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DIGITAL AWARENESS OF SMES: A QUALITATIVE ANALYSIS

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ABSTRACT

DIGITAL AWARENESS OF SMES: A QUALITATIVE ANALYSIS

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Industry 4.0, which is on the agenda of both academia and companies operating in the field, has been the subject of many researches since the day it was announced, but still maintains its recency as a study subject. With the extensive usage of Industry 4.0 technologies by the developed countries of the world, this concept has turned into a trend that has become almost a necessity to be followed by the rest of the world. At this stage, the way for companies to survive in local and global competition is through their digital transformation, and in order to realize this transformation, companies need to have high digital awareness. In this study, digital awareness and perceptions of Industry 4.0 technologies of managers of SMEs in Ankara operating in the IT sector, which is the locomotive of digital transformation in Ankara was analyzed within the framework of a qualitative research design, using the data from in-depth interviews made with 20 interviewees. According to the results of the research, participants perceive digitalization and Industry 4.0 as different but related concepts. There are different views on new generation technologies, even some participants consider the technologies as a marketing tool, digital transformation plays an active role in the outsourcing decisions of companies, the problems that arise despite its flexibility the time and cost savings these technologies provide to companies. The main disadvantages consists of security problems and lack of qualified employees. While additional research is needed to further understand the digital awareness of companies to reveal more comprehensive

results. It is hoped that the results of this study will benefit the actors of the relevant sectors and the researchers working in this field.

Key Words: digitalization, digital awareness, Industry 4.0 applications, SMEs techno-business

ÖZET

KOBİ'LERİN DİJİTAL FARKINDALIĞI: NİTEL BİR ARAŞTIRMA

UZUNER, Candar
İşletme Yönetimi Yüksek Lisans Tezi

Danışman: Doç. Dr. İrge ŞENER
Ocak 2022, 136 sayfa

Günümüzde hem akademinin hem de sahada faaliyet gösteren firmaların gündeminde olan Endüstri 4.0, duyurulduğu günden bu yana birçok araştırmaya konu olmuş olsa da hala bir çalışma konusu olarak güncelliğini korumaktadır. Endüstri 4.0 teknolojilerinin dünyanın gelişmiş ülkeleri tarafından kullanımının yaygınlaşmasıyla birlikte bu kavram, dünyanın geri kalanı tarafından da takip edilmesi neredeyse bir zorunluluk haline gelen bir trende dönüşmüştür. Bu aşamada rekabette tutunabilmenin yolu; işletmelerin dijital dönüşümlerini gerçekleştirmelerinden geçmekte, bu da firmaların dijital farkındalıklarının yüksek olmasını gerektirmektedir. Bu çalışmada, Ankara'da, bilişim sektöründe faaliyet gösteren KOBİ'lerin dijital farkındalıkları ve Endüstri 4.0 teknolojilerine yönelik algıları; nitel bir araştırma deseni çerçevesinde, 20 katılımcıyla gerçekleştirilen mülakatlardan faydalanarak analiz edilmiştir. Araştırma sonuçlarına göre, katılımcılar dijitalleşmeyi ve Endüstri 4.0'ı farklı ancak ilişkili kavramlar olarak algılamaktadır. Yeni nesil teknolojilere yönelik farklı görüşlerin olduğu, dijital dönüşümün firmaların dış kaynak kullanma kararlarında etkin rol oynadığı, firmalara sağladığı zamandan ve maliyetten sağlanan tasarruflara karşın ortaya çıkan problemler tespit edilirken, firmaların dijital farkındalıklarının daha derinlemesine araştırılabilmesi için ilave çalışmalara ihtiyaç olduğu değerlendirilmiştir. Başlıca dezavantajlar güvenlik sorunları ve kalifiye çalışan eksikliğidir. Çalışmanın sonuçlarından ilgili sektörlerin aktörlerinin bu alanda çalışma yapan araştırmacıların istifade edeceği umulmaktadır.

Anahtar Kelimeler: dijitalleşme, dijital farkındalık, Endüstri 4.0 uygulamaları, KOBİ, teknoloji işletmeler

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LIST OF ABBREVIATIONS

Abbreviations

AI	:Artificial Intelligence
ARDL	:Autoregressive Distributed Lag
BIM	:Building Information Modeling
BTYK	:Supreme Council of Science and Technology
CCTV	:Closed Circuit Television
CRM	:Customer Relationship Management
C-TAM-TPB Combined	:Technology Acceptance Model and Theory of Planned Behavior
DT	:Digital Twin
DTM	:Undersecretariat of Foreign Trade
DTP	:State Planning Organization
DTPB	:Decomposed Theory of Planned Behavior
ERP	:Enterprise Resource Planning
EU	:European Union
GPS	:Global Positioning System
HM	:Undersecretariat of Treasury
IaaS	:Infrastructure as a Service
IDT	:Innovation Diffusion Theory
IDT	:Innovation Dissemination Theory
IoS	:Internet of Services
IoT	:Internet of Things
IT	:Information Technology
KOSGEB	:SME Development and Support Organization
M2M	:Machine to Machine
MEB	:Ministry of National Education
MIT	:Massachusetts Institute of Technology
ML	:Machine Learning

MoF	:Turkish Ministry of Foreign Affairs
NIS	:National Innovation System
NLP	:Natural Language Processing
NLU	:Natural Language Understanding
PaaS	:Platform as a Service
PCS	:Powerline Carrier Systems
R & D	:Research and Development
RFID	:Radio Frequency Identification
SaaS	:Software as a Service
SCP	:Supply Chain Management
SCT	:Social Cognitive Theory
SLT	:Social Learning Theory
SMAC	:Social, Mobile, Analytics, Cloud
SME	:Small and Medium Enterprises
STB	:The Ministry of Industry and Technology
TAM	:Technology Acceptance Model
TAM2	:Extended Version of Technology Acceptance Model
TOBB	:Turkish Union of Chambers and Exchange Commodities
TPB	:Theory of Planned Behavior
TPE	:Turkish Patent Institute
TRA	:Theory of Reasoned Action
TSE	:Turkish Standards Institute
TTGV	:Technology Development Foundation of Turkey
TUBA	:Turkish Academy of Sciences
TUBITAK	:Scientific and Technological Research Council of Turkey
TURKAK	:Turkish Accreditation Agency
V2X	:Vehicle to Everything
YÖK	:Higher Education Council

INTRODUCTION

Although many studies have been carried out on digitalization, digital transformation and Industry 4.0 technologies, the subjects are still up-to-date and both the academy and the industry are intensely interested in and working on. In short, digital transformation consists of implementing a digital business model by changing the company model and utilizing technology to deliver value generation processes. The fundamental reason that digitalization is becoming more significant nowadays is that it simplifies, speeds up, and streamlines business operations. With the prevalence of elements such as Industry 4.0, big data, artificial intelligence, Internet of Things, and knowledge in the realm of international business are fast changing and evolving, today a company's management expectations are vastly different from those of 15 to 20 years ago.

According to Schwertner (2017), strategy is moving, it must have a clear vision of the company's improvement, then rely on the unlimited possibilities of these technologies associated with the chosen strategy. Additionally, Torun and Cengiz (2019) found that there is a positive and significant effect of perceived ease of use on perceived usefulness, perceived usefulness over intention to use, perceived ease of use on intention to use, and intention on usage behavior. In the light of these findings, as much as it is necessary to identify the needs of companies and implement the right digital transformation strategy, it is also important to understand the perception levels of companies towards these technologies, their acceptance level and their attitudes towards using them.

Over the years, many theories have been developed to explain the variables and processes in technology acceptance and intention to use it. These theories generally serve the same purpose, are complementary to each other, or approach technology acceptance with other moderating and mediating variables. The Theory of Reasoned Action which is developed by Ajzen and Fishbein (1967) is mentioned as the first of these models that started to be put forward in the 1960s, has the feature of being the first study aimed at predicting, explaining and influencing human

behavior. Since it lacks moderator variables in the theories developed in later years, it is a more generic theory that was not developed for a specific technology or behavior. As with the first developed theory, other models also have certain limitations. In one model, environmental factors are ignored, while in the other, intrinsic factors are ignored and the degree of acceptance of behavior and technology is tried to be understood. Although many theories have been developed over the years, it is clear that this field, which still needs to be studied and improved, will remain popular for a long time.

Developing technology is a phenomenon that informatics and industry sectors, which are the application areas, are constantly on the agenda and have to be followed. The standards which are determined and used by the developed countries of the world are accepted by the vast majority of the world and become a strategy to be followed, and they are also used in developing countries. Industry 4.0, which was first announced at the Hannover Fair in 2011, was presented to the German government by preparing a handbook in 2013 by the engineers who coined this term. Following significant breakthroughs in the IT sector, businesses were forced to stay up with global changes and establish strategies in order to maintain their competitive advantage in the face of increasing competition. The aim of this approach is to realize the technologies at the center of these strategies as interconnected devices that, unlike the classical equipments, operate at less cost, consume less energy, occupy less space, are more economical in terms of resources and memory. Naturally, Turkey was also affected by this evolvement, and developments and projects for new generation technologies started to be implemented in the informatics sector, which is at the coalface of the business. By examining their portfolios, it has been determined that mostly companies operating in technoparks are working on Industry 4.0 technologies and developing projects for private or public institutions.

Examining only the rate of use of these technologies and process integrations of small and medium-sized enterprises operating in the IT sector is not enough to reveal the stage of the sector. The fact that employees adopt, accept and understand the reasons for using the technologies used will play a decisive role here. The way to stay competitive is to integrate the latest generation tools into the necessary departments for the needs of the company and to make companies superior to the position that traditional methods can bring. At this stage, starting from the top managerial level of the companies, all employees should follow the trends

continuously, and the knowledge, competence and awareness of employees' on the instruments should be increased.

Within the scope of this research, the digital awareness of SMEs operating in Ankara, Turkey and their perceptions of Industry 4.0 technologies were tried to be understood. In this context, the confusion between certain concepts, the understanding and attitudes of company managers towards new generation technologies have been tried to be explained. Furthermore, the advantages and disadvantages of technologies, the problems encountered, and the effects they create on competition have been tried to be revealed and evaluated.

Phenomenological research design is chosen in study within the framework of qualitative research to investigate the research questions. In terms of research technique, content analysis method was chosen in the framework of qualitative research design. The data collected with in-depth interview method within the scope of the research were examined with content analysis. The interviewees who are the managers or the co-owners of the information technology companies were selected with the purposive sampling method as they can provide in-depth and detailed information about the phenomenon under investigation.

In order to understand the awareness, understanding and perceptions of Turkish SMEs on the concepts of digitalization and Industry 4.0, this study is divided into four chapters. The first part is the introductory part of the study which gives information about the bacground of the research topic, explains what the research aims to find and the importance of the research. The second part of the study is devoted to the literature review of the subject; the confusion between some concepts was explained, the Industry 4.0 phenomenon and the technologies referred to this concept were mentioned. In addition, previous studies on the subject of research are included, actors contributing to innovation in Turkey, government incentives and their amounts were mentioned in the second part. In the third part, data collection method of the research, data analysis method and findings were given. In the fourth and final part, the results were discussed and recommendations were provided.

CHAPTER I

LITERATURE REVIEW

1.1 NEW TECHNOLOGIES AND TECHNOLOGY ACCEPTANCE

Today, with the development of technology, the development and change of the tools and methods used bring along many innovations both in home and in work. In these days, when entering a period where business methods, speed and time perceptions change and many processes are managed regardless of place, it is important to understand, accept instruments and create an intention to use technology. The integration of interconnected, data transferable smart machines, autonomous systems, cloud servers into the business processes of companies does not guarantee that they will be used effectively. They must be accepted by the entire firm, understood exactly what they were developed for and embedded in business processes, and intention to use must be ensured so that these technologies give the firm a real competitive advantage. In the 1960s, these issues gained more importance with the introduction of electronic devices such as printers, fax machines and eventually computers to companies. In this direction, technology adoption models have been started to be developed that explain with certain variables how people will behave in the face of developing technology. All technology adoption theories are designed to measure a person's level of acceptance and satisfaction with a technology, but they are measured from different angles depending on the composition or determinants that represent their structure (Momani and Jamous 2017).

The first technology acceptance theory is Theory of Reasoned Action (TRA) which was developed in the field of social psychology by Ajzen and Fishbein in 1967. According to Ajzen and Fishbein (1980), TRA is designed to express any kind of human behavior, it is not designed to explain any technology or certain behavior. The purpose of TRA is to investigate the relationship between attitude and behavior

using two main concepts: “compatibility principle” and “behavioral intention”. “Attitude” is defined as an individual evaluation of an object, “belief” is defined as the relationship between an object and an attribute, and “behavior” is defined as an intent or result (Lai 2017). With this characteristic, TRA is a predictive model and is used to predict individual actions based on specific criteria in various areas such as banking, public, education, and industry (Mishra 2014).

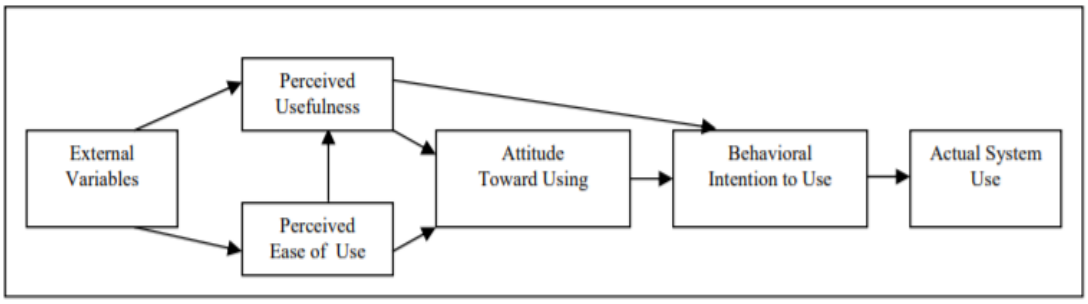
Theory of Planned Behavior (TPB) is the extended version of TRA. The usage of many different technologies and understanding of individual acceptance has been successfully explained by applying TPB. As Ajzen (1985) stated that this theory is moderated by three major components; attitude towards behaviors and subjective norms adopted by TRA, and perceptual behavioral controls.

Decomposed Theory of Planned Behavior (DTPB) is an extension of TPB which was proposed by Taylor and Todd in 1995. TPB is extended by decomposing attitude beliefs, normative beliefs, and control beliefs into multidimensional structures, providing greater descriptive power and a more accurate understanding of behavioral precursors (Hastuti et al. 2014). DTPB extends TPB to include three elements: relative benefits, compatibility, and complexity which are the three factors of Innovation Dissemination Theory (IDT) (Momani and Jamous 2017). According to Taylor and Todd (1995), DTBP has several advantages. First, decomposing beliefs should make the relationship between beliefs and the precursors of intent clearer and easier to understand. Second, DTPB is more administratively relevant by focusing on specific beliefs, decomposition can provide a stable set of beliefs that can be applied to different settings. It is needed to provide a more consummate perspective of IT use, as there are large number of factors that can influence adoption and use.

The Technology Acceptance Model (TAM) was first proposed by Fred Davis in 1986 and was further developed in 1989. Studies of TAM have focused on very specific areas of software and have also expanded into other areas. TAM proposes that the predictors of ensuing behavioral intentions, user attitude towards using the technology, and actual usage are the perceived ease of use and perceived usefulness of technology (Masrom 2007). Studies show that ease of use and perceived usefulness have a positive impact on attitude. Exogenous variables are those that cannot be controlled. Ease of use refers to the ability to do a lot with little effort. Perceived benefit refers to a situation where performance will increase. Attitudes towards usage include emotional states such as liking/disliking technology. In terms

of technology acceptance, intent to use is the possibility that an individual will use a technology. The Figure 1 below shows the first and the original form of Technology Acceptance Model that was introduced by Davis in 1986 for his doctoral proposal.

Figure 1: Original Technology Acceptance Model



Source: Davis (1986)

As an adaptation of TRA, TAM is especially tailored to investigate the users' acceptance of technology and information systems. Although TRA and TPB are enabled to investigate the system use by incorporating subjective norms and perceived behavioral controls into attitudes towards the use of technology, Technology Acceptance Model is suitable for application in online context for various advantages (Chen et al. 2011).

Venkatesh and Davis (2000) proposed TAM2 Model which is also called Extended Version of Technology Acceptance Model by adding some variables to the TAM model. They argued that perceived ease of use, perceived usefulness, and intention to use can be affected by variables such as users' experience on technology, their voluntariness to use it, and the suitability of their job position (job relevance) to use the technology in question, and a clearer result can be obtained by taking these variables into account. As an example, the existence of voluntariness or usage experince of technology are moderators to perceived usefulness or perceived ease of can cause conrete changes in technology acceptance by an increase in the user's experience level, voluntariness or both.

In 1995, Taylor and Todd created the Combined TAM and TPB model by combining the TPB model from the study of social psychology with the TAM model from the IT industry in order to improve the use of behavioral factors in technology adoption. C-TAM-TPB Model provieds hybrid model of two previous models by combining perceived usefulness of TAM with the predictors of TBP model.

According to Safeena et al. (2013), the underlying structure of the TAM does not adequately represent the specific effects of technology and context of use that may alter user acceptance; the factors influencing the adoption of a new IT that varies with technology, target users and context. TAM and TPB theories postulated that behavior is determined by the intention of performing the behavior. Taylor and Todd hypothesized that perceived utility is positively affected by ease of use perceived usefulness and attitudes are positively affected by ease of use. Therefore, attitudes, perceived behavioral, and subjective norms control positively influence usage behavior (Momani and Jamous 2017).

Innovation Diffusion Theory (IDT), on the other hand, is one of the oldest social science theories that allows researchers to investigate any type of technology. Rogers (2003) proposed that there are four major factors for predicting behavior - innovation, time, social systems, and communication channels. Also, the terms innovation, communication and diffusion explained by himself as follows: By adopting a new procedure, introducing a new technology, or improving a successful idea to produce new value, innovation is the process of upgrading an area, product, or service. Communication is the process by which information is created and shared with others to achieve a common understanding. The process by which an innovation is spread over time among the individuals in a social system is called diffusion. Rogers (1962) proposed a total of five user categories to standardize the usage of user categories in diffusion studies. These categories are; innovators, early adopters, early majority, late majority and laggards respectively. From innovators to laggards, the degree of connections and contacts to scientific resources, interactions with other innovators are getting lower which does not solely determine the level of technology adoption of those groups. Additionally, it is stated that observability, relative advantage, trialability, complexity, and compatibility are the five innovations attributes that have effect on individual's behavior and technology adoption (Rogers 1983).

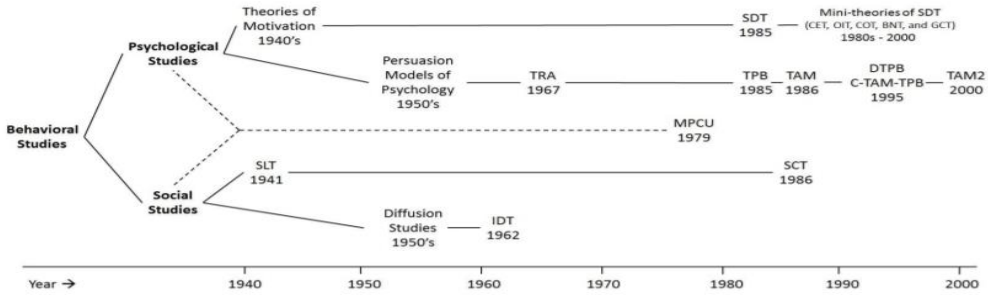
As an explanation of behavior, motivational theory has supported the research of psychology. These studies show that motivational theory contains two main motivational factors which are intrinsic motivation and extrinsic motivation. Extrinsic motivation refers to doing something because it produces a measurable outcome, whereas intrinsic motivation refers to doing something because it is naturally enjoyable or joyful (Ryan and Deci 2000). Davis et al. (1992) tested

extrinsic and intrinsic motivations for the use of technology in the workplace and have been found to be the main impetus for a person's intention to carry out the actions of using technology. They described the external motivation to use technology as a benefit of using it and the internal motivation to use it as a joy to use it. They found a relationship between usefulness and being enjoyed. Enjoyment has a strong influence on the intent when an information system is perceived to be more useful. In short, enjoying information systems increases useful systems' acceptance, but at the same time does not significantly affect the acceptance of useless systems.

Bandura developed Social Cognitive Theory (SCT) as his continued work on Social Learning Theory (SLT). According to Bandura (1986), observational learning is knowledge acquired through cognitive processing of events in the environment, not simply by imitating the activities of others. According to him, learning by observation may or may not involve imitation. Bandura argues that reinforcement is not necessary for learning. Learning occurs when individuals process environmental events cognitively. Therefore, cognitive processes have an important place in his theory. Bandura stated that vicarious reinforcement, vicarious punishment, vicarious motivation, and vicarious emotion are the indirect experiences that provide learning. These past experiences affect strengthening and expectations, regardless of whether the person is behaving in a particular way, and why the person is expressing that behavior. SCT argues that previous experience creates expectations for results related to the performance of certain actions.

As shown in Figure 2 below, the evolutionary stages of all the above-mentioned technology acceptance theories and models, which diverge in two directions, psychology and sociology, can be summarized in the form of a time series diagram.

Figure 2: Chronological graph for the evolution of technology acceptance theories



Source: Momani and Jamous (2017)

1.2 TERMINOLOGY ABOUT NEW TECHNOLOGIES

The convergence of social, mobile, analytics, and cloud computing - also called SMAC technologies - has led to a spread of digitalization that blows revolutionary change in business and society with an unprecedented manner (Legner et al. 2017). Digitalization is becoming more and more important to managers and political decision makers as it consists all aspects of social and professional life. It has become a hot topic in newspapers, magazines and conferences. Terms such as digital, digitalization, digital business and digital transformation are just some of them that buzz in the ears of managers in many industries. Digitalization is seen as solution for most of the problems that businesses face, it is said that with digitalization, we will enter into a new era as the industries revolutionalize.

The dictionaries have not any clear definitions for the terms digital, digitalization, digital business and digital transformation. In order to understand how to make business become more digitalized, managers have to understand these terms and relate them to their businesses since terms differ from one job to another. For example, for the service sector, digitalization means different in terms of business models and management perspective compared to manufacturing line of business. This chapter aims to eliminate confusion in terms to better understand them which are used by the majority of business world.

1.2.1 Concepts Related to Being Digital

To decide how we can define the terms digitization and digitalization, 'digital' concept must be considered first. From the Oxford Advanced Learner's Dictionary official website,[1] the term "digital" has different meanings and uses in different sectors. Definitions are as follows:

> "*1) using a system of receiving and sending information as a series of the numbers one and zero, showing that an electronic signal is there or is not there.*
>
> *2) connected with the use of computer technology, especially the Internet.*
>
> *3) (of clocks, watches, etc.) showing information by using figures, rather than with hands that point to numbers.*"[1]

Based on these definitions, it can be said that the word "digital" has many different meanings. Most of people think of this term as something related to

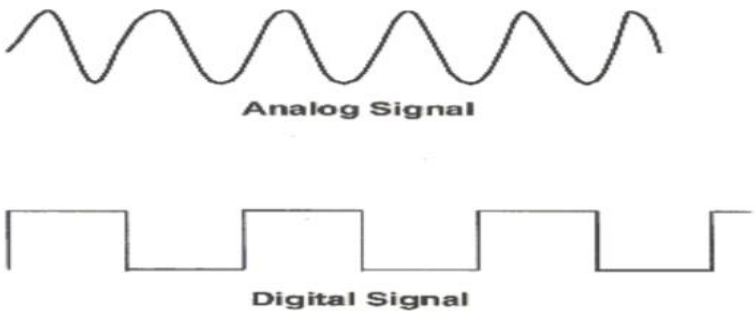
[1] Oxford Advanced Learner's Dictionary Web Site: https://www.oxfordlearnersdictionaries.com/definition/english/digitalization?q=digitalization

technology and computers, but it is just one of its definitions. It seems it hasn't been identified specifically and it can be the reason that there are misunderstandings between individuals when discussing the term. When there is too much misunderstanding of a defitinion, it is harder to study on this topic academically.

