutions & Innovation, Germany.
- DHL (2016a). Logistics Trend Radar Report, Publisher: DHL Customer Solutions & Innovation, Germany.
- DHL (2016b). Robotics in Logistics Report, Publisher: DHL Customer Solutions & Innovation, Germany
- DHL (2018). Logistics Trend Radar Report, Publisher: DHL Customer Solutions & Innovation, Germany.
- Erdal, M.(2005)Küresel Lojistik, Uluslararası Taşımacılık ve Lojistik Hizmet Üretenleri Derneği (UTGKAD) Yayını, İstanbul.
- Erkan, B. (2014). Türkiye’de Lojistik Sektörü ve Rekabet Gücü. ASSAM Uluslar arası Hakemli Dergi, Yıl: 2014, Sayı: 1, 44-65.
- Erol, S., Schumacher, A. & Sihn, W. (2016). Strategic guidance towards Industry 4.0– a three-stage process model. COMA'16.
- Erturan,D., Ejder İ., & Ergin,E.,(2017). Muhasebe Denetiminde Nesnelerin İnterneti: Stok Döngüsü. Muhasebe ve Finansman Dergisi, ss:75-85
- Eser, U. (2014). Dünya Yeniden Sanayiye Dönerken Türkiye Dünya Sanayinin Neresinde. İktisat ve Toplum, (45), 27-44.
- Firat O.Z. & Firat S.Ü. (2017.) Endüstri 4.0 Yolculuğunda Trendler ve Robotlar. İstanbul Üniversitesi İşletme Fakültesi Dergisi, Cilt: 46, Sayı:2, Kasım 2017, 211-223.
- Galindo, L. D. (2016). The Challenges of Logistics 4.0 for the Supply Chain Management and the Information Technology, Master Thesis Spring 2016, norwegian University of Science and Technology.
- Genç, S. (2018), “Sanayi 4.0 Yolunda Türkiye”. Sosyoekonomi, Vol. 26 (36), 235-243.
- Göçmen E. & Erol, R. (2018). The Transition to Industry 4.0 in One of the Turkish Logistics Company. International Journal of 3D Printing Technologies and Digital Industry, 2:1, 76-85.
- Günay, D. (2002). Sanayi ve Sanayi Tarihi. Mimar ve Mühendis Dergisi, (31), 8-14, İstanbul.
- Hermann, M., Pentek, T. & Otto, B. (2016, January). Design principles for industrie 4.0 scenarios. In System Sciences (HICSS), 2016 49th Hawaii International Conference on IEEE, 3928-3937.
- Hieber, R. (2002), "Supply Chain Management: A Collaborative Performance Measurement Approach", Zurich.ss:8-12.
- Hofmann, E., & Rüsç, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. Computers in Industry, 89, 23-34.
- Hompel, M., & Kerner, S. (2015). Logistik 4.0. Informatik-Spektrum, 38(3), 176-182.
- Horenberg, D. (2017). Applications within Logistics 4.0: A research conducted on the visions of 3PL service providers, Bachelor's Thesis, University of Twente.
- İçten, T., & Bal, G. (2017). Artırılmış gerçeklik üzerine son gelişmelerin ve uygulamaların incelenmesi. Gazi Üniversitesi Fen Bilimleri Dergisi, Part C: Tasarım ve Teknoloji, 5(2), 111-136.
- Kara, M., Tayfur, L., & Basık, H. (2009). Küresel Ticarete Lojistik Üslerin Önemi ve Türkiye. Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 6 (11).
- Karayalçın Ş., (1986) Endüstri Mühendisliği ve Üretim Yönetimi Elkitabı II, İstanbul: Çağlayan Kitabevi.
- Lee (2013). Internet of things. In: Evolution of Telecommunication Services, Berlin,ss. 257-258.
- Lin, B., Jones, C. A. (2009). Digital Supply Chain Management And Implementation: A Research Review,ss: 592-593
- MÜSİAD (2015). Lojistik Sektöründe Sürdürülebilirlik Yeşil Lojistik. İstanbul:
- MÜSİAD 2015 Lojistik Sektör Raporu [99].
- MÜSİAD (2017). Endüstri 4.0 ve Geleceğin Lojistiği. İstanbul: MÜSİAD, 2017 Lojistik Sektör Raporu [103].
- Orhan,O.(2003), Dünya'da ve Türkiye'de Lojistik Sektörünün Gelişimi, 2003.
- Özdemir, F. S., & Gökmen, M. K. (2016). Lojistiğin Evrimi ve Türkiye’deki Önlisans ve Lisans Programları Yönünden Lojistik Öğretimi. Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 9(3), 115-135.
- Özdemir, A., & Özgüner, M. (2018). Endüstri 4.0 ve Lojistik Sektörüne Etkileri: Lojistik 4.0. İşletme ve İktisat Çalışmaları Dergisi, 6(4), 39-47.
- Özsoylu, A. F. (2017). Endüstri 4.0. Çukurova Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 21(1), 41-64.
- Öztürk, S. (2018). İmalat Sanayinin Dijital Dönüşümü. T.C. Bilim, Sanayi ve Teknoloji Bakanlığı, Verimlilik Genel Müdürlüğü, Anahtar Dergisi, Nisan 2018, Sayı 352.
- Paprocki, W. (2016). How Transport and Logistics Operators Can Implement the Solutions of “Industry 4.0”. In TranSopot Conference (pp. 185-196). Springer, Cham.
- Porter,M (1990). "The Competitive Advantage of Nations", Harvard Business Review, March-April, ss.72-91.
- Ramanathan, R., Ramanathan, U., & Ko, L. W. L. (2014). Adoption of RFID technologies in UK logistics: Moderating roles of size, barcode experience and government support. Expert Systems with Applications, 41(1), 230-236.

- Reeves, P. & Mendis, D. (2015). The Current Status and Impact of 3D Printing Within the Industrial Sector: An Analysis of six Case Studies. Project Report. London: IPO.
- Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. Boston Consulting Group, 9. (<https://eta.borusanlojistik.com/blog/22>)