Before discussing the concepts, it is necessary to explain the concepts one by one and to clarify the confusion. The topics of digization, digitalization and digital transformation, which are used interchangeably, are actually definitions that each have different meanings and overlap or separate in the context of the technological framework it surrounds.

The technical process of converting analog signals into digital forms, and ultimately into binary digits is called digitization. Since the first computer is invented, digitization is the essence of the new era technologies (Tilson et al. 2010). Digitization (i.e. the process of converting analogue data into digital data sets) "is the framework for digitalization, which is defined as the exploitation of digital opportunities" (Rachinger et al. 2018). The Figure 3 below shows the difference between analog signal and digital signal.

Figure 3: Analog vs Digital Signal



Source: Asafe et al. (2015)

The benefits are huge and examples can be given from different industries: One bank cut the cost of mortgage and reducing pre-approval time from days to minutes by digitizing the mortgage application and decision-making process. Buying a ticket for a concert on smart phone has replaced the need to go to store and buy a paper ticket therefore it is considered digitized. Shoe retailers have developed an inventory management system that allows customers to quickly see if their shoes and

sizes are in stock. This saves time for customers and sales staff (McKinsey & Company 2014).

Many people are confused about terms, either because of ignorance or for their own profit, and they are causing confusion by talking about different things under the same name. To satisfy management, project approvals, and enhance sales, some have began to refer to digitalization as digital transformation.

Some call digitization as digital transformation to reassure management, approve projects, and sell. Since the purpose of this research is to put forth the companies' awareness on the digital transformation and the current level of using Industry 4.0 instruments, the key term is digitalization. The use of digital technology and digitized data to facilitate or improve processes is referred to as digitalization. According to Andersen (2018), a more clear definition of digitalization is creating a business culture where digital information is in the heart of the organization which makes it possible the use of digitized data and digitalization related technologies in order to create revenue, improve business by means of digital transformation.

Digitalization boosts efficiency and output while lowering expenses. Existing business processes are improved by digitalization, but they are not changed or transformed. That is, we require a method for transitioning from a human-controlled event or series of events to a software-controlled event. It also creates opportunities for engaging in research collaborations with industry. Education sector can be given as an example. Due to the ubiquity of digital technology, companies feel cornered with traditional ways of working and often seek innovation projects in research and education from universities (Legner et al. 2017). Companies expect students and researchers to provide a view from outside to inside into digital opportunities in their sectors and to help them to innovate and improve digital business models, goods and services.

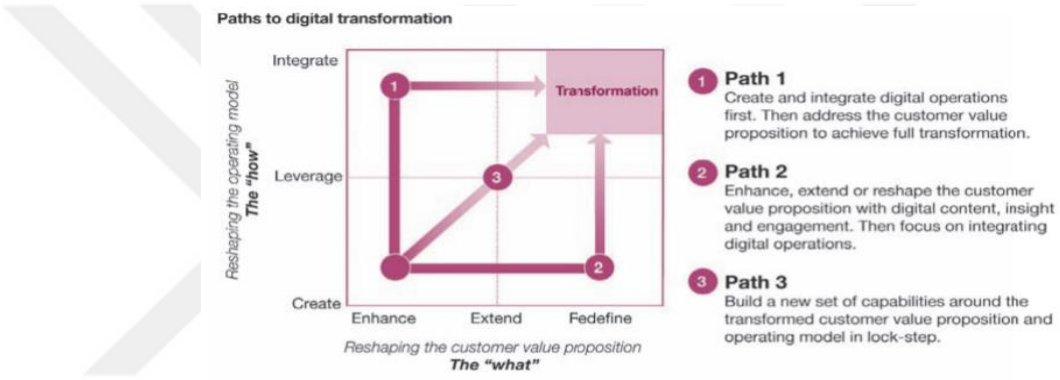
Companies can work on a variety of digital initiatives, ranging from process automation to computer training for personnel. Digital transformation is not a project that businesses can undertake. This wide word, on the other hand, refers to a customer-driven company transformation that necessitates both organizational changes and the use of digital technologies.

Digital transformation looks different from company to company, so it is difficult to come up with a universally applicable definition. Digital transformation, on the other hand, can be defined as the integration of digital technology into all

aspects of an organization. This is profoundly altering how organizations function and provide value to their clients.

Even the companies in physical industries don't start their digital transformation process from null in today's world. Most organizations try to improve customer service and enhanced customers experinces by using digital information to set interactive web sites. It also creates basic operational functions such as online channels and digital supply chain tracking. From this starting point, a company's strategic transformation approach most likely follows one of three paths (Berman 2012) as shown in Figure 4:

Figure 4: 3 Paths of Digital Transformation



Source: IBM Institute for Business Value Analysis (2011)

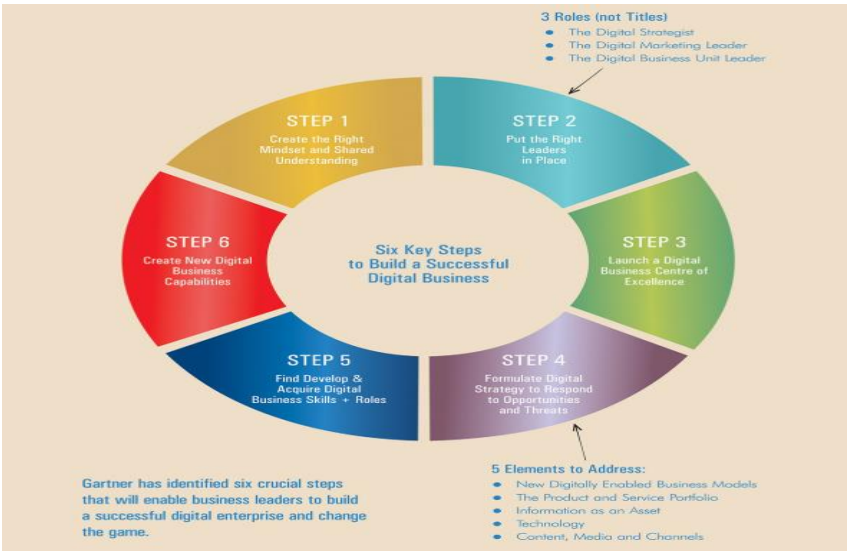
As a summary of digitization, digitalization and digital transformation, the figure below shows how the terms are interpretated as simple as possible. There is a clear connection between all three terms, the scope increases at each step.

Figure 5: Connection Between Terms

Digital technology have altered the way people conduct business, shop, work, and live. They are affecting practically all company operations and industries, and

they are changing society. In the context of digital transformation, digital disruption, business optimization, and integration, the term "digital business" is used. The range, on the other hand, is much wider. It is also about digital marketing transformation, social business, and it shouldn't be forgotten that the avalanche of new technology and digital appeal can neglect the human element (Forrester 2014). The Gartner definition, however, brings up another question – *"What is a digital business ? Digital business is the creation of new business designs by blurring the digital and physical worlds."* (Forbes 2018). This definition sounds hopelessly vague. To understand the term digital business, the blurring points must be explained. Manufacturing businesses can be good example to eliminate confusion in terms. Information technology integrated into traditional manufacturing technology (especially the use of computers) leads to the development of digital manufacturing technology, improving automation and digitization of design, manufacturing and management, and facilitating the global flow and disposal of manufacturing resources, forced the pace of manufacturing industry globalization (Xiong and Yin 2006). As a result, characteristics such as product functionality, quality, performance, and price have changed qualitatively, resulting in many new products. So, it can be said that the digitalization of business blurred the functions and implementations of traditional methods. Gartner also introduced "Six Key Steps to Build a Successful Digital Business" in 2014, that can help to build a successful digital business (Figure 6).

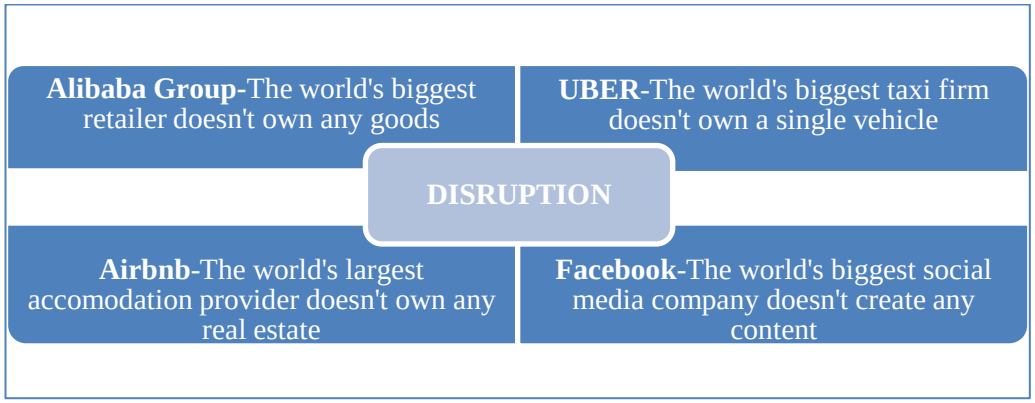
Figure 6: Six key steps to build a successful digital business



Source: Sourcing Hardware (2020)

Disruption of digital disruption describes the process of explaining how new entrants can compete well with established companies. Business model innovations allow market entrants to enter the market with less expensive, easy-to-use, but inefficient products (Christensen 2006; Christensen et al. 2015). Often the big enterprises have their focus on enhancing their service for their large-scale clients and therefore ignoring some low-end markets. New disruptive vendors attack these neglected markets at low prices, and established companies let them due to the low attractiveness of the markets (Vagle 2018). Digital disruptors use free tools available on the Internet to penetrate the market and shake the competitive environment. They usually gain traction by focusing on the interests of their customers rather than product functionality, supply chain, or information management (Mcquivey 2013). With these new entrances, some new challenges arise. These problems are frequently caused by new market entrants, but they can also be caused by established firms that develop new solutions and business models based on newly acquired digital skills. These new solutions and business models result in changes in consumer behaviour. The market participants need to adapt their strategies to ensure long-term survival. Figure 7 below shows some examples of digital disruption:

Figure 7: Examples of disruptive business models



Examining at the example above, it's clear that there is one important thing that all of them have in common. In other words, it is not technology, it is the turmoil caused by people's changes. The way people use technology is changing, which is changing the expectations of their behavior and service demand.

1.2.2 Technology Trends and Aspects of Digital Transformation

In the last few decades, technology has radically changed the way things are done. It no longer uses traditional methods, whether for business or social reasons. As a result of fast advancing technological advancements, life, interaction, search and shopping today are different than they were 10 years ago. Without a doubt, technology plays a role in the success of modern businesses. Everything is digital nowadays, from marketing to public relations to security. Especially in the last decade, impressive improvements have unleashed brand new functionalities in communication, and connectivity technologies. In post-dotcom decade, both established companies and start-ups have used low-cost / performance levels of computers and to connect their corporate infrastructure to the new digital era, they need worldwide connectivity over common protocols (Bharadwaj et al. 2013).

Furthermore, as El Sawy (2013) states that products and services are increasingly incorporating digital technology, making it gradually difficult to separate digital products and services from the underlying information technology (IT) infrastructure. New technologies are the key to enable digital solutions, giving people the ability to digitize everything from files to physical processes (Vagle 2018).

In this chapter, some of the latest technology trends will be discussed to see which part they may take in digital transformation of businesses. Technology trends such as industry 4.0, cloud computing, Internet of Things (IoT), big data, artifical intelligence (AI), blockchain technologies, and digital twin will be discussed and be the main part of this study when evaluating businesses' level of digital transformation.

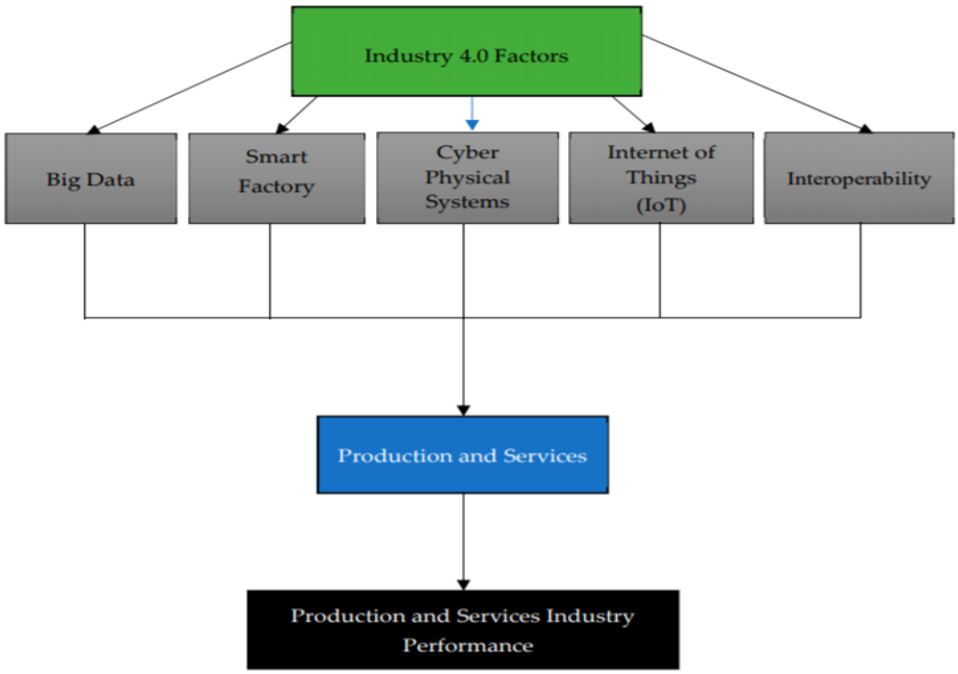
1.2.2.1 Industry 4.0

The introduction of mechanical production techniques using water and steam power marked the start of the first Industrial Revolution in the late 18th and early 19th centuries (Xu et al. 2018). The period from 1870 to 1914 is known as the Second Industrial Revolution, or technological revolution. Also shaped by today's electricity, it has enabled the electrification of factories and modern production lines. With the help of electricity, mass production was started. However, unemployment increased as many factory workers were replaced by machines. Electronics, telecommunications, and computers are brought with the third revolution. The Third

Industrial Revolution has made space travel and biotechnology possible thanks to new technology. The fourth Industrial Revolution so-called Industry 4.0, involves combining traditional and industrial manufacturing practices and platforms with the latest smart technologies (Bernard 2018). It focuses primarily on the implementation of large-scale machine-to-machine communication and the Internet of Things to improve automation, communication, and self-monitoring, and handle problems deploying intelligent machines without any human interference (Moore 2019).

Digitalization of businesses is directly related with three major elements of Industry 4.0- Internet of Things, big data, and smart factory which will be discussed throughout of this study. Inside a modular smart factory, cyber-physical systems monitor physical processes, develop virtual representations of the physical world, and make decentralized choices. Through internal and organizational services provided and employed by actors in the value chain, cyber-physical systems connect and collaborate with one another, as well as coordinate with people, thanks to the Internet of Things (Hermann et al. 2016). All of these factors have important implications for small and medium enterprises' (SME) production and service, and increasing efficiency (Imran et al. 2018). Figure 8 below explains the direct effect of Industry 4.0 on production and services performance:

Figure 8: Industry 4.0 effect on performance



Source: Imran et al. (2018)

1.2.2.2 Cloud Computing

The term "cloud" refers to Internet-accessible servers as well as the software and databases that operate on them, which are stored in data centers all over the world. Users and companies can no longer operate physical servers or run software applications on their computers thanks to cloud computing. Users can access the same files and programs from virtually any device thanks to the cloud. This is due to the fact that the calculations and storage are made through a server in the data center rather than on the user's device. This allows users to log in to their Instagram account and find their old account, including all of their photos, videos, and history, even after switching from their old phone to a new one. It works the same with cloud e-mail providers as well as cloud storage providers.

The introduction of cloud computing has resulted in a significant shift in the way that information technology (IT) services are created, developed, deployed, scaled, upgraded, supported, and billed for (Marston et al. 2010). To leverage the potential of the cloud to transform the industry's internal processes, customer relationships, and value chains, companies need to decide how to achieve the best use of cloud-enabled business models to drive growth and gain significant, sustainable competitive advantage (Berman et al. 2011). Transitioning to cloud computing saves firms money on IT and overhead. For example, unlike cloud providers, they don't have to update and manage their own servers. This has a particularly negative impact on small enterprises that may not have been able to afford to invest in internal infrastructure. It enables them to outsource their infrastructure requirements via the cloud at a minimal cost. To gain such benefits, businesses should know about the differences among services and clouds. Cloud computing can be classified into 3 different service models and 4 different clouds as follows:

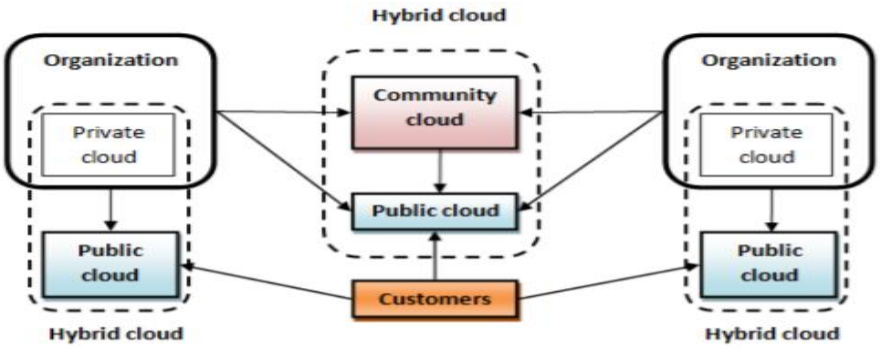
Services include Infrastructure as a Service, Platform as a Service, and Software as a Service. All three cloud computing services are explained as follows:

- Infrastructure as a Service (IaaS): Users' access to a feature IaaS enables users to deploy and operate any software, including operating systems and applications, by providing processing, storage, networking, and other essential computing capabilities (Chun and Choi 2013). Drop Box, Amazon EC2 and Akamai can be given as examples of IaaS providers (Youssef 2012).

- Platform as a Service (PaaS): Platform as a Service provides users with an easy-to-use application development environment (Yi and Zhang 2012). For instance, multiple users in different countries can collaborate on website development using a cloud-based PaaS service (Youssef 2012). Google Aps Engine, Azure and Aptana can be given as examples for PaaS.
- Software as a Service (SaaS): Users can access applications such as SalesForce, Gmail, and Google Docs through a variety of devices such as mobile phones and tablets.

  There are four main types of cloud; public cloud, private cloud, community cloud, and hybrid cloud. These can be described as follows:
- Public Cloud: This cloud model is built to provide any organization with unlimited storage and improved internet connectivity (Diaby and Rad 2017). It is all owned, hosted and operated by a third party provider.
- Private Cloud: Cloud infrastructure operates exclusively for organizations (Savu 2011). The Private Cloud allows the company itself, third parties, or both to rent, own, manage, and operate the underlying cloud infrastructure (Mell and Grance 2011).
- Community Cloud: Community cloud infrastructure is monitored and used by different institutions with the same core business, the same project, or an infrastructure of shareable requirements to reduce IT running costs (Diaby and Rad 2017).
- Hybrid Cloud: The cloud infrastructure of hybrid clouds is made up of two or more public, private, or community cloud components (Youssef 2012: 839). The cloud computing deployment models are shown in Figure 9 below.

Figure 9: Cloud computing deployment models



Source: Youssef (2012)

1.2.2.3 Big Data

As Information Technology (IT) revolutionized people's lives, collection of digital data grew rapidly. Today, vast amounts of data are generated daily in the fields of science, business, manufacturing, and our private lives. However, the increasing amount of data in our digital world seems to be accelerating the progress of our computer infrastructure (Chen et al. 2013). Traditional computing technologies such as data warehouses and databases are becoming inefficient in terms of the amount of data they can process. The main reason for this increase is the use of PCs, smartphones, tablets, the Internet and sensors (Berntsen 2018). Such an increase causes a new challenge and it is known as big data.

There is no generally accepted definition of big data, but people usually indicate as this: "Big data should include data sets with sizes beyond the ability of commonly used software tools to capture, manage, and process the data within a tolerable elapsed time." (Chen et al. 2013: 157). In light of this idea, researchers have summed up three significant parts of enormous information that go beyond the capacity of our present information handling innovation. They are Volume, Velocity and Variety, known as 3Vs.

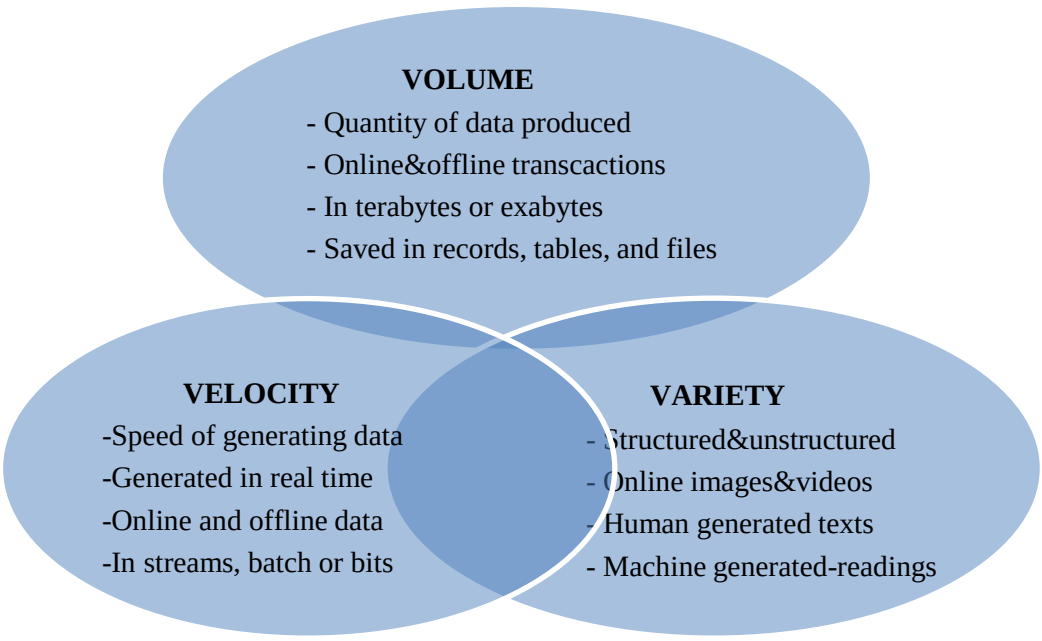
The size of an organization's data is measured by the volume of big data. Every second, more data is transferred than was stored on the Internet 20 years ago, and big data is rising by the second (Hofacker et al. 2016). Challenge caused by the data volume is the most noticable one and it can be said it is the primary attribute of big data. In the sciences like biology, meteorology, and astronomy, scientists constantly face computational limitations due to the growing amount of data (Chen et al. 2013). The greater the amount of data, the more likely the exploration-oriented companies will contain new and unique insights that may benefit (Johnson et al. 2017). The factors such as data type and time are the determinants of definition of big data volume (Gandomi and Haider 2015). In many businesses, for example, data collected for general data warehousing differs from data collected specially for analysis (Russom 2011).

A company's ability to quickly process big data must be especially valuable in an environment characterized by rapid and volatile changes in customer needs and wants (Johnson et al. 2017). Velocity may be preferred to think of it as the frequency of data generation or the data delivery. Consider the flow of data from all types of devices and sensors, such as robot manufacturing machines, thermometers that

senses temperature, microphones that listen to movement in a safe place, and video cameras that look for something specific or a specific face in the crowd (Russom 2011). The widespread usage of digital devices like smartphones and tablets has resulted in unprecedented data collecting and an increase in the demand for real-time analytics. Big data's speed gives new product managers with quick information and allows them to better respond to difficult situations in order to increase performance.

One of the reasons big data is so big is that it comes from more different sources. Variety is the format and type of data generated, from traditional structured data to unstructured text, news, updates, and social media videos and photographs, as well as GPS cellphone signals, are sufficient (Hofacker et al. 2016). Hoarding the data is not a new topic but effective analysis of this hoarded data is new for businesses. To better understand the problem and to provide better services, businesses should bring different types of data together and correlate their meanings. Structured data, semi-structured data, and unstructured data are the three forms of data that can be classified. As Chen (2013) remarks there have been advanced technologies for processing each of these types of data, such as databases and information retrieval. Integration of these technologies, on the other hand, remains as a challenge. Figure 10 below explains characteristics of each dimensions of big data.

Figure 10: 3Vs of Big Data



Big data is meaningless without analysis. Only when it is used to make decisions does it reveal its actual worth. To enable evidence-based decision-making, businesses require effective techniques for translating rapidly changing and diverse data into relevant knowledge (Gandomi and Haider 2015). Text analytics, video analytics, audio analytics, social media analytics, and predictive analytics are the five primary steps in the process of extracting big data.

In the following sections, these stages are briefly discussed. Broader explanation of analytics techniques are beyond this study and since the main topic of this study is not big data analytics, following are just the subset of the available tools for analyzing the structured and unstructured data.

Examples of text data stored by businesses are social media feeds, emails, blogs, online forums, company documents, messages, and call center logs (Gandomi and Haider 2015). Companies can provide better service to satisfy customers, carry out market research to better understand the demand and to observe brand reputation. For example, with the use of text analytics, companies can forecast stock markets based on information from financial statistics (Chung 2014).

Compared to other methods of data mining, video analytics is still in its infancy (Panigrahi et al. 2010), other techniques have been developed to analyze real-time and recorded video. The proliferation of closed-circuit television cameras (CCTV) and video-sharing websites' growing popularity are the two main drivers of increased computer-based video analytics (Gandomi and Haider 2015). Videos and images are 80% of all the unstructured data in the world. All of this information is saved and analyzed for later use, but videos contain a lot of data and are often large (Verma et al. 2016). Not all of videos are useful or they don't contain massive information. It is one of the big data analytics problem because there are innumarable videos that creates junk in information.

Audio analysis is the analysis and understanding of audio signals captured by digital devices using a variety of enterprise applications. In health care, this type of analysis helps to treat certain medical conditions such as cancer or depression that affect a patient's communication patterns (Hirschberg et al. 2010). Another example can be given from call centers which audio analytics is used for sufficient analysis of millions of minutes of phone calls to gain information to identify problems or poor functions in the product or service for better service.

Social network analytics refers to the analysis of structured and unstructured data obtained from social media channels, blogs, social news, and websites. Research on social media has intensified in recent years due to a great interest in the applications and unique challenges and opportunities associated with the social sciences and engineering (Zeng et al. 2010). Marketing in particular has become a major application of social media analytics. This may be due to the increased popularity and acceptance of social media by consumers from all around the world (He et al. 2013).

Predictive analytics is a technique that can extract information from existing data sets to predict future outcomes and identify patterns (Zeng et al. 2010). Predictive analytics are used in actuarial, marketing, telecommunications, retail, travel, mobility, financial services, healthcare, pharmaceuticals, and social media. Examples include the identification of a suspect after a crime or credit card fraud at the time of the crime (Steven 2014). Predictive analytics is sometimes defined as a higher degree of forecasting that generates prediction values for each individual organizational piece. It distinguishes from forecasting. Predictive analytics has been used in numerous sectors such as retail, health, sports, insurance and energy.

1.2.2.4 Internet of Things

The term Internet of Things is used more and more today, but there is no general definition or understanding of what it really is (Flüchter and Wortmann 2015). The origin of the Internet of Things (IoT) dates back more than 15 years and is based on the work of the Massachusetts Institute of Technology (MIT) on radio frequency identification (RFID) infrastructure (Atzori et al. 2010). IoT was generally defined as:

> "*a global network infrastructure where physical and virtual objects with unique ID are discovered and integrated seamlessly (taking into account security and privacy issues) in the associated information network where they are able to offer and receive services which are elements of business processes defined in the environment they become active*" (Kiritsis 2011: 480).

Other IoT definitions concentrate on Internet-related factors, such as Internet protocols and network technology. One definition focuses on the semantic challenges of the IoT, such as those related to storing, retrieving, and organizing large amounts of information (Atzori et al. 2010).

The Internet of Things gives the ability to people and things to communicate whatever is the time, place or thing by using any service or network or path. As a result, addressing components such as Computing, Convergence, Content, Connectivity, Collections, and Communication are disclosed in a framework where people and things or things and things interact freely (Vermesan et al. 2011).

As IoT solutions are expanding into almost every area of our daily lives, the areas of application of IoT technology are diverse and at the same time very large. Widely used IoT applications are explained below.

- Smart Home and Buildings

Smart home concept has attracted attention of both industry and academy since it was used for the first time. Researchers have mostly studied infrastructure, intercommunication, architecture and realization of smart home concept. As it is mentioned that smart home is "a dwelling incorporating communications network that connects the key electrical appliances and services, and allows them to be remotely controlled, monitored or accessed" (Jie et al. 2013: 1789).

Smart energy applications are centered on smart electricity, gas, and water meters, while intelligent security systems have attracted a lot of interest in the smart home or building industry (Vermesan et al. 2014)

As electronic technology converges, the field of home automation is expanding rapidly (Robles and Kim 2010). Entertainment, security, convenience, and information systems are all part of home networks. PCS (power line carrier systems) are technologies that employ existing electrical wiring in the home to convey coded signals to outlets or programmable switches. The signals transmit directives that communicate with specific device addresses and also control when these devices are used.

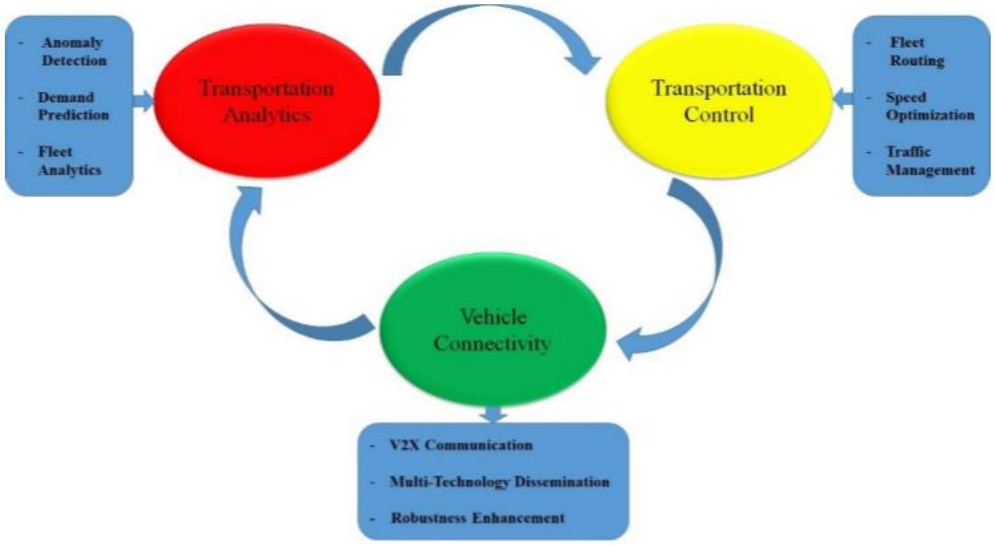
- Smart Transportation

Transport development is one of the indicators of national well-being (Mohammed and Ahmed 2017). IoT provides solutions for fare collection to board commercial airlines and goods carried by the international cargo system, passenger and baggage management, and responds to growing global demand for security guidelines support government and shipping companies to meet the growing global demand for safety guidelines (Bandyopadhyay and Sen 2011).

The smart transportation deals with three main components which are shown in Figure 11 below; they are transportation control, transportation analytics, and

vehicle connectivity. The transportation analytics shows the demand prediction analysis and anomaly detection. In addition to traffic control, vehicle route and speed control are both referred to as traffic control, which is closely related to how vehicles are actually connected (V2X communication) and is usually dominated by the proliferation of multi-technology dissemination (Mohammed and Ahmed 2017).

Figure 11: Smart Transportation Aspects



Source: Mohammed and Ahmed (2017)

When opposed to traditional ways, shipping companies can pack containers more effectively because containers can scan and weigh themselves. When IoT technology is used to manage passenger baggage at airports and on flights, it allows for automatic tracking and classification, speedy baggage search, and increased security (Bandyopadhyay and Sen 2011).

- Smart Factory and Smart Manufacturing

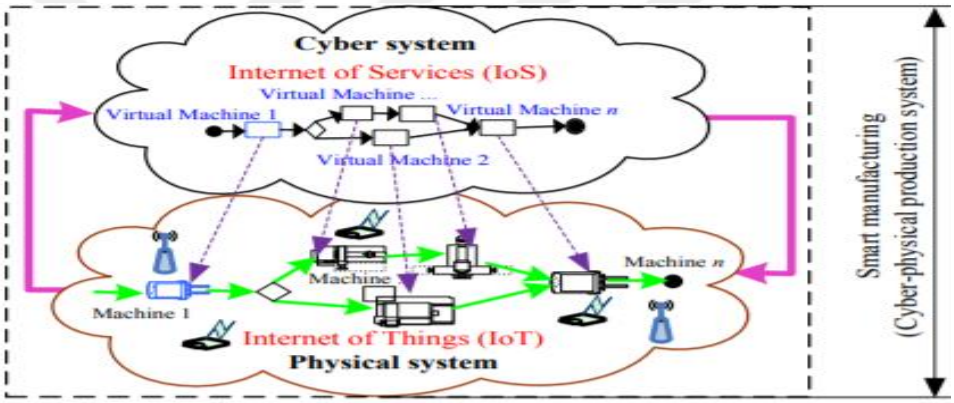
Smart factories, according to Benioff (2015), provide new value to the manufacturing revolution by incorporating artificial intelligence, machine learning, information technology automation, and M2M communications into the manufacturing process. Fine-grained data is used as input data for more advanced production planning and logistics. Manufacturing systems that are smart and self-organizing can be built around identifiable pieces (Bandyopadhyay and Sen 2011).

While new technologies such as automation, robotics, and automated mobility all contribute to smart manufacturing, machine-to-machine communication

allowed by the "industrial" Internet of Things will improve working conditions for smart factories and smart manufacturing based on big data. The analytical capabilities afforded by the volume and diversity of data gathered are utilized to optimize industrial operations in order to reduce maintenance downtime, failures, and energy usage dramatically.

Figure 12 below illustrates smart manufacturing as a networked physical production system that is seen as a combination of Internet of Things and Internet of Services (IoS). In cyberspace, like the cloud, production assets are virtualized and packaged as a cloud service that can be shared and consumed on-demand through IoS (Yao et al. 2017)

Figure 12: Smart manufacturing exemplified as a cyber-physical production system



Source: Yao et al. (2017)

Because there are many production parts, and often a manufacturing department is not able to handle complex tasks, it is necessary to use a component part of that department to operate a manufacturing business process using intelligent optimization algorithms. The optimized business processes are created in the network then moved to the physical layer for execution by connecting each cloud production service (virtual machine) to the corresponding physical machine (Yao et al. 2017).

- Automative Industry

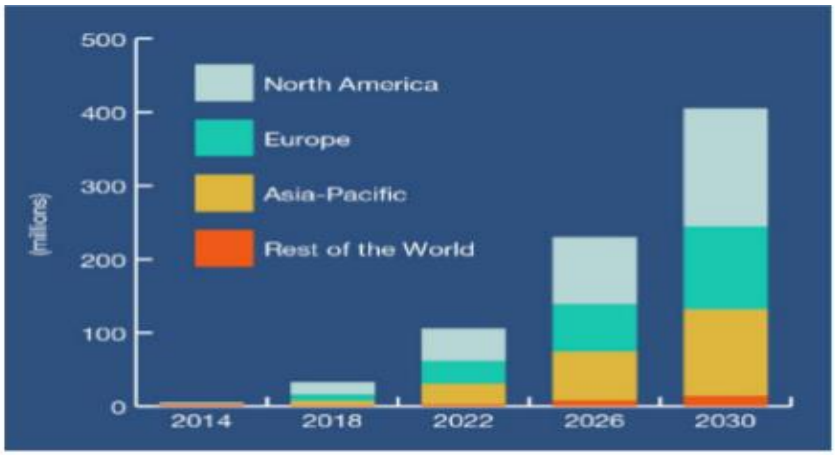
Modern automobiles, trains, buses and bicycles are equipped with sophisticated sensors and actuators with increased computing power. Smart technologies are being used in the car sector to monitor and report metrics ranging from tire pressure to access to other vehicles (Bandyopadhyay and Sen 2011).

The car industry will benefit from IoT-related technologies, with connected cars playing a key part in future roadways and economies (Krasniqi and Harjrizi 2016). The automotive industry is evolving from a product-centric period to one focused on services and experiences, with hardware giving way to software, functionality giving way to information as a significant value-added object, and from industrial silos to complicated networking. It depicts the shift to new environments (Meyerson 2016).

The Internet of Things is not only transforming the automotive sector, but it is also sparking a power struggle between established manufacturers and software developers (Ninan 2015). While the auto industry is considered to be the territory of automakers, automakers are a new territory of the growing ecosystem of actors, with all actors trying to unleash their value and software developers look like they are getting a share in the market (Krasniqi and Harjrizi 2016).

Smart vehicles are not fictitious or futuristic technologies that are far from reality technologies and improvements. In fact, there are some self-driving cars like Tesla's, Google's and Nissan's. Figure 13 below illustrates the global market forecast for modificated vehicles with IoT applications, showing estimates for some regions in millions.

Figure 13: World market forecast for registered vehicles with IoT applications



Source: ABI Research (2020)

- Retail, Logistics and Supply Chain Management

Internet of Things can provide a lot of advantages in retail and supply chain management (SCP) operations. For example, with items equipped with radio-

frequency identification and smart shelves, many applications can be optimized by a retailer. Automatic inventory checks, real-time inventory monitoring, shortage tracking, and shoplifting detection can be performed (Bandyopadhyay and Sen 2011). The Internet of Things has the potential to offer significant savings potential for retailers, as it has been found that 3,9 % of global lost sales occur when shelves are empty and shoppers return with the products they want (Gruen et al. 2002).

Moreover, IoT helps to make the data available from the retail to optimize the logistics of the whole supply chain. By knowing a retailer's inventory and sales data, manufacturers can produce and ship the required quantity of goods, avoiding overproduction or underproduction situations (Bandyopadhyay and Sen 2011).

Although the Internet of Things is promising and is projected to have an upward trend, important challenges remain unresolved not only from a technology perspective but also from a business perspective. The advent of Internet-connected products raises many operational-level questions as well as strategic questions. Managers, for example, are required to examine the opportunities and challenges that the advent of the Internet of Things can produce for their firms and the fields in which they work at the strategic level. As a result, business models must be updated or changed in response to industry boundaries and the positioning of new products on the Internet of Things may need to be reevaluated as competition grows. shifts and expands (Wortmann and Flüchter 2015).

Managerial issues are likely to occur at the operational level as new software cultures collide with existing business practices. In marketing, new after-sale services and marketing tools could be useful in establishing contact between customers and linked items, as well as meeting the requirements of connected products. To facilitate the development of connected products, for example, new design concepts may be required to enable ongoing product upgrades or personalisation (Fleisch et al. 2014).

1.2.2.5 Artificial Intelligence

Artificial intelligence (AI) is one of the most exciting technologies that has started to change both people’s and businesses’ ways of doing. The robots and machines which thinks, learns and acts like humankind are not fiction anymore. Machines (or computers) that simulate cognitive functions that humans identify with the human mind, such as learning and problem solving, are commonly referred to as

artificial intelligence (Russell and Norvig 2009). The term also applies to all machines with features related to the human mind, such as learning and problem solving. To better understand the AI, some of the most relevant technologies of AI should be covered, that are-machine learning ML), computer vision and natural language processing (NLP).

- Machine Learning

Machine learning (ML) studies the automatically improved computer algorithms which is affected by experience (Mitchell 1997). Figure 14 shows the working principles among traditional programming of machine learning. In traditional programming, programmer have data and and program run through computer and gets an output at the end. In machine learning, programmer have data and the desired output run through her/his computer and gets the program at the end.

Figure 14: Working Principles of Traditional Programming and Machine Learning

Traditional programming principles

Machine learning principles

Machine learning algorithms are utilized in a range of areas when developing standard algorithms to do the needed tasks is difficult or impossible. The impact of artificial intelligence is to restructure core processes and business models for using machine learning in manufacturing, retail, transportation, finance, healthcare, legal, advertising, insurance, entertainment, education, and all other industries (Brynjolfsson and Mcafee 2017).

- Computer Vision

Computer vision is an area of computer science concerned with developing digital systems capable of processing, analyzing, and comprehending visual data in a human-like manner. Computer vision duties include capturing, processing, interpreting, and comprehending digital images, as well as collecting dimensional data from the real environment to create digital information and symbols (Klette 2014). This interpretation of images can be regarded as the separation of symbolic information from visual data using models built with the help of geometry, physics, statistics, and learning theory (Forsyth and Ponce 2003). Computer vision has a wide range of applications, from controlling robots to facial identification to self-driving automobile configuration and movement recognition.

- Natural Language Processing

Natural Language Processing (NLP) is a field of study and application that investigates how computers can comprehend and change natural language documents and noises in order to perform useful tasks (Chowdhury 2005). In the early days of artificial intelligence, the field of NLP was known as Natural Language Understanding (NLU), but now it is widely agreed that the aim of NLP is directly related to NLU, which has yet to be achieved (Liddy 2001).

NLP is the driving force of personal assistant applications such as Siri, Alexa and Cortana. Additionally, it is used for translation applications such as Google Translation and Interactive Voice Response applications which are used in call centers to respondent customers' certain requests. Chatbots are the most used applications that comes from NLP, when the topic comes to the digitalization of businesses such as call centers. Chatbots are conversation agents developed with computer programs to simulate intelligent conversations (Doshi et al. 2017). Chatbots do not operate for eight hours a day and do not require sleep, therefore they are constantly available. Angry clients who do not receive prompt responses may abandon the company's website and never return. Chatbots can help businesses to avoid this problem and keep their clients.

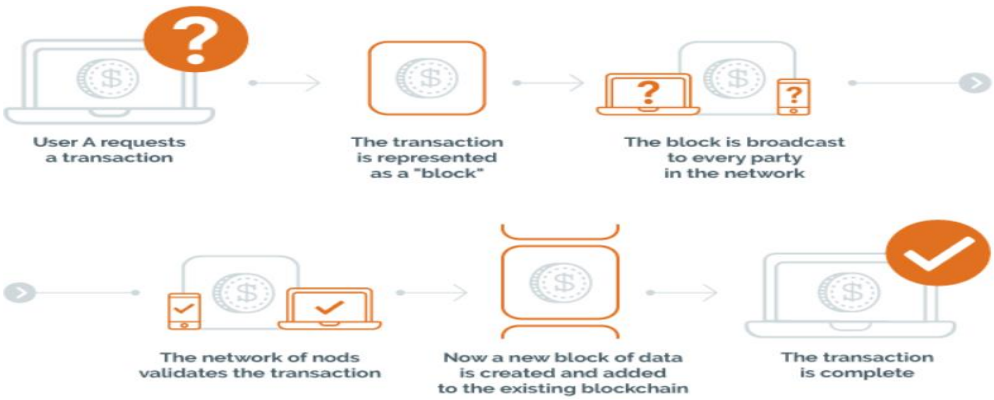
1.2.2.6 Blockchain and Distributed Ledger Technologies

Current digital economy and transactions rely on trusted authorities. As almost all online transactions depends on someone telling the truth - whether it is an e-mail service provider notifying you that an e-mail has been delivered, a certificate

authority stating that a particular digital certificate is trusted, or a social network such as Instagram or Facebook remarking that life event posts are only shared with friends, or a bank ensuring that money is sent to a loved one in a distant country (Crosby et al. 2016). The fact is that in almost all of the transactions, it has to be trusted a third party for keeping digital assets secure and private. But another fact should be taken into account that these third parties can be hacked or manipulated.

A blockchain is a decentralized database of records, or a public directory, of all completed transactions or digital events that is shared among participants (Crosby et al. 2016). Blockchain is based on the structure of the distributed ledger and the consensus procedure (Underwood 2016). This isn't "simply a record," though, because it might also contain "smart contracts," which are blockchain-based programs that operate exactly as they're programmed without the risk of censorship, downtime or fraud (Buterin 2014). Blockchains can be public and unlicensed, enabling anybody to use them (Bitcoin and Ethereum are examples), or private and licensed, forming a limited group of known participants operating in a specific industry or supply chain (Underwood 2016). Figure 15 below explains how blockchain technology works.

Figure 15: How Blockchain Technology Works



Source: Hassan et al. (2018)

Bitcoin is the most popular example that is inherently tied to blockchain technology. While blockchain is currently viewed primarily as the technology that enables cryptocurrencies like Bitcoin, it could very well become an even more valuable catalyst for social and economic transactions, such as profile of ownership of general-purpose digital assets (Lindman et al. 2017). Blockchain applications and business models are being developed at a rapid pace in the financial sector while

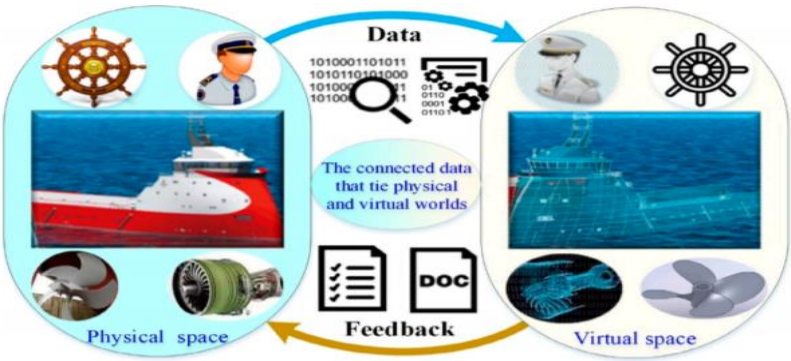
companies in a wide range of industries, from shipping and transportation to healthcare and entertainment, are adopting blockchain technologies to coordinate the transfer of goods (Beck et al. 2017).

1.2.2.7 Digital Twin

Digital twins are integrated multi-physical, multi-scale, stochastic simulations of complex products that map the service life of the corresponding twins using the best physical models available, sensor updates, and more (Tao et al. 2018). With a desire to reduce time and boost interest in product creation, the use of digital twins, or virtual product simulations of genuine things, has grown. These models are being progressively richer with production and operational data as a result of digitalization of production, network-physical production systems, and increased efforts in data collecting and processing (Schleich et al. 2017). Internet of Things, artificial intelligence, machine learning, and software analytics are all combined in digital twins (Microsoft 2020). Furthermore, digital twins serve to facilitate failure prediction, diagnosis, and maintenance in a digital manner by providing correlation and dynamic synchronization between production planning and implementation (Qi and Tao 2018). Simulation and seamless data transfer from one lifecycle phase to the next are central to the concept of digital twins (Söderberg et al. 2017).

In both industry and science, digital twins are gaining traction as a way for organizations and customers to obtain a product's whole digital footprint, from design through manufacture to the end of its lifecycle (Tao et al. 2019). A digital twin (DT) is made up of three components: a physical product, a virtual product, and a link between the physical and virtual products (Glaessgen and Stargel 2012).

Figure 16: General digital twin mode for a product



Source: Tao et al. (2019)

Figure 16 depicts a product in digital twin mode. In virtual space, virtual representations of products are mirror images of physical products. By gathering data to forecast, estimate, and analyze dynamic changes, virtual models can grasp the condition of physical components (Qi and Tao 2018).

CHAPTER II

CURRENT SITUATION OF DIGITAL TECHNOLOGIES IN TURKEY

2.1 INSTITUTIONAL FRAMEWORK

The state agencies are more important and special than other institutions and organizations in the design and implementation of science, technology and innovation policies due to their legislative and administrative powers. As Biçme (2019) states that a country's innovation system is a system made up of many elements such as government agencies, private sector organizations, educational institutions and non-governmental organizations; in order for this system to be established on solid foundations and to function properly, it must guide the system by policies and laws implemented by the state which is called National Innovation System (NIS). NIS is a framework of actor of innovation and innovation related institutions that is directly involved in the generation, dissemination, diversion, and interrelationships between innovation actors (Chung 2002). The innovation actors can be explained under six headings (Lyasnikov et al. 2014):

- "*the state sector (State and local enforcement authorities undertake activities to support innovation),*
- *the business sector (small, and medium enterprises, large corporate establishments);*
- *the scientific-research sector (academie, non-governmental research institutes, scientific-research institutes);*
- *the sector for technology transfer and intermediaries (technoparks, business incubators, clusters, and special economic zones);*
- *the public sector (organizational and open-to-innovation civil society);*
- *the partner sector (foreign partners of innovation)*"

Although the economy has shifted from being driven by agricultural to being dominated by the industrial sector, the NIS remains fractioned and weak (Bozkurt and Vaidya 2004). The lack of continuity in the implementation of decisions made it

difficult to implement the national innovation system. From an industrial point of view, it can be indicated that businessmen are not interested in science and technology because there is no basis for industrialization or culture such as technology learning, and technology transfer cannot be internalized (Biçme 2019).

It is seen that especially in developing countries, it is necessary to follow the developing technology closely and to make necessary investments and incentives for companies operating in the IT sector to achieve world standards. Being the sole authority in this regard, states should take this responsibility and open new institutions or ministries or revise existing ones, collaborate with companies to increase the efficiency of industrial actors in the system. The basic objectives related to Turkey's industrial research and development (R & D) and innovation are considered as below (Yanıktepe and Çavuş 2011: 9215):

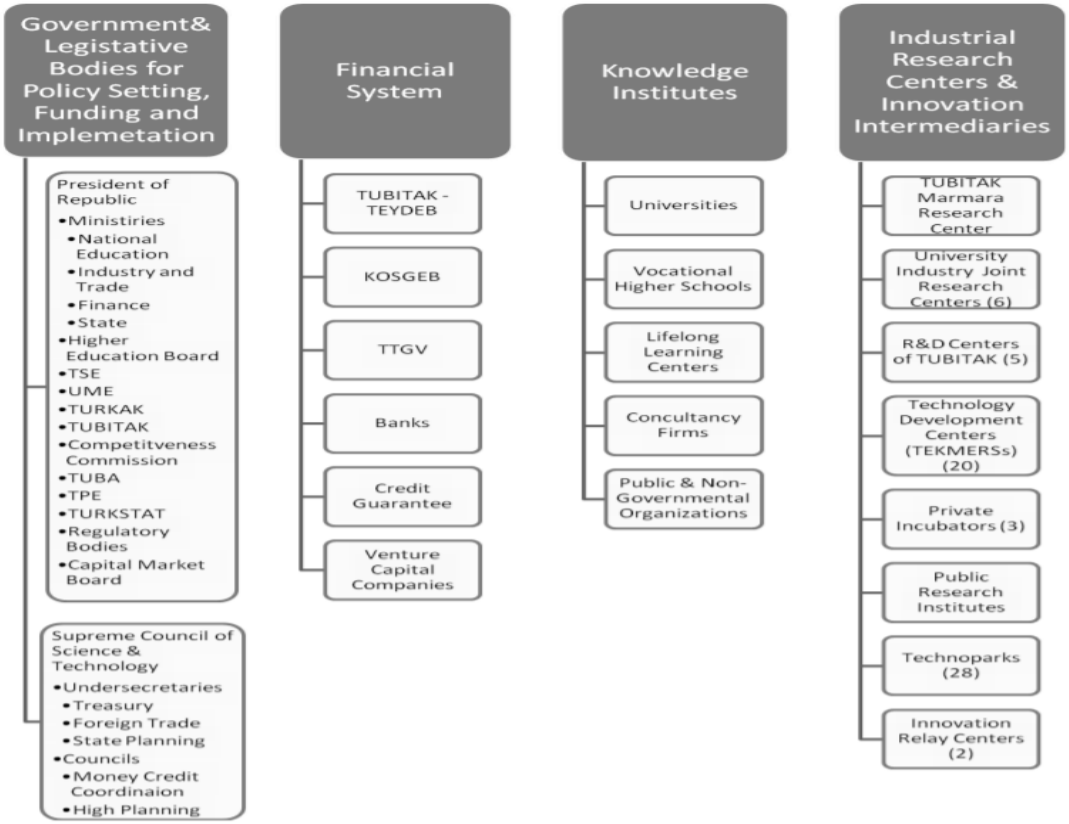
> "*1.To increase awareness of the society on science, technology and innovation.*
> *2. Reseach projects mainly focused on priority areas,*
> *3.To increase the capacity of science, technology and innovation and transform this capacity into socio-economic value added.*
> *4.To increase private sectors' demand and strenghten its capacity for R & D,*
> *5.To increase university-public and private sector cooperation.*"

The cornerstones of competitiveness and catching world standards in informatics are transferring innovation and the capital to the experts of the subject for research and development. As the number of private firms, government organizations or academy engagings in R&D increases, knowledge in the field increases and the opportunity to benefit from the real potentials of technologies arises. However, this opportunity alone is not enough. In order to benefit from this opportunity, the institutions that develop knowledge, which are generally academic institutions, should be in constant contact with companies in the sector and government affiliates, and steps should be taken to provide incentives for information and capital exchange to companies that will put technology into practice (Sandberg et al. 2011).

As can be seen in Figure 17, in the two columns on the left side of the figure, Supreme Council of Science and Technology (BTYK – Turkish abbreviation for Bilim ve Teknoloji Yüksek Kurulu), Scientific and Technological Research Council of Turkey (TUBITAK - (Turkish abbreviation for Türkiye Bilimsel ve Teknolojik Araştırma Kurumu), and SME Development and Support Organization (KOSGEB – Turkish abbreviaton for Küçük ve Orta Ölçekli İşletmeleri Geliştirme ve Destekleme

İdaresi Başkanlığı) are stated as government and legislative bodies for policy setting, funding and implementation; in the columns of the right side, universities, learning centers, public research institutes and technoparks are placed as the actors as civil societies or institutions that produce know-how, many of which need incentives and entrepreneurial investments to be paid for by the government.

Figure 17: The general actors for industrial R&D and their dependency level between them



Source: Yanıktepe and Çavuş (2011)

Some of the main actors of innovation system of Turkey are as follows:

2.1.1 Supreme Council of Science and Technology

The Supreme Council for Science and Technology (Turkish abbreviation: BTYK) was established on October 4, 1983 with Decree No. 77 published in the journal 18181 to guide and coordinate research policies. and develop in the field of science and technology in line with national security goals, and economic and social development (Statuary Decree on the Establishment of BTYK 1983). BTYK meetings, which are in close relation with the ministries and state affiliates

established for the technological development of the country, are managed by the prime minister of the time the meeting was held. Preparation of BTYK works and secretariat services are carried out by TUBITAK (Apaydın 2015). BTYK's main mission is to support long-term science and government development of technology policies (Yaşar 1999). The duties of BTYK are as follows (Statuary Decree on the Establishment of BTYK 1983):

a. To assist the government in determining long-term science and technology policies.
b. To determine research and development targets in the fields related to science and technology.
c. To determine the priority research and development areas, to prepare plans and programs related to them.
d. To assign public research institutions in line with the plans and programs in the field of research and development, to cooperate with the private sector when necessary and to determine the incentive and regulatory measures related to the private sector.
e. To prepare drafting bills and legislation in the field of science and technology for the activation and development of the science and technology system
f. To determine the necessary measures for the training and effective use of human resources for research and ensure its implementation.
g. To determine the necessary principles and procedures for private institutions to establish research and development centers to monitor, evaluate and direct activities.
h. To determine how much research and development investment should be made in which areas.
i. Ensuring coordination between sectors and organizations in programming and execution phases.

2.1.2 Scientific and Technological Research Council of Turkey (TUBITAK)

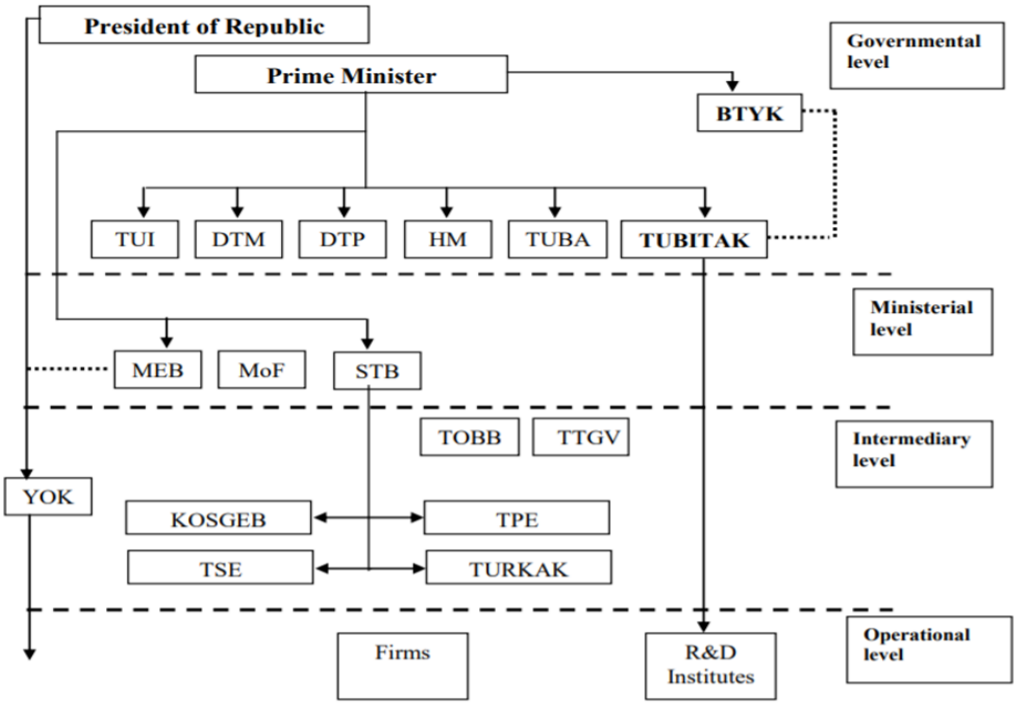
TUBITAK, which was established in 1963 to support young scientists, supports the projects and scientists of its stakeholders who carry out R&D and innovation studies in line with its mission, and carries out R&D studies in its center and institutes in line with the priorities of the country. The implementation of activities to raise awareness and research capacity for scientific, technological and

innovative activities in society has been realized through magazines, books, competitions and festivals standing from the establishment of TUBITAK. Institutional mission on TUBITAK official website (tubitak.gov.tr) is; “For the security, health, welfare, peace and social development of our country and humanity;

- To support the national science, technology and innovation ecosystem,
- Developing high value-added products and services with science-based technology,
- To ensure the production of qualified knowledge and the development of qualified human resources for these purposes.

To better understand the position of TUBITAK in the hierarchy of institutions, it is necessary to draw on Figure 18, a compilation of Sheraz (n.d.).

Figure 18: NIS Institutions of Turkey



Source: Sheraz (n.d.)

As it can be seen, unlike other institutions, TUBITAK, which is directly affiliated with BTYK, is one of the determinant institutions in the policies developed by the government for the public, private sector and academia, the incentives offered, the support programs prepared and the grants given to newly opened businesses if they fulfill the necessary conditions. TUBITAK was tasked for the first time with

creating documents for the determination of Turkey's science and technology policy, titled "Turkish Science Policy; 1983-2003." The establishment of the Supreme Council of the Scientific and Technical Committee (BTYK) in 1983 and the assignment of TUBITAK to the secretariat functions of this committee made this responsibility a clear and specific task.

In the report published by TUBITAK in, some support and grant programs are mentioned. The support and grant programs specified in the report (TUBITAK 2013), created to contribute to initiatives and R&D studies in industry and academia are as follows:

- 1003 Support Program for Priority R&D Areas Projects;

The purpose of this funding program is a national study that is outcome-oriented, has observable goals, and observes the dynamics of relevant science i in priority areas identified by national scientific, technology, and innovation initiatives to support and coordinate development projects, and are carried out within the framework of these projects. For the year 2020, the lower and upper limits of the support for the projects to be supported separately in each of the three scales have been determined. For small-scale projects, upper limit is 750,000 Turkish Lira, while it’s up to 1,500,000 TL for medium-scale projects, and 3,750,000 for large-scale projects.

- 1005 National New Ideas and Products Research Support Program;

The goal of the program is to fund applied research and/or experimental development projects with the goal of generating a new national/international product, process, method, or model that will minimize our technical reliance on foreign sources and/or boost our country's competitiveness. The maximum amount of assistance for projects in 2021 is 300,000 TL.

- 1505 - University-Industry Cooperation Support Program;

Through this program, it is aimed to promote the commercialization of knowledge and skills in universities, research infrastructures, public research centers and laboratories, and to transform them into products or processes and transfer them into industries according to the needs and promises of organizations residing in Turkey. Projects that develop new methods and manufacturing technologies to manufacture new products, develop or improve existing products, improve product quality or standards, or reduce costs are funded by TUBITAK and contracting

organizations. For 2021, the part of the project budget to be covered by TÜBİTAK is limited to 750,000 TL.

- 1511 Priority Areas of R&D Support Program;

The 1511 program initiates capacity building with project support in areas of inadequate capacity to identify national needs, technically manage institutions and ensure sustainable technology development in the short and medium term. It is considered very important for providing project-related support. The Technology Oriented Industrial Move Program is a special program to strengthen the support and incentives of the Ministry of Industry and Technology, TUBITAK and KOSGEB to increase value-added production in Turkey in the middle and high technology sector. As part of this program, it is planned to expand the domestic production capacity of important products for Turkey with high potential. In the program, the project limits will be determined in the call, with a funding rate of 60% for large organizations and 75% for small businesses.

- 1512 Entrepreneurship Progressive Support Program;

The 1512 Entrepreneurship Support Program provides qualified entrepreneurship and innovative products to help entrepreneurs transform technology and innovation-oriented business ideas into companies with high added value and qualified employment potential. Activities are supported from the idea stage to market preparation to promote to a high level.

- 1602 Patent Support Program;

"The 1602 TUBITAK Patent Support Program aims to enhance the number of domestic and international patent applications as well as patents issued in our country."

- 1707 Call for SME Support on Order-Based R&D Projects;

"Its purpose is to transform proposed solutions that meet customer needs into marketable results and contribute to the export of these results through research and development by SMEs. It also contributes to the development of foreign cooperation of domestic companies. In this way, organizations are expected to have a positive impact on the import-export balance of our country by increasing their market share abroad for a certain product/process. The project budget will be at most 2,500,000 TL."

2.1.3 Small and Medium Enterprises Development Organization (KOSGEB)

Because of the fact that the services, which Small Industry Development Organization (KÜSGET – Turkish abbreviation for Küçük Sanayi Geliştirme Teşkilatı) and Insurance Training Center (SEGEM – Turkish abbreviation for Sigortacılık Eğitim Merkezi) try to realize within the framework of the project agreements, are time-bound, cannot adequately meet the needs at the country level, the "Law on the Establishment of the Small and Medium-Sized Industry Development and Support Administration (KOSGEB)" was drafted and published in the Official Gazette. No 20498 on 20 April 1990 (KOSGEB 2011). Due to the increased economic value creation and employment potential of non-manufacturing sector, and the demand for SMEs other than in the manufacturing sector, KOSGEB needed to target all expanding SMEs.

KOSGEB (2019), corporate mission is stated as; "By enabling SMEs and entrepreneurs enabled to reach to a competitive, technological, and innovative structure with effective support and services, to increase their share in economic and social development.", while its vision is stated as "Stronger SMEs, developing economy with KOSGEB".

There are a variety of marketing tools and methods to help companies become global, compete fiercely in the international market, and succeed in the environment; one of the most important of these vehicles is participation in an international trade cooperation (Aycı 2011). In addition to opening support programs for fair participations, KOSGEB is a member of international organizations with activities and collaborations related to SME activities in order to gain a place in international competition. KOSGEB participates to the SME related activities of following international organizations of which Turkey is a member: Organisation for Economic Development and Cooperation (OECD), United Nations (UN), Developing-8 (D-8), Economic Cooperation Organization (ECO), Organization of Islamic Cooperation (OIC), Conference on Interaction, and Confidence Building Measures in Asia (CICA) The Black Sea Economic Cooperation (BSEC) (KOSGEB 2011).

According to the KOSGEB 2020 Annual Report, the supports offered in the context of service are as follows (KOSGEB 2020):

- R&D and Innovation Support Program;

“To SMEs and entrepreneurs approved by KOSGEB boards; for rent, machinery-equipment, hardware, raw materials, software and service procurement, consultancy, training, promotion, abroad congress, conference, fair visit and technological cooperation visit, test-analysis and certification, industrial and intellectual property rights registration, initial capital expenses and personnel working on the project, a total of 750,000 TL (upper limit) support, of which 300,000 TL is reimbursed is given.”

- International Incubation Center and Accelerator Support Program;

“The purpose of this program; products of technological R&D and innovation activities carried out in our country to take place in international markets, increasing exports, to support the establishment of a international incubator center for domestic technology intensive businesses to take part in advanced entrepreneurship ecosystems. Support upper limit; $100,000 in Foundation and Hardware Support, within the scope of Operational Expenses Support upper limit is 3,750,000 USD. The support rate is 80% in the 1st and 2nd years, and 60% in the 3rd, 4th and 5th years.”

- SME Technological Product Investment Support Program;

“With this program; it is aimed to support the investments to be made by enterprises in order to ensure the production and commercialization of products that arise as a result of R&D/innovation activities or that are located in the medium- high and high technology field and will contribute to the current account. Within the scope of the program; the upper limit of the support to be given in low and medium low technology areas in order to ensure the production and commercialization of the products resulting from R&D/innovation activities is 1,000,000 TL with and 300,000 TL without reimbursement. The upper limit of the support to be given in medium-high and high-tech areas is 6,000,000 TL, including 4,200,000 TL with and 1,800,000 TL without reimbursement.”

- Foreign Market Support Program;

“With this program; to develop and open up the technology and capabilities of SMEs to overseas markets, increase their share in overseas markets, convert SMEs into international competitors, increase the number of SMEs that start exporting, and increase the number of SMEs to start e-commerce is intended." The total upper limit of the support to be given within the scope of the program, 70% non-refundable and 30% reimbursement for all expenses other than personnel

expenses is TL 300,000. The duration of the project is at least 8 months, maximum 24 months.

2.2. STUDIES IN TURKEY

Research on digital technologies has accelerated in recent years as these technologies become the necessities of digital transformation of any organization. Reviewing the studies conducted since 2011, it has been determined that most are conceptual. When the literature on big data and digitalization of companies is examined, it has been determined that the rate of conceptual studies is higher than conceptual studies for other technologies. Studies aiming to measure the level of perception of technologies by users and trying to reveal the integration levels of technologies in companies have been observed to be very few compared to conceptual studies. Although qualitative and quantitative studies on banking, agriculture and logistics have been carried out, a review has not been conducted on all Industry 4.0 technologies of companies operating in the IT sector. More empirical studies have been conducted on cloud computing technology compared to other technologies. Moreover, blockchain and digital twin topics are less studied compared to the internet of things and cloud computing technologies. The reason why the literature on artificial intelligence studies is not included in this section is that the studies are concentrated in the fields of engineering and psychology, and no significant studies have been carried out in the social sciences. A literature review for technologies is given in Table 1, 2, 3, 4, 5, and 6; the aim, methodology, sample and result of the studies are summarized.

Table 1: Studies about Big Data

Studies on Big Data		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Arslantekin and Doğan (2016)	To be able to reveal the relationships of big data with the next generation of technologies by conceptually explaining the big data that institutions and organizations interested in technology have been interested in recent years.	Big data is bringing about great changes not only in technology, but also in the way we think, perceive, and study. It has been concluded that institutions, organizations and individuals cannot be excluded from these changes.

Continuation of Table 1

Author	Purpose of Study	Conclusion
Altunışık (2015)	To explain what is the big data phenomenon, what are the current application results, what is needed to successfully implement big data, and the problems and identity of big data conceptually.	Research has concluded that a two-step program needs to be implemented to see the benefits of using big data more quickly. The first step in these steps is to take advantage and convenience of new technologies and analytics, and the second step is to redesign the workflow to effectively implement change management.
Atalay and Çelik (2017)	The use of artificial intelligence and machine learning methods in big data analytics are discussed and some examples of applications of these methods are provided, particularly in clustering, classification, neural networks, text mining and web search, idea mining, and sentiment analysis.	It is concluded that big data provides businesses with far more intelligence and foresight from artificial neural networks processing through deep learning, natural language processing, image recognition, and direct personalization techniques.
Çakırel (2016)	It expresses the theoretical definition of big data and briefly expresses what companies can expect from big data.	It is stated that the era of big data, companies not only gave up because of the amount of data, but also asked management questions, clearly stated their goals, and explained what success was.
Eyüpoğlu et al. (2017)	To address big data sources, need of big data tools to protect systems, and the difficulty of keeping them secure.	The proliferation of different types of data, such as media sharing and social networks, creates privacy-related issues.
Argan and Demirtaş (2015)	To define the concept of big data and describes applications and management in marketing research.	Big data from a variety of industries, including retail, healthcare, government, energy, and information technology, is analyzed. They argue that companies need to prepare for changing and enriching market competition through the use of big data.

Continuation of Table 1

Author	Purpose of Study	Conclusion
Aktan (2018)	He described the big data phenomenon in its components and sources, focusing on the benefits of big data in several application areas. We also investigated the big data analysis process and the operation of the Hadoop software architecture, the benefits of big data and the resulting security issues.	He suggests that technically, identification needs to be implemented in access control such as big data tools, authentication, authorization, and access registration.
Bayrakçı (2015)	He explained big data using the latest statistical analysis methods and research methods in the social sciences, and consider the use of big data in academic research.	Big data analysis methods have been found to be compatible with current statistical methods and similar to the social science research process.
Işıklı (2014)	Big data from a technical approach is claimed to be more than just Google experts, statisticians, and economists. It is said that it should be reconsidered to gain a new understanding of the general humanities with a philosophical approach.	He came to the conclusion that we need to prepare ourselves for the advantages of digital computational thinking based on big data, including data, digital culture and digital information.
Özbilgin (2015)	To define big data, explain how it is stored, and detailed case studies	He proposes to increase the use of big data and explain the importance and usefulness of big data to public sector managers by taking samples in Turkey.
Altındiş and Morkoç (2018)	It provides information on today's key concepts of big data and health care big data and health care applications.	They found that big data technology can eliminate, understand, classify, learn, predict results, and model large amounts of data generated in the healthcare sector.
Altun et al. (2017)	To discuss Turkey's current situation with the public sector on public policy and explore possible uses of big data in Turkey.	They found that big data could be processed by internal and external audits. Transparency and public accountability on effectiveness issues increase sector opportunities.

Continuation of Table 1

Author	Purpose of Study	Conclusion
Gökalp et al. (2018)	To define big data and data science and explore the current situation and challenges companies face in integrating data science into their businesses.	They identify and understand data sources to use the data collected from these sources, especially necessary for companies that do not use big data in that sector, in order to improve their competitive advantage in future sectors.
Orka (2017)	The purpose of this study is to identify the areas of application of cloud computing and big data technologies in the public and private sectors and their impact on Turkey's customer relationship management and marketing strategies. **Sample Size**: 13 **Data Collection Tool**: In-depth interview	In our country, it is quite difficult to apply international standards in the field of big data. Most of the research is done by foreign international companies in our country. From the information obtained and the feedback of private sector officials, it can be seen that our country is following these technologies, slightly behind the rest of the world.
Quantitative Studies		
Aslan and Özerhan (2017)	To highlight the impact of big data on the accounting industry over the next 10 years. **Sample Size**: 740 **Data Collection Tool:** Survey	As a result, professional accountants benefit from using big data in financial reporting, manufacturing, auditing processes, internal control and audit issues, risk identification, decision making, planning, and costing over the next decade.
Ayvaz and Salman (2020)	To determine the maturity of the use of Big Data technology in companies operating in Turkey. **Sample Size**: 101 **Data Collection Tool**: Survey	In the companies surveyed in Turkey, it is observed the emergence of big data visualization tools and the widespread use of scripting languages (Raguseo, 2018). Natural language processing (NLP) software, social network analysis software, and predictive analytics software are the least suitable for big data technology. It also states that companies can use big data strategies while determining that different types of data may be needed.

Table 2: Studies about Digitalization

Studies on Digitalization		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Türker (2018)	In reaction to the digital world, describing the advances and studies that are shaping the worldwide accounting profession to meet the demands of the global corporate world.	He suggests that financial institutions, policy makers, regulatory agencies, mmunity should be informed on the and the business coprofession of accountants and how their members are being rebuilt.
Bakırtaş and Ustaömer (2019)	A discussion of the digitization process in the Turkish banking sector and a survey of investment in this area and the utilization of digital banking in light of the current situation.	By looking at the number of branches and employees, it is found that they tended to decline gradually from 2014 to 2018. It is also said that in recent years, concepts such as artificial intelligence and cloud computing have permeated the banking sector.
Balcı (2020)	To find out if international logistics reflects digital trends such as blockchain technology, artificial intelligence, and smart robots.	We conclude that within the general structure of the sector that embraces the existence of technology, blockchain has identified the benefits of proper evolution. She also said that the biggest threat to the long-term presence of the logistics industry is not acting according to digital systems and the trends that accompany them.
Avaner and Fedai (2017)	Discussing the decision-making process and thus the impact of medical information systems on medical services and investments.	They argued that by organizing states and their employees across the country to collect network data for private sector hospitals, investment in private insurance and testing services increased. It is also said that these studies led to the establishment of information systems and the exchange of data with the private sector.

Continuation of Table 2

Author	Purpose of Study	Conclusion
Değirmencioğlu (2016)	A discussion of the innovation journalism approach and the method of digital reporting using the process of digital transformation in the media sector.	He pointed out that journalism today has evolved into a structure that helps citizens create and share content on social networks such as Facebook and Twitter with the help of communication technology development.
Yardımcıoğlu et al. (2019)	To address the impact of Industry 4.0 on the future of the audit profession.	They came to the conclusion that the forecasts show that in addition to the traditional accounting recording function, it will be useful in the areas of auditing and consulting.
Demirci (2018)	It discusses digital medical technology used by today's medical services and medical users and expected to be used in the next few years, and its applications, advantages, disadvantages, and the current state of Turkey.	It is stated that thanks to digital technologies and applications in health care, there is a shift from a traditional approach to health to a more personalized approach to health.
Denizhan and Özkanl (2020)	Investigating the current state of Turkish ports on the digitization and technology of the five largest ports. They also analyzed the digitization process at European ports, using the examples of Hanover and Rotterdam ports.	Research has shown that Turkish ports still have a long way to go in terms of digitalization, but they are not too late to connect. They suggested checking the current status of the port before starting digitization. Then required conversion can begin.
Balık et al. (2019)	To determine which port needs more digitization in the selected news.	It is understood that ports operating in Turkey do not fully integrate digitalization into the agenda. On the other hand, it cannot be said that digital transformation is not on their agenda. At the moment, the main gateways are Akdeniz Gateway, Asyaport, DP World and MIP.

Continuation of Table 2

Quantitative Studies		
Author	**Purpose of Study**	**Conclusion**
Koç and Albayrak (2015)	To improve the scale to determine the degree of academic digitization. **Sample Size**: 342 **Data Collection Tool**: Survey	It shows that there are significant differences by title in terms of the level of technology use and the overall level of digitalisation in social life. In addition, the GPA is considered high because academics working in the sciences use technology more intensively and thus achieve significantly higher rates than academics working in the fields of science, technical and social studies.
Adiloğlu and Güngör (2019)	To obtain a understanding of how digitalization is affecting auditing tools and processes. **Sample Size**: 235 **Data Collection Tool:** Survey	The essential investments in these areas have yet to be made by audit companies. According to reports, 90% of audit firms do not offer these services and do not invest in infrastructure or employees. Tax audits are the primary emphasis of these accounting businesses.

Table 3: Studies about Internet of Things (IoT)

Studies on Internet of Things (IoT)		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Gülşen (2019)	To take a broader look at the Internet of Things (IoT) in the retail industry.	He pointed out that analyzing the potential and benefits of IoT-based applications opens up enormous opportunities for both retailers and consumers. Due to the lack of widespread use of IoT technology in Turkey, we have not reached the data to lay the groundwork for quantitative research.

Continuation of Table 3

Author	Purpose of Study	Conclusion
Altınpulluk (2018)	To explain what the Internet of Things is and the history of it. After the explanation, he dealt technology in a traditional educational process.	Training conducted in a traditional classroom provides some sample applications related to the use of IoT technology in open and distance learning systems. Recently, he said, innovative trends like the IoT pave the way for an educational revolution.
Ergin and Erturan (2017)	Examine the transformation of auditing, the role of the auditor in future business ventures, and the application of the Internet of Things concept to the audit inventory cycle.	They compared the traditional audit approach with the IoT audit approach and provided related examples. Ultimately, they conclude that IoT will change the inventory needed for production, monitor the production line, put it up for sale, and make information available to customers on the Internet.
Akyüz and Gündüz (2017)	They provided detailed information about the Internet of Things (IOT) and its use. They also mentioned information about applications in the veterinary sector and the location and importance of the Internet of Things in intelligent livestock.	At the end of their research, they discovered that IoT could be used to improve the rapid response of technical staff to possible animal health problems in both barn and farm environments and provide more accurate diagnosis.
Özdemir et al. (2018)	They examined 50 magazine articles. They took into account the trust in the Internet of Things, the use of the Internet of Things in different areas, and how the Internet of Things has transformed existing technology.	They noted that their work will lead other scientists who want to work on the subject. It also explains the governance of IoT and how difficult or impossible to control it.
Büyükkalaycı and Karaca (2019)	Concepts are explained by reviewing the existing literature on the relationship between Marketing 4.0 and the Internet of Things.	According to the findings of the survey, IoT is one of the most significant technologies for gaining a competitive advantage in the Marketing 4.0 competition and retaining existing consumers while attracting new clients.

Continuation of Table 3

Author	Purpose of Study	Conclusion
Ercan and Kutay (2016)	To review IoT adaptation studies in industrial production and discuss its positive contributions in various application examples such as automated storage, preventive maintenance, underground mining land, smart environment system.	They conclude that IoT improves quality, reduces costs, and has many positive impacts on energy efficiency, performance, competitive products, and problems.
Göçoğlu (2020)	In the context of the Internet of Things, examine the digital revolution seen in the delivery of public services based on administrative discipline.	He categorized sectors such as environment, security, and transportation to see the field of applications and the degree of Internet of Things usage. At the end of his research, he discovered that scientific research on the IoT was needed to better understand the IoT and better meet public needs.
Klein and Meydanoğlu (2016)	Defining the possible contribution of Internet of Things technology to a company's marketing activities.	Research has shown that it is possible to improve personalized marketing, increase CTR, provide immediate feedback to improve products and services, and increase customer value by claiming customer value.
Doyduk and Tiftik (2017)	To create a general description of the Internet of Things, then analyzing the concepts in terms of business opportunities, productivity, and profitability prospects.	Research has come to the conclusion that with the help of the Internet of Things, companies can develop strategies in a more accurate, realistic and goal-oriented way. It is argued that the new industry understanding of Industry 4.0 will bring the Internet of Things to enterprises with speed, flexibility, efficiency, value and performance.
Quantitative Studies		

Continuation of Table 3

Author	Purpose of Study	Conclusion
Topaloğlu et al. (2019)	To evaluate college students' perspectives on the concept of the Internet of Things. **Sample Size**: 286 **Data Collection Tool**: Survey	According to the scale results, the sections read by the participants make a big difference in terms of the elements of smart home management systems and smart to mobile technology. It is founde that there are not significant differences between the gender factors of the study participants.
Kağnıcıoğlu and Çolak (2019)	To explain consumer behavioral intent towards future adoption of Internet of Things (IoT) technology. **Sample Size**: 377 **Data Collection Tool**: Survey	As technology matures, the overall benefit or effort of consumer expectations will be directed towards the expected joy and entertainment. Consumers who are tech-savvy at a high level are less afraid and have more joy when interacting with new technologies. We believe that the ease of use will improve as we gain more control over IoT technology. This makes consumers feel safer and more relaxed when using these technologies.
Sedefçi (2018)	To examine the impact of smart devices and the technologies they use to facilitate the customer experience using the Internet of Things infrastructure. **Sample Size**: 523 **Data Collection Tool**: Survey	People of different generations share a common understanding of digital transformation adoption and positive customer experiences while having different goals and mindsets when using these intelligent machines. They have positioned smart products at different points in their mind. The direct positions bear traces of the characteristics of each person's generation.

Table 4: Studies about Industry 4.0

Studies on Industry 4.0		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Ergin and Erturan (2018)	Studying the impact of Industry 4.0 on changing economic activity in the accounting profession	They concluded that not only accounting, but all sectors would be affected by the Industrial Revolution. Robots have replaced muscle strength, and humans have been told that they need to be prepared for this change. Finally, they explained that future managers need to be informed about these changes and have a better understanding of management for them.
Yıldız (2018)	A discussion of the general structure of a digital supply chain that makes a company's supply chain activities easier and more efficient. He conducted general literature reviews, conversions from traditional supply chains to digital supply chains, and digital supply chain characteristics.	At the end of his research, he concluded that digital transformation allows companies to reduce costs by bringing their relationships with customers online, to see competition more transparent, quickly penetrate new markets with the help of ease of investigation.
Aydın (2018)	Analysis of the relationship between Turkey's technological progress and employment structure by the ARDL method from 1981 to 2015. An analysis of Turkey's employment structure, using data on R & D spending and telecommunications technology exports to represent technological progress and using employment data for college graduates.	It was found that technological advances in the country were shifting the demand for work in higher education. In other words, it has been observed that graduate employment is increasing with the advancement of Turkish technology.

Continuation of Table 4

Author	Purpose of Study	Conclusion
Zorlu et al. (2018)	Investigate the impact of new manufacturing processes on stock management methods.	At the end of their research, they came to the conclusion that Industry 4.0 created manufacturing possibilities that were previously unavailable. Therefore, inventory management methods are changing accordingly.
Rasgen and Gönen (2019)	A discussion of production, packaging, and transfer simulation for companies that offer Industry 4.0 integration.	They have produced a report showing that the job description has changed and the need for intellectual skills in the accounting department of a company has increased. The process is claimed to be held by the computer regardless of the number of transactions.
Özdemir and Özgüner (2018)	To take a closer look at the Industry 4.0 revolution and show the innovation will bring to the logistics industry.	It is concluded that by making the risks they might face in logistics processes visible, real-time material flows could be tracked and transition planning could be possible.
Atik and Ünlü (2018)	An analysis of 28 EU countries and Turkey to determine Turkey's relative Industry 4.0 performance compared to EU countries. To achieve this, they conducted factor and cluster analysis on 28 EU countries and Turkey using 10 Industry 4.0 indicators.	They found that countries with similar economic conditions and levels of development were grouped into the same cluster. Turkey belongs to the same cluster as Hungary, Latvia and Poland and is listed as a poorly performing country in the transition to Industry 4.0. Finally, they made some recommendations on the transformation process in Turkey.
Tekin and Karakuş (2018)	Discussing which technology uses in Industry 4.0 applications are based on companies in the sports industry, and which new and different products can be developed.	They observed that buyers of all sports products, especially fans, pay close attention to applications that use industry technologies such as smart shoes and wearable nanotechnology.

Continuation of Table 4

Author	Purpose of Study	Conclusion
Akçacı and Bulut (2017)	To examine the Fourth Industrial Revolution by its basic concepts. They also discussed the transition of the Turkish economy to Industry 4.0 in terms of R&D and communication indicators.	They found that technology utilization seems to be very high in Turkey, but especially households. On the other hand, it can be said that public and private companies usually do not use the Internet to enter new markets.
Öztürk and Koç (2018)	Discussing the furniture industry's approach to Industry 4.0, the impact Industry 4.0 will have on the furniture industry, and evaluate the transformation and transformation process.	It is mentioned that new technological trends such as smart manufacturing plants, artificial intelligence and 3D printers are important to remain competitive in Turkey and around the world.
Mil and Dirican (2018)	To explain existing concepts for new concepts and try to understand the financial impact of future technologies such as robotics, automation, multidimensional printers and virtual reality on the finances of tourism companies and the tourism industry.	At the end of their research, it is specified that this subject is new to both the academy and the industry, but there are not many quantitative studies and statistics on this subject. However, they found that Industry 4.0 technology enabled 10% GDP growth, a $ 20 billion contribution to BIST.
Gabaçlı and Uzunöz (2017)	To explore the evolution of Industry 4.0, the factors leading to Industry 4.0, and the projected impact of the revolution on the automotive sector.	They found that Turkey was ranked between industry 2.0 and industry 3.0, and that the automotive industry was highly valued in terms of technological change compared to most sectors. They also suggested that automation could be a pioneer in a revolutionary journey to Turkey's Industry 4.0.
Yüksel and Şener (2017)	To show the effects of Industry 4.0 at organizational level. **Sample Size**: 13 **Data Collection Tool**: In-depth Interview	Although the full transition to the Fourth Industrial Revolution has not yet taken place, some industries and companies are informing themselves about Industry 4.0 through conferences and international visits.

Continuation of Table 4

Author	Purpose of Study	Conclusion
Yosumaz and Özkara (2019)	To establish an example for other garment companies by describing how digitalization initiatives in the labor-intensive garment sector have progressed and been implemented, aided by the Industry 4.0 process. **Data Collection Tool:** In-depth interview	Using the results of data analysis, it is observed that data from machines, especially employees, , vertical integration, and data generation operations is being performed. In connection with this, information such as employee performance, capacity information, machine failure information, heat, vibration, technical information and machine availability is obtained which reduce error rates and improves work quality.
Yaşar et al. (2017)	To determine if Turkish manufacturers are aware of the concepts and benefits of Industry 4.0, the technologies they are using, how they affect productivity and cost, and the challenges they face when deploying. **Sample Size**: 33 **Data Collection Tool**: In-depth interview	The results show that companies are aware of the challenges of Industry 4.0, but 42% of the companies are not yet ready for these technologies. Among them, autonomous robots, and real-time performance management applications were preferred. The biggest challenge is the lack of qualified employees to properly understand Industry 4.0 technology.
Quantitative Studies		
Öztemel and Gürsev (2018)	To understand how industry actors perceive the impact of the 4th Transformation and the world of logistics. **Sample Size**: 90 **Data Colleciton Tool**: Survey	It was found that the Industry 4.0 approach was not properly perceived and certain technological components caused negative opinions. Most companies are SME and their investment in new technology has not been enough to gain a cost advantage.
Torun and Cengiz (2019)	To identify F.E.A.S. Student perspectives on Industry 4.0 as part of a technology acceptance model. **Sample Size**: 462 **Data Collection Tool**: Survey	Perceived ease of use has a positive and direct influence on perceived benefit, perceived benefit has a positive and direct effect on intention to use, and intended use has a positive and direct effect on customer behavior. As a result, a greater number of university students are familiar with Industry 4.0.

Continuation of Table 4

Author	Purpose of Study	Conclusion
Kamber and Bolatan (2019)	To determine whether manufacturing companies in Turkey are familiar with Industry 4.0 concepts, what is the use of information systems within the operational framework, the depth of data analysis, etc. customer, etc. **Sample Size**: 202 **Data Collection Tool**: Survey	The results show that most companies are familiar with Industry 4.0. In addition, it can be said that there is no difference in the intensity of technology use in the process of product and service design to production, here there is a difference in the intensity of information system usage in different fields as planning, production, estimation and supply chain.
Ersöz et al. (2018)	Measuring company awareness of Industry 4.0 in Turkey. The goal of the study was to see how targeted Industry 4.0 policies of institutions and educational programs differed depending on the demographics of various Turkish business operators. **Sample Size**: 32 **Data Collection Tool**: Survey	Research shows that perceptions of Industry 4.0 vary across sectors. In addition, the perceived level of companies is affected by their partnerships abroad. Research shows that the company is entering mid-level Industry 4.0 jobs, such as autonomous robotics, cloud computing, simulation and data science. Finally, they mention that Industry 4.0 knowledge varies by employee education level.
Akgül et al. (2018)	Investigating students' perceptions of the pros and cons of Industry 4.0. Sample Size: 307 Data Collection Tool: Survey	Research shows that engineering students have more knowledge about Industry 4.0 than social science students. In addition, the technologies most known to students vary according to their level of study. While engineering students gain more knowledge about the Internet of Things and simulation, the technologies social science students are most familiar with are big data and cloud computing. In addition, as the level of students' understanding of Industry 4.0 technologies increases, their belief in the benefits of these technologies increases.

Continuation of Table 4

Author	Purpose of Study	Conclusion
Atak (2018)	To examine the factors such as factors that encourage the development of Industry 4.0 technology, difficulties encountered, adoption strategies, organizational structure and skills of the workforce. **Sample Size**: 231 **Data Collection Tool**: Survey	Research shows that there is a significant difference in perceptions of Industry 4.0 with respect to the role of technology parks and support for the company's position in Industry 4.0 development. The averages of companies where their positions are leader and follower are higher than others (Atak 2018). In addition, it has also been found that there is a positive relationship between the level of achievement of business expectations and the skills and products of employees, workforce services and infrastructure for Industry 4.0.

Table 5: Studies about Cloud Computing

Studies on Cloud Computing		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Seyrek (2011)	Discussion on cloud computing development and related technologies of cloud computing. It also discusses cloud computing applications and their benefits in terms of flexibility, cost, and quality of service.	At the end of the research, it is suggested that instead of owning this type of technology, especially small businesses could save money by outsourcing them and paying third parties for utilization. In addition, another proposal was made for large enterprises that would give cloud computing the importance needed to maintain rivalry.
Elitaş and Özdemir (2014)	To draw attention to the main goal of companies in today's business world, to create and manage accounting systems at a low cost and with advanced technological means in one structure.	In his research, different types of cloud services are examined, models of cloud computing in terms of the risks it poses, and their reflections on the accounting transformation.

Continuation of Table 5

Author	Purpose of Study	Conclusion
Sarıtaş and Üner (2013)	To explore how to use the potential of the complementary cloud for different learning activities such as active learning, collaborative learning, and mobile learning. In addition, they tested its integration in education by giving several cases to explain.	They conclude that these infrastructures, especially in the education sector, reduce the budgets required for hardware and software purchases as well as for technical installations. Because this technology allows various applications to work even through low performance computers and computer peripherals.
Baysal and Göktaş (2018)	To observe the method of digitalization of human assets management. They additionally cited cloud computing and its packages in human assets management. Number of corporations are given that the use of cloud computing inclusive of Turkcell Cloud Computing and TTNET Cloud and their futures.	Research has concluded that the use of cloud computing is needed for both individuals and businesses to overcome storage capacity issues on computers and other devices. They also said that this technology will be more important than ever as the amount of data grows in this era.
Topakçı and Ünal (2013)	Investigation of the structure of cloud computing technology and the availability of agricultural production processes.	It is said that companies in the agricultural sector were unaware of cloud computing technology and information was exchanged using traditional methods. It is also suggested that by making these technologies available to farmers, all kinds of information could be analyzed to solve the problem.
Aktepe and Saatçıoğlu (2017)	To contribute to the ever-growing cloud computing research, by researching the logistics sector in Turkey. **Sample Size**: 10 **Data Collection Tool**: In-depth interview	The results show that most companies are aware of cloud computing technology and its importance. However, some companies have no knowledge of cloud. Reasons to use cloud computing were found as continuous development of technology, cost reduction, etc. Several reasons have been found for not using cloud computing, such as privacy issues, incompatibility with legal processes.

Continuation of Table 5

Quantitative Studies		
Author	**Purpose of Study**	**Conclusion**
Cengiz and Bakırtaş (2019)	Examining whether the characteristics of companies and employees using cloud computing technology differ in terms of perceptions, behavioral intentions, and cloud usage. **Sample Size**: 411 **Data Collection Tool**: Survey	It is found that employees' perceptions of the ease of use of cloud computing differed in terms of training time in cloud computing and average time using cloud computing. In addition, the perceived usefulness of cloud computing and its use varies by industry, capital structure, and year of establishment.
Akar and Mardiyan (2016)	Analyzing elements affecting the adoption of cloud computing and making use of structural equation modeling approach to investigate the essential dimensions of the adoption. **Sample Size**:306 **Data Collection Tool**: Survey	82% of organizations report that they are saving money by choosing cloud computing services. From a security point of view, organizations don't hesitate to embrace the idea that their systems are secure in the cloud.
Okan et al. (2016)	To discover how cloud computing technology is affecting informatics in the public and private sectors and so-called electronics innovation in Turkey. **Sample Size**: 82 **Data Collection Tool**: Survey	Study has shown that organizations (public or private) feel that they do not have enough trained and experienced staff to implement cloud computing processes. In addition, both public and private sectors have higher-than-expected awareness of cloud computing.
Saygıner and Ercan (2020)	In Izmir, Turkey, to identify the benefits and problems of cloud and non-cloud adoption enterprises in the field of cloud manufacturing and services, and to provide recommendations based on their perceptions of the problem. **Sample Size**: 176 **Data Collection Tool**: Survey	The analysis has shown that service companies are more inclined to adopt cloud computing than manufacturing companies. In addition, infrastructure services as virtual computers, data storage, and processors are employed instead of software services (Enterprise Resource Planning), Customer Relationship Management, and platform services and the cloud is said to be beneficial.

Table 6: Studies about Blockchain and Digital Twin Technologies

Studies on Blockchain and Digital Twin Technologies		
Theoretical and Qualitative Studies		
Author	**Purpose of Study**	**Conclusion**
Bakan and Sekkeli (2019)	To conduct and understand through literature review from sources such as international literature, books, journals, dissertations, and internet resources to theoretically understand the benefits of blockchain technology in supply chain management.	One of the most significant advantages of blockchain technology, it is decided, is that it ensures a high level of security. Another method is simultaneous monitoring that provides good transport inspection for all parties. It should be noted that this advantage is mainly used in fields such as chemicals and electronics.
Karahan and Tüfekçi (2019)	To investigate the potential impact of blockchain technology and ledgers on the audit profession and the nature of blockchain technology.	It is said that blockchain technology allows auditors to focus on topics other than selecting samples to test. This is possible because these techniques provide concurrent and conditional validation without deleting data.
Özturan et al. (2019)	To determine the level of blockchain technology awareness and readiness of the banking sector in Turkey. **Sample Size**: 11 **Data Collection Tool**: In-depth interview	It is found that in terms of institutional readiness, large public depository banks took the top three positions out of 11 respondents. In addition, it is reported that the Turkish banking industry is starting to adopt blockchain technology.
Erol et al. (2019)	Using a list of indicators, determine the feasibility of blockchain in various industries such as logistics and supply chains, energy, finance, automotive, pharmaceuticals, and agriculture and food. **Sample Size**: 15 **Data Collection Tool**: Survey	The results show that the financial, healthcare, logistics and supply chain sectors are the most viable areas for blockchain projects. This study also found that the auto industry is the least viable industry for blockchain.

Continuation of Table 6

Yükçü and Aydın (2020)	This study addressed historical developments in the concept of digital twins and provided general information about the use of digital twins.	The cost impact of the digital twin model, hence its emergence from the cost accounting window, and its use as a cost reduction method were evaluated. This study was conducted to shed light on the lack of Turkish sources and the point of view of cost accounting.
Ceylan (2020)	To identify the concept of a digital twin and its benefits to the construction industry and the technologies required to create a digital twin.	It is mentioned that the features that BIM brings can strongly support a data modeling approach that lies on a digital twin basis.
Gürel and Özen (2020)	To analyze and compare traditional and modern audit frameworks. In addition, it isrecommended that digital dual control applications as a method that can be integrated into modern auditing.	It is said that with controlled digital twin technology, every physical can be represented by a twin, and will be able to direct national resources more efficiently.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

3.1. RESEARCH QUESTIONS AND RESEARCH PURPOSE

The technologies related to Industry 4.0 phenomenon are limited in use by technology enterprises in Turkey. Although there are many companies throughout the Turkish industry who are not yet aware of the benefits of these technologies and the fact that the companies that do not use them will be left behind in the competition, there are also other companies that have started to operate to produce these technologies and end-user companies that benefit effectively from these technologies. Consequently, the perception levels of managers' through some concepts, to reveal whether they are working on related technologies, the advantages or disadvantages they achieve, their preferences to outsource or produce in-house, the competitive power they acquire and their future plans are tried to be understood in the scope of this research. In this context, the two research questions are as follows:

Research Question 1: What is the level of digital awareness of Turkish SMEs ?

Research Question 2: What is the perception of Turkish SMEs on Industry 4.0 related technologies?

3.1.1 Research Method and Research Design

Phenomenological research design is chosen in study within the framework of qualitative research. In this type of research design, researchers move away from their own experiences, preconceived notions, and biases to understand how phenomena is simulated for interviewees; it is not something the researcher understands, it's a process called bracketing (Elkatawneh 2016). Phenomenology is a study that aims to understand the subjectivity, experiences, and perspectives of the interviewees. This is based on the fact that there are several interpretations of the

same experience and basic thoughts that make up the meaning of many of these remarks or events. This approach involves lengthy and in-depth interviews with diverse interviewees to gather information about unique personal experiences that provide a rich definition of human experience. In terms of research technique, content analysis method was chosen in the framework of qualitative research design. The data collected with in-depth interview method were examined with the NVivo 12 software program.

3.1.2 Data Collection

Semi-structured interviews were conducted with the managers of private sector companies working on the Industry 4.0 related technologies in order to understand the current situation and obtain information through the concepts and technologies that emerged in the literature review of the study. Interview questions (Appendix) are prepared to the perception levels of managers' through some concepts, to reveal whether they are working on related technologies, the advantages or disadvantages they achieve, their preferences to outsource or produce in-house, the competitive power they acquire and their future plans are tried to be understood in the scope of this research. A total of 20 interviewees were asked 15 open-ended questions to try to identify overlapping or divergent ideas around the same phenomenon. All 20 interviewees were interviewed online, and their answers were recorded both by recording the interview on the computer and by note-taking technique. While creating the interview questions, the relevant field was reviewed in detail and expert opinion was sought. Interview questions were evaluated by two academicians who are experts in their fields. Afterwards, the purpose of the interview and the purpose for which the results will be used were included in the introduction part of the interview form, which was finalized by rearranging. The interviews were made on online communication platforms by making an appointment via telephone or e-mail in advance, lasted an average of 40 minutes. Table 7 provides demographic information for the 20 interviewees in the study. All 20 interviewees are the managers of the companies and are in a position to have a full knowledge of the entire activity of the company, not only with certain departments. In addition, the sector information of the companies and whether they are the manufacturer or user of such technologies are given.

Table 7: Company-Interviewee Information

Company Information			**Interviewee Information**		
Company	Industry	Producer/User	Occupation	Age	Education Level
1	Informatics	Producer	Industrial Eng.	40	Master's Degree
2	Informatics	Producer	Software Eng.	26	Bachelor's Degree
3	Informatics	Producer	Industrial Eng.	36	Bachelor's Degree
4	Informatics	Producer	Computer Eng.	24	Bachelor's Degree
5	Informatics	Producer	Computer Eng.	32	Bachelor's Degree
6	Informatics	Producer	Software Eng.	34	Bachelor's Degree
7	Informatics	Producer	Computer Eng.	40	Bachelor's Degree
8	Informatics	User	Software Eng.	54	Master's Degree
9	Informatics	Producer	Computer Eng.	42	Bachelor's Degree
10	Informatics	User	Computer Eng.	30	Bachelor's Degree
11	Informatics	User	Software Eng.	56	Master's Degree
12	Informatics	Producer	Geophysics Eng.	55	PhD
13	Informatics	Producer	Computer Eng.	50	PhD
14	Informatics	User	Computer Eng.	39	Bachelor's Degree
15	Informatics	User	Computer Eng.	47	Bachelor's Degree
16	Informatics	User	Software Eng.	55	Master's Degree
17	Informatics	Both	Computer Eng.	32	Bachelor's Degree
18	Informatics	User	Computer Eng.	50	Bachelor's Degree
19	Informatics	Both	Software Eng.	40	Bachelor's Degree
20	Telecommunication	Both	Computer Eng.	48	Bachelor's Degree

20 interviews were analyzed with content analysis. According to the analysis, of 20 companies, 19 (95% of total) are from information sector, and 1 (5% of total) is

from telecommunication sector. These companies differ in terms of their positions in supply chain as well as the sectors in which they operate. 10 (50% of total) are producer of one or more of the Industry 4.0 related technologies and services, 7 (35% of total) are end-user of these applications and 3 (15% of total) are producer and user at the same time. When the information of the interviewees are examined, it is seen that all interviewees are of engineer origin, and the vast majority (17 people per 20 people) are software engineers or computer engineers. It was determined that only two of the interviewees were appointed to the manager position due to their field experience and technical competence, and the remaining 18 interviewees were the sole owners or co-founders of the companies they worked for. The interviewees' ages varies; the youngest is 24 years old and the oldest is 56 years old, while the ages of the other interviewees are among this range. The point about the age of the interviewees is that interviewees aged 40 and over are much more likely to participate in graduate education programs than interviewees under the age of 40. In fact, in the sample of the study, no interviewee under the age of 40 completed a master's or doctoral program, while 4 of the interviewees over the age of 40 were competent persons with master's degrees and two with doctorate degrees.

3.1.3 Analysis of Data

In-depth interviews are focused interactions in which the interviewer tries to find out what others know about a topic, learning and documenting what the person has been through, thinking, and feeling about the topic, and the meaning or importance of that topic (Mears 2012). The aim is to provide an atmosphere for interviewees to express and detail their opinions as possible by asking semi-structured questions. This improves the validity of the results produced, as the interviewees can be assisted to understand the questions and the interviewer can ask for clarification and seek additional answers if necessary (Coombes et al. 2009).

In the responses received from the interviewees, repeating answers are put together and the codes are provided, these codes which provide integrity of meaning are put together and the categories are created, and the themes are determined by combining related categories. The goal of qualitative content analysis is to classify a big volume of text into numerous efficient categories that reflect related meanings. It goes beyond mere word counting (Weber 1990). In addition to this method, two other methods are used. One is that the collected data is given by adhering to its

original state and quoting the answers of the interviewees directly.In this way, the reliability and validity of the originality in question is tried to be maintained. In the other method, the researcher analyzes the data using his own interpretations as well as descriptive and thematic analysis (Baltacı 2019). In one study, one, several or all of these methods can be used together.

In Table 8, most repetitive 50 words from the words with at least 3 letters are provided according to all the answers given by the interviewees. The most repeating word is "utilization". Here, the intention of "utilization" can be interpreted as the use of technology. Considering the questions posed to the interviewees; since the departments used by the technologies, the reasons for their use, the uses, the advantages and disadvantages of their use are asked, it is usual for the interviewees to be the most repeating word to benefit from these technologies. In addition, as another reason, the opposite answers given by manufacturers and consumers is the reason why the word "utilization" is the most repeated word. While the executives of the producer companies stated that they produced these technologies but did not make use of them, the companies that were the consumers of the technologies stated that they used these technologies and benefited from them in many areas. The words - software, data, cloud and follow the word "utilization".

Table 8: Word Frequencies for All Nodes in the Sample

Word	**Count**	**Weighted Percentage (%)**	**Word**	**Count**	**Weighted Percentage (%)**
utilization	65	1,51	employees	23	0,54
software	45	1,05	number	23	0,54
company	44	1,03	process	22	0,51
technologies	43	1	programs	22	0,51
data	39	0,91	participant	20	0,47
work	38	0,89	sources	20	0,47
cloud	35	0,82	artificial	19	0,44
customer	33	0,77	disadvantage	19	0,44
big	32	0,75	legal	19	0,44
think	32	0,75	need	19	0,44

Continuation of Table 8

years	32	0,75	want	19	0,44
since	31	0,72	ıot	19	0,44
open	30	0,7	old	18	0,42
companies	28	0,65	products	18	0,42
business	27	0,63	also	17	0,4
digitalization	27	0,63	cost	17	0,4
sector	27	0,63	size	17	0,4
advantage	26	0,61	develop	16	0,37
make	26	0,61	engineer	16	0,37
industry	26	0,61	technology	16	0,37
processes	25	0,58	management	15	0,35
production	24	0,56	system	15	0,35
structure	24	0,56	working	15	0,35
time	24	0,56	computer	14	0,33
computing	23	0,54	established	14	0,33

The followings are the codes, categories, and categories from the answers. The questions related to all four elements are indicated in parenthesis. Written in bold font in the hierarchy chart; Managers' Awarenes of Digitalization and Industry 4.0 Terms, Positive Features of Technologies, Negative Features of Technologies, and Statements have been determined as the themes of the study. Under these four themes; Digitalization, Industry 4.0, Advantages, Effects on Competitivenes, Reasons For Preference, Disadvantages, Problems Encountered, Opinions for Effective Use, and Reasons for Outsourcing were determined as the categories of the study. Each item under the categories constitutes the codes of the study. In line with the answers received from the interviewees, the answers that were repeated and had the same meaning with each other were gathered under certain codes. The themes of the study were formed by bringing together the semantic integrity of the categories created by the combination of these codes, and they were finalized in the diagram. Table 9 reveals this relationship between codes, categories and themes.

Table 9: Hierarchy Chart

- **Theme:** Managers' Awarenes of Digitalization and Industry 4.0 Terms (Question 4, 5)

Category: Digitalization

Codes:

- Transition from analog to digital
- Industry 3.0 related issue
- Processes carried to electronic forms
- Data processing to create strategy
- Automation
- Process integration for efficiency

Category: Industry 4.0

Codes:

- Integrated operation
- Fewer people in procsses
- Superior production
- Self-decision making
- Portable processes
- Direct data reading

- **Theme**: Positive Features of Technologies (Question 7, 9, 13)

Category: Advantages

Codes:

- Time and place flexibility
- Lowering errors
- Efficiency of production
- Flexibility to change

Category: Effects on Competitiveness

Codes:

- Shorter delivery times and respond speed
- Affordable prices
- Large serving width
- Ease of managing

Continuation of Table 9

Category: Reasons For Preference

Codes:

- Eliminating unnecessary costs
- Efficiency of production
- Data analysis
- Being automatically supported

- **Theme**: Negative Features of Technologies (Question 9, 12)

Category: Disadvantages

- Regular follow of changing trends
- Disappearance of some job positions
- Threats posed by security vulnerabilities
- Overdependence on the services

Category: Problems Encountered

- Additions on existing programs
- Staff incapabilities
- Performance differences
- Staff changes
- High cost

- **Theme**: Statements (Question 10, 11)

Category: Opinions for Effective Use

- Regular follow of updates of instruments
- Improvements on existing products
- Recording of work
- Employee empowerment

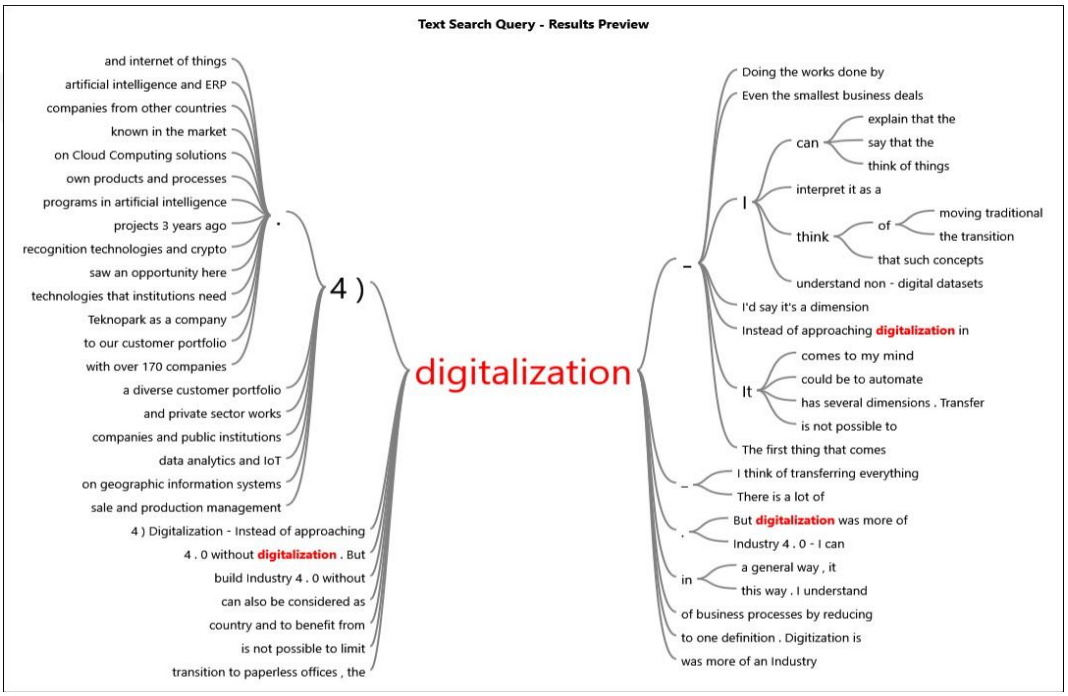
Category: Reasons for Outsourcing

- Choosing proven products
- Monitoring process
- Developments on open sources

3.1.3.1 Views on Digitalization and Industry 4.0

In the 4th question of the study, the interviewees were asked, *"What comes to your mind first when you think of digitalization?"*. The word tree was created in order to make the data more understandable and interpretable with the visualization of the data in the study. In the word tree, 'digitalization' is selected as the key word, identifying the words or groups of words that are gathered around this concept. In Figure 19, word tree for 'digitalization' can be seen.

Figure 19: Word tree for 'digitalization' in all nodes related to in-depth interviews transcripts



In the following quotations from the transcripts, the perception, and the awareness of managers on the term 'digitalization' is tried to be understood. As seen, some interviewees indicated technologies such as the Internet of Things, artificial intelligence, enterprise resource programming package programs, cloud computing solutions and data analytics with the concept of digitalization which are actually associated with Industry 4.0. Despite this confusion, 14 out of 20 (70%) respondents stated that the concepts of digitalization and Industry 4.0 are interrelated but have different meanings and serve to different purposes. "Transfer of the tasks that used to be done with certain methods or directly by hand to digital media" has been identified as one of the most repeated answers. Moreover, some of the answers are

related to ‘digitization’ term which means transition from analog to digital forms of any kind of business. Some of the exemplary answers are as follows:

Interviewee 2:

> “*Examples such as replacing the wired phones we used in offices in the past years with digital call centers and switching to paperless document systems are the subjects of digitalization. Of course, digital transformation alone is not enough for a company to use Industry 4.0 instruments in a sufficient way. It is worth noting that these concepts should be in harmony with each other, but they are distinct concepts.*”

Interviewee 4:

> *“Even the smallest business handles its business digitally instead of using old-fashioned bills. It can be defined as more automatic and systematic execution of work that used to be done more manually.”*

Interviewee 7:

> “*I perceive digitalization as a transformation in all processes of the enterprise, rather than simply switching to paperless offices or explaining the transition to e-invoice use. In planning, production, sales, and marketing, I think of a transition from analogue methods to digital alternatives. Digitalization is a transformation in which time and place constraints are eliminated, the process can be continuously monitored, and errors can be detected without realization.”*

Interviewee 8:

> *“There are several dimensions of digitalization. Almost every job that used to be executed and recorded with printed forms is now executed digitally and stored on the cloud. On the other hand, there's some things being automated. An example is that self-learning machines do some work themselves.”*

Interviewee 12:

> *“I understand the digitization of non-digital data groups and processes. This can be a simple document registration system, a change of communication or a change of method in education.”*

Interviewee 14:

> “*I think of transferring ledgers to Microsoft Excel and then to some packaged programs. Analogue work can be interpreted as managing with a little less paper and much more automated. It is to manage the process by transferring the trading side of a job, the accounting part, to the computers*.”

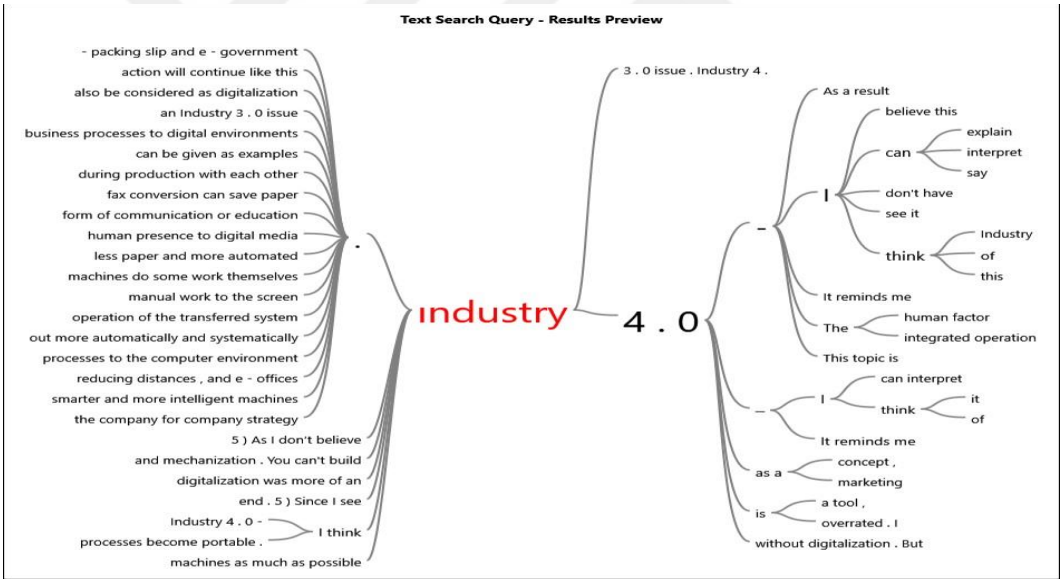
As indicated by interviewees, it can be also stated that a business cannot build an Industry 4.0 infrastructure without the needed level ol digital transformation of business processes.

Interviewee 1:

> "*It is necessary to consider digitalization and digital transformation under the name Industry 3.0 and evaluate it during that period. I do not find it meaningful and correct to commemorate the digitalization that brings with its robotics in autonomous processes and production together with Industry 4.0. However, I should mention that it is not possible for a company that has not realized its digital transformation to comply with Industry 4.0 and to use the technologies of this revolution."*

In the fifth question of the interview, the interviewees were asked; *"How would you describe Industry 4.0?".* A word tree was created for the answers given to the question and the keyword of the word tree was chosen as 'Industry 4.0'. In Figure 20, word tree for 'Industry 4.0' is demonstrated.

Figure 20: Word Tree for 'industry 4.0' in all nodes related to transcripts of in-depth interviews



In the following quotations from the transcripts, the perception, and the awareness of managers on the term 'Industry 4.0' is tried to be understood. Based on the analysis outputs, two distinct opinions can be mentioned on the concept. One of them is the view that considers Industry 4.0 as an industrial revolution, stated that developments such as the ability of devices to communicate with each other, the ability of smart devices to take decisions and actions without human factors by virtue of the developed software, and developing marketing tactics in this direction by

analyzing raw data and to find out customers' shopping habits and needs are the benefits of this industrial revolution.

Interviewee 3:

> *"I can think of a system where people are placed in the center and the process can be improved with artificial intelligence, which is supported by software and easier to follow. Although there is talk of unmanned factories, rather than going in this direction, I interpret this industrial revolution as the integration of technologies that can make decisions, manage certain processes without human intervention, read errors and make sense of data."*

Interviewee 4:

> *"It can be defined as the processes of autonomy in production and service and software doing business to the forefront, where the human factor is minimized. Especially with the introduction of smart robots and smart workplaces into our lives, companies had the opportunity to eliminate some problems that may arise due to the human factor. It can be interpreted as taking better service with less cost and fewer people."*

Interviewee 6:

> *"I interpret it as the transfer of software to industry, robots and autonomous systems. In addition, every company now has large amounts of raw data in its hands. This data is based on the data that you can use information about customers' purchases, information about the work the company does during the production process, information that will be used to make projections, i.e. to make future predictions. Analyzing and exploiting such data is one of the issues of Industry 4.0."*

Interviewee 8:

> *"This concept should be handled with the Internet of Things technology. It can be defined as the operation of decision-making processes in machines by directly collecting data from the devices in the industry and processing this data. In fact, it can be interpreted as preventing possible errors in the activities within the enterprise by not only taking decisions but also taking precautions. In addition, with the help of self-learning smart devices, I can specify that some processes become functioning by being automated."*

On the contrary, the other view indicates that it is not possible to talk about an industrial revolution, while it is argued that the technologies mentioned with this industrial revolution have already been developed and used for years, it is said that it is unnecessary to mention the related technologies with this revolution and cannot go beyond a sales strategy. Below some opinions are listed:

Interviewee 13:

> *"I am against separating technological developments in this way and drawing narrow boundaries by talking about a definite border such as Industry 4.0. As someone who has spent years in the industry and has been following technological developments closely for a long time, I can say that technological developments are not implemented overnight like a miracle, on the contrary, the transitions between developments are very smooth."*

Interviewee 14:

> *"I don't think it's right to consider such developments in the name of an industrial revolution. Both in Turkey and around the world, many products related to big data and IoT have been sold for millions of dollars, especially under the name Industry 4.0, although these technologies were already being developed. I consider it as a big marketing move. In my opinion, companies have made these purchases not to improve their processes, but to catch a trend and say that they are taking advantage of these technologies."*

Interviewee 15:

> *"I think that industry 4.0 and digitalization are concepts that have a lot of meaning. So much so that, the market is presented by telling more than it promises and a demand is created for it. I can interpret that technologies become portable which speed up and facilitate processes. I think Industry 4.0 is a tool, not a goal."*

Interviewee 20:

> *"I strongly oppose such concepts. I think Industry 4.0 is overrated. I interpret it as a so-called industrial revolution, in which a few big companies make up their products to sell more. It is nothing more than marketing the technologies that are already being used in the name of a revolution."*

In the fifth question of the interview, the interviewees were asked; *"Which technologies do you think are included under the concept of Industry 4.0?".* Table 10 below shows the order in which the interviewees specified the technologies. That is, the technology indicated by 1 in each line is specified first, while the last digit in the line represents the last specified technology. Internet of Things was the most cited technology first, cited by 12 out of 20 interviewees, while artificial intelligence and big data were cited only once. The Internet of Things is followed by cloud computing and big data as the second and third most frequently cited technologies. In addition, the interviewees made no mention of blockchain and digital twin technologies. Interviewee 13 and Interviewee 15 did not want to specify any

technology; they stated that the reason for this was that Industry 4.0 did not go beyond a marketing strategy and that these technologies were already developed and used without being referred to as a revolution.

Table 10: The Order In Which Technologies Are Specified

	Technologies			
Interviewees	Cloud Computing	Big Data	IoT	Artificial Intelligence
Interviewee 1	1		3	2
Interviewee 2			1	2
Interviewee 3		2	1	3
Interviewee 4	4	2	1	3
Interviewee 5			1	2
Interviewee 6		2	1	
Interviewee 7			1	
Interviewee 8	2		1	
Interviewee 9	2	3	1	4
Interviewee 10			2	1
Interviewee 11		2	1	
Interviewee 12			1	
Interviewee 13				
Interviewee 14		1	2	3
Interviewee 15				
Interviewee 16		2	1	
Interviewee 17	3	2	1	
Interviewee 18	1			
Interviewee 19	1	4	2	3
Interviewee 20	1	3	2	4

3.1.3.2 Reasons for Preference

According to the answers obtained from the interviews, it is determined that the reasons for the interviewees to prefer Industry 4.0 technologies are generally about three issues; efficiency in production, data analysis and reducing costs. In this context; the answers provided by the interviewees to the *"What are your reasons for choosing this service or services that you mentioned?"* question are as follows:

According to Interviewee 3, the main reason is to take steps to ensure that the digital infrastructure keeps up with the competition necessities in the companies they

serve and to realize the digital transformations of the companies. Unless the infrastructures of the companies are ready, the software to be used in the technologies that have entered our lives with the last industrial revolution will have no meaning. After equipping the management, production, sales, and marketing processes of companies with new generation instruments, these technologies will play a major role as the used software that will bring efficiency in production.

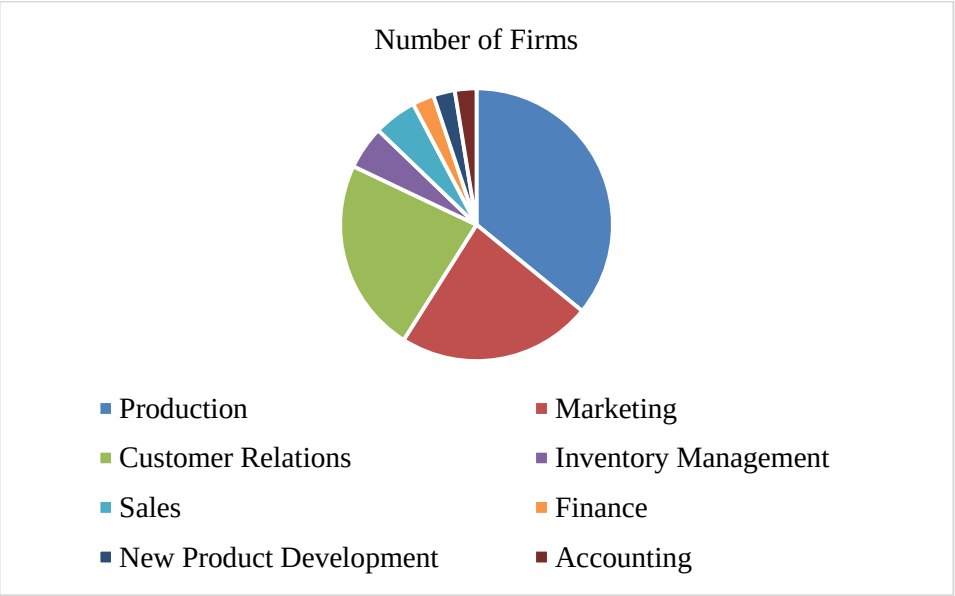
Considering today's conditions, companies should not only take decisions by considering environmental conditions and evaluating their strengths and weaknesses, but also develop accurate forecasting and projections for the future as Interviewee 14 indicates. Realizing this estimation is only possible by processing and analyzing the raw data of customers and sales figures. At this stage, it is both to make the data meaningful and to catch the trend. Interviewee 16 mentioned that by collecting historical data, they examine the data change over time. By examining the purchases made by the customers in the past, they create a roadmap for themselves by trying to understand how they can act in case of an increase, decrease or going for the alternatives in the last purchases. The interviewee stated that in addition to the return on the business of this method, companies must exceed a certain size in order to carry out data analytics, their infrastructure should be suitable for this, and the cost of analysis should be reduced by making use of economies of scale.

Interviewee 9 states that they both save on labor costs and try to eliminate errors that can occur with human work. At a critical point in the process, another employee is needed to control the work of the person in a key position. In fact, there may even be a third employee assigned to control these two employees, depending on the degree of complexity of the task. Therefore, they strive to reduce their costs by reducing the human factor as much as possible and transferring the work to be done, the decisions to be made and the control of the work done to the machines. According to Interviewee 20, cloud computing technology is preferred because of its low-cost advantage. All archives, e-invoices, user information, and business process storage are stored in the cloud at once, instead of being protected by paying for each separate server. In this way, both the whole copy is kept together, and any possible storage problems are constantly monitored by the cloud computing server, so the company does not deal with an extra cost for the solution of these problems.

3.1.3.3 The Departments Which Technologies Are Used

In the eighth question of the study, the interviewees were asked; *"In what business processes or departments are these technologies used extensively?"* , the answers given to the question were visualized by expressing them in different colors as seen in Figure 21.

Figure 21: Distribution by Percentage of Departments Benefiting from Industry 4.0 Technologies



When it is examined, the departments that benefit the most from Indusrty 4.0 technologies are; production (70%), marketing (45%) and human resources (45%) departments. Other departments are listed from the most used department to the least; inventory management (10%), sales (10%), finance (5%), new product development (5%), and accounting (5%) respectively. Interviewee 8 stated that the department where they benefit most from Industry 4.0 technologies is production. As a company, they make use of IoT solutions for issues such as keeping track of customer demand, resource management, inventory management. Interviewee 12 transferred that those big data analytics are extensively used in data transfer, data exchange and data analysis. He adds that they need data analysis most in the production stage as they try to understand customer requests from raw data, fully meeting customer expectations in manufactured products. According to the same interviewee, with the data obtained from social network, companies can also support their marketing efforts and they can increase their sales and customer satisfaction.

3.1.3.4 Advantages

The most repeated advantages of the answers given to the *"What do you think are the most important advantages and disadvantages of these technologies?"* question are; time and place flexibility and flexibility to change. The related answers are as follows:

- time and place flexibility

Interviewee 4 and Interviewee 19 stated that they benefited from this advantage especially during the pandemic period, while expressing the flexibility of time and place as an advantage, and that if they do not take advantage of these, they will not be able to do their work during the pandemic or even come to a standstill completely. Their remarks are as follows:

Interviewee 4:

> *"In fact, we have seen the biggest advantage that I can interpret for our company since the pandemic was declared. Due to the pandemic, moving away from our old working methods and doing things remotely has now become a necessity rather than an arbitrary thing. Essentially, the most basic feature of the services we use is that they are not dependent on old physical technologies. It offered us a place where the process can be managed regardless of time and place, where the work done in the shared areas and the point reached can be objectively monitored and interpreted."*

Interviewee 19:

> "*Since we are working on our own private cloud server, we have carried out our business without any interruption in our communication and data sharing with our offices in Kyrgyzstan and Azerbaijan during the pandemic period. Without this area, we would not be able to do it without disrupting the work during the pandemic."*

The other interviewees, on the other hand, stated the elimination of time and place restrictions as an advantage, while comparing them to the old-fashioned way.

Interviewee 2:

> *"We carry out the system installations in the companies we have agreed to do business with, and the malfunctions that may occur after the installation, in our own offices, without being physically present at the place where the system is installed. There are old-fashioned methods that we hear in our rival companies, and outdated methods that are still carried out by monitoring the fault lamp from a control box of the machines. Instead of constantly checking the fault lamp to see which of the five servers will break, we control the whole process through software."*

Interviewee 13:

"The elimination of place restrictions is one of the most obvious advantages I can think of. Developing technology brings some more environmentally friendly and green alternatives to our lives in many areas. I can simply give libraries or archives as examples. You can move a library of millions of libraries anywhere in the world in a tiny external memory or cloud server."

Interviewee 16:

"*Let alone the benefits of Industry 4.0 in our lives, in the past the only way to send a message or measure blood pressure was to go to the relevant institution. Many issues, such as the way we communicate, the way we do business, the way we preserve information, have changed over the years. This change made it possible to carry out the works without allocating a great time and place."*

- flexibility to change

Due to the nature of the work done by companies operating in the software sector; Non-repetitive software is developed directly depending on the customer's request and the need to use it. According to the interviewees, this necessity brings with it a flexible development process. These instruments, which can be added on and shaped into the desired shape, offer companies the chance to respond to different requests and do business. The statements are as follows:

Interviewee 3:

"*When we look at the open sources we use within the scope of digital transformation, I can state the biggest advantage of it as being suitable for change. Since we are a software company, the work we do is not standardizable. Since we realize project-based software and developments due to the nature of our business, it is a must for the resources we use to keep up with this variability. Here, open sources are scalable and can be developed on. In this way, we can respond to similar or divergent needs in companies of different scales."*

Interviewee 10:

"*Due to our field of work, we cannot do a uniform job. Since we produce solutions according to the needs of the customer, there may be differences in scale or complexity between the projects I do. In order to respond to such different requests, we prefer package programs that are suitable for working with Industry 4.0 instruments."*

3.1.3.5 Disadvantages

The most repeated disadvantages in the answers given to the *"What do you think are the most important advantages and disadvantages of these technologies?"* question are; the necessity of constantly following of the changing trends, becoming overdependent on the services used, threats posed by security vulnerabilities, and disappearance of some job positions or departments at all. Disadvantage related answers are as follows:

- regular follow of the changing trends

When the answers of the interviewees to this question are examined, it is seen that the most recurring disadvantage is 'regular follow of the changing trends'. According to the interviewees, changing trends, any updates to the package programs used or final products can be very decisive. So much so that these changes, which can even render the programs unusable, should be followed regularly, and there should be personnel in charge just for this. Related answers are as follows:

Interviewee 2:

> "*In my opinion, the biggest problem of new generation technologies is that updates are constantly coming and companies have to follow them constantly. If we miss even the slightest update to any package program that we provide from outside, the service can become unusable. To overcome this problem, sometimes we must have a staff member in charge of it only. Since old technologies are usually physical devices, for example, if we connect a 20-year-old copier today, it still works, but new generation technologies are constantly evolving and forcing the user to go through these changes."*

Interviewee 10:

> *"Since we do not have a large number of employees, it is usually up to me or my partners to follow the current developments. The cost of staying away from the agenda, even for one day, can be very high in the IT sector. Therefore, instead of taking some time out on certain days and trying to understand what happened, I spend a certain amount of time every day just to follow the world so that I can understand what competitors are working on and whether the instruments I have are still sufficient."*

Interviewee 17:

> *"The rapid change brings a serious need to follow along with its benefits. This acceleration can sometimes put companies in a panic. Of course, it should be followed, but it is also important to implement these changes within the company*

with firm steps. In this sense, speed may not always be to our advantage. Unless we apply it at the right time, it does not benefit us no matter how much we follow and catch the trend."

Interviewee 19:

"Especially recently, the speed of change and the general attitude towards moving away from the old ways as soon as possible have forced every company operating in the sector to follow its follow-up. It has become such that some days of the week we ask some of our employees to drop their jobs for a day or two and research and report on what is being developed in the world and their implications for our business."

- overdependence on the services

This code was included in the study as one of the important problems, after the interviewees stated that they became dependent on Industry 4.0 technologies during the process and that they did not even remember how to do business without these technologies. Related quotatitons are as follows:

Interviewee 11:

"*It is possible to say the disadvantages both on the basis of individuals and businesses and even countries. If we look at it on an individual basis, we take away some of the software and inputs that I had to do manually in the past, and now we optimize some of them with autonomous systems that we have developed ourselves and some that we provide from outside. There is always the risk of not being able to manage my work in case of any malfunction in the autonomous system I mentioned, because I don't even remember how these works were done without the autonomous system during the process. Although I don't want to admit it, it makes me dependent on these technological systems in a way."*

Interviewee 18:

"*When we look at it on the basis of businesses, although we got rid of our dependence on many old-fashioned things, our dependence on electricity continues and I think it always will. No matter how digital the processes become, life in most of the world will come to a standstill in case of any large-scale power outage. Where there is no internet, all the technology we have will become meaningless."*

- threats posed by security vulnerabilities

Interviewee 17, who perceives security vulnerabilities as an important disadvantage, stated that there is a security hole even in the most secure system, and that the safest system is to pull the plug. It has been tried to draw attention to this

disadvantage by considering the answers about the 'threats posed by security vulnerabilities' code. Examples are as follows:

Interviewee 11:

> *"These technologies are changing very quickly and I think no one is fully aware of the risks that this change brings. Hackers or people who know the business are always very likely to steal the information of very large companies, as there are already many examples of the theft in question."*

Interviewee 17:

> "*Since there is no such thing as a perfect system, even large-scale companies such as Tesla and SpaceX can access all kinds of information by detecting the vulnerability in the system, even if they keep the security measures at the highest level. Even the CIA, the Pentagon can be hacked in today's world. While we as people in the industry are discussing Industry 4.0 and Industry 5.0, many institutions in some Russian states have returned to the use of typewriters simply because of security holes."*

- disappearance of some job positions

This code was used to explain the opinions of the interviewees about the development of autonomous systems and decision-making mechanisms which would eliminate some lines of business. Related answers are as follows:

Interviewee 8:

> *"Today, information is produced and consumed very quickly. In the coming period, many professions will disappear with digitalization. In order to adapt people to the profession areas that will create the jobs of the future, we need to train people who can really digest and use information. Instead of evaluating our children as successful or unsuccessful in the future, we need to prepare them for life by getting really good information."*

Interviewee 14:

> *"When the industrial revolution took place 100 years ago, many people working in the fields left their jobs in the countryside and started working in factories. This transition was a result of developing technology and was inevitable. Unfortunately, there is a possibility that people who get used to their positions in the factories and learn the job during the process may lose their jobs due to the developing technologies. This is a problem not just for factory workers, but especially for middle managers, but it can affect all workgroups. With the integration of automation and robotic business processes, many business lines will disappear in the near future."*

3.1.3.6 Opinions for Effective Use

The most repeated answers given to the *"What are the decisions / things to be done by your business for the effective use of the technologies you use?"* question are; regular follow of updates of instruments and personnel empowerment. Answers are as follows:

- regular follow of updates of instruments

It has been determined that the most consensus on the things that can be done for the effective use of technologies is to ensure the continuous follow-up of the developing and changing technology. Although this method is seen as a disadvantage by some companies, the majority of the interviewees stated that it is a must for effective use. Related answers are as follows:

Interviewee 5:

> *"Maybe 10 years ago, when we developed a software and ran the system, we could respond to customers' requests for 3-5 years without making any changes or additions to it. But today, the change is so fast that we have to carry out the work with software that needs to be constantly monitored and updated. In order to maintain our effectiveness as a business, we need to do this continuously."*

Interviewee 7:

> *"A new technique is developed every year in the software industry, or a completely new technology is introduced and the use of old ones is terminated. With the advantage of being a small company, we easily add them to our structure every year and keep the system up-to-date."*

Interviewee 9:

> *"The first thing to do is to fully understand what the customer wants from us. As a project-based company, it is not possible for us to determine certain technologies and move forward. By acting in line with the wishes and problems of the customer, we need to research the technology regularly that offers the best solution and produce a product with that best solution."*

Interviewee 12:

> *"I can explain the method by which we are preferred because we do rather than what we should do. As we develop tailor-made types of work, we need to constantly learn and improve ourselves. For this reason, we continue our R&D studies to the maximum extent and keep the budget high."*

Interviewee 13:

"Since there is no package program in geomatic engineering that we trust for its reliability and acceptance in the sector, we need to develop our own processes and make our own improvements. This makes it necessary for us to carry out more R&D studies compared to companies using package programs that have proven their reliability. Although we can run the business with a few personnel for now, I foresee that we will have to establish our own R&D department in the future."

Interviewee 18:

"In our understanding, our customers are our biggest stakeholders. By listening to them constantly, understanding their changing needs and preferences, we should try to respond to these needs through new generation technologies."

- employee empowerment

The second most repeated method was determined as personnel empowerment. Company managers stated that the way to stay in the rapidly changing and expanding technology ecosystem is to keep the information of the personnel up-to-date. Examples are as follows:

Interviewee 14:

"Due to the nature of technologies, there is a need for highly qualified personnel and these personnel need to play a more active role in decision mechanisms, in my opinion. In today's competitive conditions, in the IT sector, where business is carried out according to lean production and core competencies, the engineer staff should be at the forefront of the decision stages."

Interviewee 17:

"We need to change our decision-making mechanisms. It is necessary to move away from centralized management in order to make more accurate and faster decisions about the use and integration of technology, rather than decisions about the essence of technology. The issue we are discussing should not be about using technology, but what should be done for the effective use of technology."

Interviewee 18:

"A new order should be brought, in which the hierarchy is reduced and the employees are brought to the management according to their qualifications. In today's high-hierarchical companies, decision-making processes take too long due to the superior-subordinate relationship. Bureaucracy and superior-subordinate relations should be avoided as much as possible and team leaders should be replaced by managers. Mentoring should step in instead of the classical managerial approach."

3.1.3.7 Reasons for Outsourcing

Compared to other questions, the interviewees gathered around the same answer with the highest percentage (84,6%) for *"Is the technologies you use provided by your business or do you buy from outside (from other businesses) (which brand/service)?"* question. 11 out of 13 companies that prefer outsourcing explained the reason for their preference as "preferring products that have proven themselves".

While the interviewees evaluated the development of domestic alternatives instead of the already developed software as a waste of time and cost, they also stated that there are more solutions for the problems because there is more data and documents on technologies that have reached large communities. In addition, the interviewees, who talked about some misunderstandings about open sources, especially focused on data security and sharing projects within the ecosystem. It has been reported that open source is portrayed differently in the minds as a concept, data is never shared with third parties, on the contrary, it is much more secure than many new generation package programs and has fewer security vulnerabilities. Examples of answers to the explanations are as follows:

Interviewee 1:

> *"The cost for companies to meet quality standards from the beginning to the end of the process in every job they do has increased a lot. Even for very large companies, it is impossible to cope with this cost. Therefore, it is not possible for us to develop all the technology in-house. For this reason, we benefit from the products of companies specializing in the technologies we need. It is also possible for us to develop it within our own structure, but we need to change our area of expertise and give all our focus to the relevant technology, which is not possible."*

Interviewee 2:

> *"We always use open source while developing solutions. If we consider developed open sources as the core of technology, I can interpret the products we develop as systems developed on the basis of this core. It is possible for us to develop software similar to open source, but it is not necessary. Even if we devote all our efforts and capital to developing this and succeed in a few years, technology will evolve anyway, and it will not work in our hands again. We save a lot of time and money by outsourcing instead of going through this challenge."*

Interviewee 3:

> *"We do not outsource any technology to use it in our processes. However, our use of open source is at a high level. For example, there are artificial intelligence open*

sources developed in the Google infrastructure, and we make great use of them. Thanks to the use of open source, we offer artificial intelligence and IoT solutions that are %100 our production."

Interviewee 4:

"We use both open source and some licensed products. Licensed products provide more services and are more useful in most areas compared to open sources. At points where open sources are not sufficient, we purchase licensed products by paying the fee. We do not develop it ourselves, because even if we take the time to develop it, it is not possible for us to compete with some package programs developed with years of experience, to constantly update and improve it, especially for a company of our scale."

Interviewee 7:

"We use licensed products from Microsoft and Adobe. We do this both to avoid the costs of in-house development and to use the advantages offered by these resources. One of these advantages; they are reliable sources and in no way the user's data is leaked. This assurance of security gives confidence to our customers as well as to us, because since the improvements we make are on these products, their data is safe as well as ours."

Interviewee 10:

"Especially in today's conditions, concepts such as software house and in-house developing are disappearing. Developing the whole process by the company is not a suitable choice to meet the service diversity and speed expectations of the customers. We use open sources, there are also services that we provide from outside. When open source is mentioned, of course, something in common use should not be understood. We use open sources, which have anecosystem, are preferred by as many people as possible, and have a large amount of documentation about them, so that we can both solve our problems easily and keep data safe."

Interviewee 14:

"Some package programs were purchased for business planning and salary-insurance tracking in the human resources department. Just yesterday, in a meeting we discussed the development of these in-house. These discussions are very inappropriate because it is an irrational business to develop a software that we do not have a working area and that we cannot produce and sell, even though it is on the market. In this way, we aim to better focus on our own competencies by making use of proven programs. We will not invest in our own development in the future."

Interviewee 15:

"Developing everything in-house is not among our future plans. Indeed, we do not need such an initiative. We prefer the open sources we use because they reduce the cost items at very little prices and the desired development can be made on them."

Interviewee 20:

"We make great use of Oracle and SAP. It is very important for our company to benefit from the software and investments made by such well-established companies and the work experience of people. As a company, it is not possible for us to develop this software. Maybe if we allocate the next 40 years, we can achieve an equal job, and it is not even a matter of discussion to allocate such a cost and time to it while we already have it."

Interviewee 13, who is the manager of one of the seven companies that prefer neither outsourcing nor open source use, remarked that there is no known and reliable open source or licensed product for their field of study (geomatic engineering) as one of the reasons for not choosing it. Interviewee 5 stated that due to the nature of their business, they do not need any third party products as they develop the software entirely by themselves. Interviewee 19, on the other hand, stated that the cost of developing in-house is lower when compared to the cost of purchasing from outside. He stated that in addition to the cost advantage, they were able to produce a product that was superior to licensed products in meeting customer needs.

3.1.3.8 Problems Encountered

The 12th question of the study was,*"What are the most important problems that are encountered with these technologies? What are the measures and solution suggestions that have been taken to overcome the problems encountered in these matters?*, the most repetitive ones in the answers given to the question has been detected as additions on existing programs and staff incapabilities. The answers are given under the headings of the associated codes.

- additions on existing programs

This code was included in the study as 6 (almost half) of 13 companies that preferred outsourcing stated this problem. The code of 'additions on existing programs', which is stated as the most repetitive problem, was determined because the interwiewees found the open sources they used insufficient in some stages of the software development process, and they had to make their own developments. In

addition, the interviewees reported that they were compelled to use other programs when their own development was not sufficient. Examples are as follows:

Interviewee 5:

> *"Every company's security protocol is different. When companies demand something completely different regarding security protocols or the product itself, it may be necessary to develop from scratch."*

Interviewee 7:

> *"The resources we get from outside in software may not always be the exact solution. A software that works very effectively and is used by many companies in the sector can conflict with a part of our system and prevent integration. Of course, this also applies to the software we have developed and to other companies. For such cases, we need software that will allow us to foresee the problem and save us from trying over and over again."*

Interviewee 11:

> *"The enterprise resource planning program we used was inadequate for documentation and rapid interdepartmental transmission of data. We could also do it on the program, but it was not transmitted in the time and quality we wanted. When we realized that this was a serious problem that needed to be solved, we purchased additional documentation programs to integrate them into the system."*

Interviewee 12:

> *"As projects become more complex, it becomes difficult both for the client to describe the desired job and for the predictability of the entire process. Since the detection of problems that we may encounter in the process depends on the constraints and bottlenecks, we need additional programs to detect problems in advance for the proper management of such projects."*

Interviewee 14:

> *"Sometimes even licensed products cannot meet the requirements of the desired project, and it is inevitable to experience similar situations with open sources. In such cases, we need to take the initiative and make our own improvements."*

Interviewee 15:

> *"Since they are open source free applications, we cannot expect any improvements or feedback from their creators. At the stages where they are insufficient, it is necessary to completely abandon its use or make some add-ons."*

- staff incapabilities

The 'staff incapabilities' code was included in the study, as it was determined that when the interviewees evaluated the employees operating in the sector, they

were very lacking, especially compared to their colleagues from developed countries. In addition, there is another opinion which emphasizes that the new graduates that these know almost nothing about practice. Related answers are as follows:

Interviewee 1:

> *"Dependence on staff, staff losses and rotations between jobs can create huge problems. It takes time for an employee to adapt to the environment, learn the job, and our efforts to mentor him. It is difficult to find a person who is worth the effort and time in Turkey. The inadequacies of the people working in the IT sector make us dependent or even forced to some employees."*

Interviewee 9:

> *"Our biggest problem is with personnel changes. In the software industry, there is very little workforce in Turkey who can master several software languages. When you lose such valuable personnel for any reason, it is not easy to replace someone. In addition to knowing the software languages, we also need the infrastructure to understand our process developments as a company. In order to avoid this problem, we try to set up our system as modular as possible."*

Interviewee 16:

> *"I consider the biggest problem we face as keeping the qualification levels of our employees at a level that can work with the developing technology. Today, raising capital has become easier than providing competent personnel. Since the number of experts in their field is very low, expert people can change jobs very quickly and a lot. Rather than becoming dependent on these few people, we try to stay competitive with the market by training and mentoring staff."*

Interviewee 20:

> *"There is a huge shortage of qualified personnel to use and develop these technologies in our country today. Newly graduated engineering students from the university graduate with almost nothing to do with practice. This blocks the way for progress both on a company basis and on a country basis."*

3.1.3.9 Effects on Competitiveness

The 13th question of the study was; *"Do you think these technologies have an impact on the competitiveness of your business? If so, how?"*, the most repetitive answers in the answers to the question are respectively; respond speed and shorter delivery times. The answers are given by quoting under the code topic they are associated with.

- respond speed

Respond speed, which is the most repeated answer by the interviewees, is included in the study because it is stated as an important feature in order to stay in the competition, such as reading the customer's requests faster with the help of developed processes, predicting certain problems and taking quicker action than competing companies. Related answers are as follows:

Interviewee 7:

> *"Compared to competitors, we are able to respond very quickly to customers' problems and requests regarding the product. We have terminated over 450 requests in the last 2 years. When you calculate it according to the working day, we can terminate a request almost every day by the help of the technologies we use."*

Interviewee 10:

> *"Thanks to our tracking systems, we are losing almost zero time. Customers send request documents to voice their problems with the product. If a sent document will take an average of one week to be reviewed with the traditional method, we can do this in about 2 hours and give feedback. We owe this to the technology we use, because it provides us with the detection and possible solutions of many problems before we examine them."*

Interviewee 11:

> *"Since we can make sense of big data, we can foresee solutions and suggestions for customer needs and take precautions before they are reported to us. This gives us the opportunity to act proactively. While our competitors are waiting for the needs to be communicated, we have already come up with possible solutions."*

Interviewee 15:

> *"As a software company, we are able to respond to projects faster and more flexibly compared to other companies, as we work project-oriented rather than fixed product-oriented. While product-oriented companies have to act within certain limits due to the product they have developed, we have the opportunity to exceed these limits."*

- shorter delivery times

The shortest delivery times is the second most repetitive competitive advantage. This code has been included in the study, as the importance of reducing delivery times in recent years is stated repetitively, especially the reason that people's tolerance for waiting has decreased in recent years, and saving time for customers is something that very few companies can achieve. Examples are as follows:

Interviewee 1:

> "*We are now looking for speed in every area of our lives. Whether this quest is simply about the download time of the video we want to watch on the internet, whether it is the time we have to deliver the job as a company, people's tolerance for waiting has started to decrease in recent years. The software we use and the Internet of Things technology have cut in half the delivery times of our projects. Our competitive advantage is based on our speed."*

Interviewee 5:

> "*There is no second company in our field that can develop projects in our time. Our time gain is the strongest aspect of our competitiveness."*

Interviewee 9:

> *"We have always built our system on dynamism from the very beginning. Since we develop the whole system, software and final product, we are able to respond very quickly to customers' requests. If we think of our work as dough, we work in a responsive manner that allows the customer to shape the dough as they wish."*

3.1.3.10 Future Plans of Companies

Interviewee 1 stated that they aim to increase their investments in digital marketing in the coming years. It is said that it is necessary to move marketing activities to the digital environment, especially in this period, business development processes, the way we shop, and even the way we meet have changed with the pandemic entering our lives. In addition, he stated that they plan to increase the number of employees working remotely.

Interviewee 2 stated that as a growing company, the information they obtain about their customers is increasing exponentially with each passing day. Stating that the biggest problem as a company at the moment is not being able to make sense of all the collected data, the manager stated that he has an investment idea for the analysis of big data. He said that by making sense of the data, it can be predicted that they would better understand the needs and problems of the customer and act proactively. Interviewee 16 stated that they intend to integrate cloud computing technologies more into their processes. He stated that it would be possible in the near future to respond to customers' problems faster and more effectively by creating specific user groups in cloud computing. He added that they attach importance to the issue of using data that can be read directly from the cloud.

Interviewee 5 stated that they are planning a structure that is more intertwined with artificial intelligence. She remarked that they want to work on a structure that is more open to learning and that can not only store the business process but also take decisions. Interviewee 8 stated that they have an idea that some of the work they do manually can be done with certain autonomous systems, artificial intelligence that can learn and take action. Stating that it is possible to work with artificial intelligence in real terms in more physical jobs, the manager expressed that they can benefit from artificial intelligence in stages such as job planning, assigning necessary personnel to jobs and control mechanisms.

Interviewee 17 explained their investments in blockchain and crypto technologies and that a prototype of an innovative product is ready to be on the market. He stated that the government has not yet made a statement about this technology as the reason for the delay in finalizing this prototype and putting it on the market, the participant said that they will act in accordance with the regulation and supervision to be brought by the government. He added that the elimination of uncertainties here will pave the way for new products to enter the market. Also, Interviewee 14, stating that it attaches great importance to blockchain technologies, they will make an investment in this regard, since there is much more protection in an end-to-end system compared to traditional systems, since it provides data integrity not only in terms of digital money but also in terms of security. Interviewee 18 said that they plan to work on blockchain and artificial intelligence technologies. He also expressed that he has other plans to manage banking and finance data in an integrated way with machine learning.

CONCLUSION

In today's business world, although its effects are mostly seen in the information sector, the digital transformation that spreads to all sectors and the technologies that are the result of this transformation occupy the agenda of almost all companies and its importance is increasing day by day. Digitalization and Industry 4.0 phenomena, which have gained importance in Ankara as well as all over the world, constitute the working subjects of companies operating in the IT sector. It is possible for companies to gain a foothold in the sector and to gain a place in the domestic and global market by integrating these technologies into the processes of the companies and realizing their digital transformation. Here, the duty of the companies is to closely follow the ever-changing technology and to have the necessary awareness and equipment to improve their business processes. In this study, the digital awareness of SMEs operating in the IT sector in Ankara and their perceptions of Industry 4.0 related technologies have been tried to be investigated by conducting content analysis within the framework of the qualitative method with the in-depth interviews made with 20 interviewees who are either the founder, co-founder or manager of enterprises.

When the in-depth interviews were analyzed, it was observed that the majority of the interviewees were able to distinguish between the concepts of digital, digitalization and Industry 4.0, and it was concluded that digital transformation could only be achieved by understanding and incorporating new generation technologies into the processes. It has also been deduced that digitalization and Industry 4.0 are different but related concepts, and in a sense, digitalization is a prerequisite for being included in the industrial revolution. Considering the incentives provided by the actors of Turkey's national innovation system, it has been observed that these supports were found insufficient when considered together with the last increases in exchange rates. It is believed that the awareness of companies on digital transformation can be enhanced by increasing the number of model factories,

especially by strengthening the academy-industry cooperation with the incentives to be provided.

When the perception levels and comments of the interviewees towards the concept of Industry 4.0 were examined, it was observed that there were two opposing views. While one view accepted this concept as an industrial revolution and stating the profitability provided by the technologies called Industry 4.0 in issues such as time, cost and ease of management, on the other hand, it has been determined that there is a group of managers that do not believe in this concept. In this opposing view, it is argued that Industry 4.0 is interpreted as a marketing strategy, and that the software developed for years and the products that have been brought to life existed before this revolution was yet to be talked about. In this case, while not ignoring the fact that an industrial revolution is taking place, it should be stated that it did not happen overnight, and that it came to the fore with a smooth transition in the process. Companies need to benefit from these technologies, not to catch a trend, but to take concrete steps to improve their business methods and increase their competitive advantages.

When the reasons for companies to prefer technologies are examined, it is seen that the most repetitive answers are being able to work with low cost and making sense of the collected data. By monitoring the processes simultaneously, by detecting and intervening any problem that may occur more quickly, the companies get rid of the costs caused by the problem. It has been concluded that the companies attach importance to the analysis of big data, and they believe that the massive amount of raw data they have will be processed, which will benefit both production and sales. Özdemir and Özgüner (2018), who reached conclusions supporting this inference, stated that by making the risks they might face in logistics processes visible, real-time material flows could be tracked and transition planning could be possible. Additionally, Yosumaz and Özkara (2019) determined that information such as employee performance, capacity information, quality information of manufactured products, running speed, machine failure information, heat, vibration, technical information and machine availability are obtained to be analyzed to reduce error rates and improve the quality of work. It has been understood that for sales and customer relations, services such as monitoring the purchasing movements of customers, making some predictions to forecast demand, and creating possible solutions for problems that may occur with the analysis of big data.

In the past, people had to go to the related institution if they had a paperwork, to the post office if they were going to send a mail, and to the libraries if they wanted to get information about anything. It was possible to carry out these works by personally going to the building of the relevant institution and spending time and cost for this. According to the results obtained in the study, one of the most important advantages of Industry 4.0 technologies has been determined as being able to work independently from time and place. Especially with the pandemic process, this situation plays a very decisive role in the survival and business of companies, where interconnected devices continue their processes by accessing the data carried in the common clouds wherever there is internet access, communication, document sharing, software development can be done without changing the place and therefore without losing time. In addition, it has been determined that the flexibility provided by new generation technologies to companies in project development is another perceived advantage. Since "tailor made" projects developed for the needs of the customer rather than a standardized product in the software industry are implemented, it has been determined that open source softwares that can be modified and suitable for developing different products are needed.

Although the rapid change in technology benefits companies' processes and enables them to handle projects that could not be done before, the other side of the coin should not be denied that this speed complicates the work of companies in some contexts. Continuous additions and updates in the technologies used, open source or licensed products have been determined as a factor that can make companies unable to do business if not followed closely. So much so that, companies employ some of their personnel in their companies only to monitor these developments, and ensure that the services used or produced within their bodies are kept up-to-date. Another disadvantage is the possibility that the data of the companies may fall into the hands of malicious people or rival companies due to a security vulnerability that may occur even in the most secure systems. For this reason, it has been stated that certain countries of the world have returned to the use of typewriters in government institutions. At this point, government should regulate the laws regarding cybercrime and deterrent penalties and sanctions should be introduced in order to minimize data theft.

With the automation of processes and the intrustment of multiple functions to robots and software, it is predicted that medium level management in enterprises

have begun to disappear and will disappear completely in the near future. Another disadvantage identified in the study is the expectation that some business lines will disappear in the near future; this concerns managers closely. According to Bakırtaş and Ustaömer (2019), the number of branches and employees tended to decline gradually from 2014 to 2018 as concepts such as artificial intelligence and cloud computing have permeated the banking sector. Starting from the banking sector, the fact that this spread is happening in other sectors should be known, and since some blue-collar jobs that do not require intellectual knowledge are in danger of disappearing, the young population should be directed to the professions of the future, and applied courses where new software programs and package programs can be practiced should be added to the curriculums of high school and even middle school.

In order for new generation technologies to be used effectively, businesses need to integrate technologies into their processes correctly, as well as take the right steps in both the management and production. With this study, it has been understood that while continuous monitoring of technologies is seen as a disadvantage by some managers, it is actually a necessity for effective use of technologies. If the necessary updates are not made, technologies which may become unusable after a while should be followed continuously, and people with deep knowledge about the use of these technologies should be brought to decisive positions in the management of companies. An understanding that is based on lean management which is reducing the hierarchy among employees in the management has started to dominate the business world and especially the information sector. People with high technical knowledge should be in decision making process, relationships should be built on mentoring, not the traditional supervisor-subordinate relationship. Besides, instead of traditional management, managers are required to act as team leaders and act as part and director of a team, not as the final and sole decision maker. In addition, the competencies of the company's employees should be continuously increased with regular trainings, and the managers aim to increase the awareness of the employees towards technology. In this way, it may be possible to make the integration of technologies easier and faster by increasing the employees' intention to use, their attitudes towards use, their perceived ease of use and their perceived benefit.

It has been determined that the level of outsourcing of the companies is very high and the reasons for using them are generally gathered around the same reasons.

It has been concluded that the use of open sources, which have proven themselves in the market, have their own ecosystem, and have a huge amount of documentation, are thus benefited from, avoiding the cost and time loss of in-house development. It can be said that it is not possible to develop the software of all the package programs used by the company, and that it is not possible to go beyond reinventing the wheel. As Seyrek (2011) suggested that instead of owning this type of technology, especially small businesses could save money by outsourcing them and paying third parties for utilization. Demand-oriented product and service development with existing resources should be encouraged, rather than open source or local production of licensed products. It has been determined that the security vulnerabilities that companies are afraid of are at a minimum level, especially in open sources, and there is no question of sharing the data with third parties. It should also be noted that in case of any problem faced, there are ecosystems where the solution of the problem is explained by other users, so it is possible to respond more quickly to the problems and demands of the customers.

With outsourcing, although it saves certain costs and time, it has been understood that open sources and even some licensed products are insufficient to respond to some demands and customer problems. Since open sources are free software, there is no possibility of demanding more from their creators. At this stage, the task falls to the companies themselves. It has been determined that these companies, which are faced with the necessity of making the improvements on the existing programs, either deal with this in-house or outsource an additional licensed product. It is necessary to mention another problem, which is more important than this problem and may even become chronic over time. The workforce in the IT sector is criticized by the managers, and it is thought that the ratio of the qualified workforce to the total workforce is very low. In the IT sector, which is an environment where people with high technical equipment are constantly followed by companies, the change of job of a qualified employee creates great problems for the company he/she left. As Yaşar (2017) stated that the biggest challenge for these companies is the lack of qualified employees to properly understand and use Industry 4.0 technology. Similarly, Okan et al. (2016) has concluded that organizations (public or private) feel that they do not have enough trained and experienced staff to implement new generation technologies. It is very difficult to replace qualified people in an environment where employees who do not regularly follow current

changes are insufficient in their work processes. Companies should keep employees at the required level of awareness and competence through continuing training programs. In addition, applied course hours should be added to increase awareness of Industry 4.0 technologies in universities and vocational high schools and to learn software languages. Explaining this bilateral situation, Aydın (2018) found that technological advances in the country were shifting the demand for work in higher education. In other words, it has been observed that graduate employment is increasing with the advancement of Turkish technology. In addition, Akgül et al. (2018) stated that as the level of students' understanding of Industry 4.0 technologies increases, their belief in the benefits of these technologies increases.

While there is a period in which technology develops and changes the fastest in the history of the world, it is inevitable that people's perception of time will change and their tolerance for waiting will decrease at a time when there are more options than ever before. It should be said that the way to stay in competition and create loyal customers is to keep up with this speed. In this case, it has been determined that companies have shortened their delivery times considerably and responded to customers' requests and questions much faster by utilizing new generation technologies. With simultaneous process monitoring and big data analysis, it has been understood that problems are detected and even predicted in a much shorter time.

It has been seen that the investments to be made are largely concentrated in artificial intelligence and blockchain technologies. It has been understood that the integration of systems that can follow the processes, learn and produce solutions occupies the agenda of the companies. By means of these developments, it is stated that the data is constantly monitored, possible errors can be detected and prevented in advance, and many processes can be transferred to autonomous systems out of human control. One of the important reasons for investments in blockchain technologies is that end-to-end connected systems are much more secure than traditional systems. However, it has been understood that the companies could not see the way forward in the steps to be taken for these investments. Since no regulation has been brought by the government yet, companies keep these investments on hold and declare that they will act according to the positive or negative results of the decisions. At this stage, it is of great importance that the state

acts to support the investment to be made in these technologies and to increase the usage areas, and to eliminate the uncertainty.

In the studies carried out so far, the degree of use of certain technologies by companies has been investigated, the advantages it provides and the security problems it creates have been tried to be revealed, and studies have been carried out in the fields of logistics, agriculture, education and banking. Most of these studies are conceptual studies, and it has been determined that much less empirical studies have been conducted compared to conceptual studies. The feature that distinguishes this study from the others is that it is a qualitative study that tries to reveal the degree of use of Industry 4.0 technologies, the perception level of managers, the reasons for outsourcing of companies, the advantages and disadvantages of technologies, and the future plans of companies. Although in the scope of this research, the interviews made with managers of IT companies in Ankara taken to investigation, there is a need for more primary data to analyze the managers' awareness and perception of digitalization and Industry 4.0 topics with a holistic approach. For example, the managers of companies from other provinces or besides managers, employees can be interviewed. Therefore, it may be a limitation that this study was conducted with the data obtained from managers of companies working in Ankara province. In the future studies, as well as the level of understanding of managers', state regulations and incentives on last generation technologies and their impact on companies can be examined. Moreover, in order to find an answer to the debate whether Industry 4.0 is truly an industrial revolution or just a tool, the sample of the study can be increased by interviewing more SMEs or by conducting another study with larger companies to re-test the understanding about the phenomenon. It is hoped that the research results will be benefited by relevant institutions and researchers working in this field.

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APPENDIX

APPENDIX LIST

APPENDIX 1: Question Set

Appendix 1
Question Set

1. Öncelikle kendinizi tanıtır mısınız? *(yaş, eğitim, iş tecrübesi, diğer)*

2. İşletme ile ilgili Bilgiler:

İşletmeniz hangi sektörde faaliyet gösteriyor? İşletmenizde kaç kişi çalışıyor?

İşletmenizin hukuki yapısı nedir? *(şahıs/aile işletmesi, ortaklık, limitet şirket, anonim şirket)*

3. İşletmenizin kuruluş ve günümüze kadar olan öyküsünü anlatabilir misiniz?

4. Sizce "dijitalleşme" nedir? Dijitalleşme denince aklınıza ilk ne geliyor?

5. Endüstri 4.0'ı nasıl tanımlarsınız?

- Sizce Endüstri 4.0 hangi teknolojileri kapsıyor?

6. İşletmenizin ihtiyaçlarını karşılamak için Endüstri 4.0 teknolojilerine ihtiyaç duyuyor musunuz?

7. Belirttiğiniz bu hizmeti ya da hizmetleri tercih etme nedenleriniz nelerdir?

8. Bu teknolojiler, yoğun olarak hangi iş süreçlerinde ya da departmanlarda kullanılıyor?

9. Bu teknolojilerin sizce en önemli avantaj ve dezavantajları nelerdir?

10. Kullandığınız teknolojilerin etkin kullanımı için işletmenizin alması gereken kararlar / yapılması gerekenler nelerdir?

11. Kullandığınız teknolojiler işletmeniz tarafından mı sağlanıyor yoksa dışarıdan *(başka işletmelerden)* mı (hangi marka/hizmet?) satın alıyorsunuz?

    - Dışarıdan satın alınıyorsa, işletmeniz bünyesinde bu teknolojilere yatırım yapmayı düşünüyor musunuz? Evet ise, ne zaman?

    - Bu teknolojilerin dışarıdan satın alımı veya işletme içinde sağlanmasının avantaj ve dezavantajlarından bahsedebilir misiniz?

12. Bu teknolojiler ile ilgili olarak karşılaştığınız en önemli sorunlar nelerdir?

    - Bu konularda karşılaşılan sorunların üstesinden gelebilmek için aldığınız tedbirler ve çözüm önerileri nelerdir?

13. Sizce, bu teknolojilerin işletmenizin rekabetçiliği üzerinde etkisi var mı? Varsa nasıl?

14. Gelecekte işletmenizde hangi dijitalleşme araçlarını kullanmak istersiniz? Neden?

15. Eklemek istedikleriniz?