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IMPACTS OF INDUSTRY 4.0 ON LABOUR FORCE AND BUSINESS ORGANIZATIONS: A QUALITATIVE ANALYSIS OF CONSULTANTS, EXPERTS AND UNIONS' INTROSPECTIONS

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Endüstri 4.0'ın İnsan Gücü ve Ticari İşletmeler Üzerindeki Etkileri: Danışman, Uzman ve Sendika Gözlemlerinin Niteliksel Analizi

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ABSTRACT

Throughout history, we have witnessed how human life has been affected both socially and economically by the inventions brought about by the first three industrial revolutions. After 200 years of the first industrial revolution, today we are on the verge of a fourth revolution, which is called as Industry 4.0. We can be sure that this fourth revolution will have a profound effect on both our business and daily lives. Despite the burgeoning literature on the Industry 4.0, it is difficult to estimate the way it will progress and the potential impacts it will bring out to our lives and business world. This thesis addresses the concept of Industry 4.0, which infers the primary transformation of the industrial dynamics like business models, industrial relations and policies. The study was conducted with the purpose of developing an Industry 4.0 process model for Turkey and also estimating the effects of Industry 4.0 within the changing industrial environment. By using the content analysis approach, six face-to-face interviews, thirteen secondary data and eight online magazine articles were taken into the analysis. Consequently, sixteen themes on Industry 4.0 process were found out, and an Industry 4.0 Developmental Process Model as the primary argument is suggested.

Key Words: Smart Factories, Orange Companies, Grey-Collar Workers, Society 5.0, and Industry 5.0

ÖZET

Tarih boyunca, ilk üç sanayi devrinin getirdiği icatlarla insan yaşamının hem toplumsal hem de ekonomik olarak nasıl etkilendiğine şahit olduk. Ancak bugün, İlk Sanayi Devrimi'nden yaklaşık 200 yıl sonra, Sanayi 4.0 adı verilen Dördüncü Devrim'in eşiğinde bulunuyoruz. Bu dördüncü devriminin bunun bir kez daha çalışma ve gündelik hayatımız üzerinde derin etkileri olacağından emin olabiliriz. Fakat, Endüstri 4.0 ile ilgili oluşan literatüre rağmen, Endüstri 4.0'ın gelişim aşamalarını, gündelik hayat ve iş dünyası üzerindeki potansiyel etkilerini somut ve açık bir şekilde görmek oldukça zor gözükmektedir. Bu araştırma, sektörlerin dönüşümü, endüstriyel ve toplumsal ilişkilerin değişmesi anlamına gelen Endüstri 4.0 kavramını incelmektedir. Araştırma, Endüstri 4.0'ın değişen endüstriyel ortamdaki gelişim modeli ve potansiyel etkileşimini tahmin etmek amacıyla yapılmıştır. İçerik analizi yaklaşımını kullanarak altı yüz yüze görüşme, on üç adet ikinci el veri (çevrimiçi) görüşme ve sekiz çevrimiçi dergi makalesi analize dahil edilmiştir. Sonuç olarak, Endüstri 4.0 süreci ile ilgili on altı ana tema tespit edilmiş ve birincil argüman olarak da Endüstri 4.0 Gelişim Süreci Modeli önerilmiştir.

Anahtar Kelimeler: Akıllı Fabrikalar, Turuncu Şirketler, Gri Yaka İşçiler, Toplum 5.0 ve Sanayi 5.0

CHAPTER 1

INTRODUCTION

Apart from political issues, over the past three years we have seen that climate change, economic sustainability and the scope of the Fourth Industrial Revolution are at the top of the list when it comes to issues that stand out on global platforms and in the business world. The "Fourth Industrial Revolution" that emerged in Germany is at the top of the agenda of the world as a whole, including in Turkey (Fırat, Yurtsever, İleri, & Kıvılcım, 2017).

The Fourth Industrial Revolution (Industry 4.0) is developing trends that affect all sectors of the economy and firms of all sizes, and it encourages all of the firms from different sectors to sustain the industrial activities. Industry 4.0 transformations are also critical to the success of companies with a focus on the big picture in forward-looking strategies and policies of enterprises, investment, development plan-projects and applications (Fırat, 2016).

In 2011, for the first time, the term of Industry 4.0 was uttered in Hannover Trade Fair in Germany. Three years later, the German National Academy of Sciences and Engineering published the Industry 4.0 Manifesto and declared it as a national industrial strategy. According to this manifesto, Industry 4.0 is characterized by real-time communication and connections between people, machines, and products, in addition to a highly customized and digitized intelligent manufacturing model that is exceedingly flexible (Stock & Selinger, 2016). The essence of this intelligent manufacturing model is the transformation of production from a central production type to a local production type and the conversion of products from standardized to customize; users are entirely able to participate in the production. This participation requires a comprehensive ICT (Information and Communication Technologies) adaptation by the manufacturing industry and additional structures known as cyber-physical

production systems (CPPS), which bring elements of the virtual world into the real world (Deloitte, 2014).

It is generally acknowledged that industry has undergone four revolutions (First, Second, Third and Fourth Industrial Revolutions); the transitions between these revolutions, along with previous technologies, required innovations. Factories are the first to be impacted by these innovations because of their role in the production. Even though it seems like Industry 4.0 will only affect factories, it will, in fact, change all sectors soon, including our daily social experiences. By definition, it is aimed to produce better quality, cheaper and faster production with the acquisition of intelligent robots. At this point, increase in the usage of robots in production will decrease the need for labour-force, and it creates a question mark about the future of humans in terms of employment (Sayılgan & İşler, 2016).

Before the Industrial Revolutions, the economic structure was mostly dependent on agriculture and animal husbandry. Artisans and craftsmen carried out non-agricultural production, such as carpentry, ironworking, and weaving, manually. The First Industrial Revolution, which was triggered by the invention of the steam engine, provided a transition from an economic structure based on the iron, agriculture and labour force to a new and different socio-economic and cultural structure shaped by mechanization and mass production (Spath, et al., 2013).

The Industrial Revolutions, which have caused significant social, economic and cultural changes, took place over an extended period. In the nineteenth century, the First Industrial Revolution occurred with the addition of water and steam power to industry. At the beginning of the 20th century, electricity was at the focal point of the Second Industrial Revolution. After World War II, computers and automation formed the bedrock of the Third Industrial Revolution. It is striking that technology has been at the forefront of all

three revolutions (Crafts, 1996). In the contemporary era, which has been called the Fourth Industrial Revolution (Industry 4.0), we see that multiple technologies are articulated to form new and complex combinations. What we have seen so far is just the tip of the iceberg. This multi-technological interaction has led to discussion and debate about whether this is an early socio-economic revolution. There are those who debate whether this is an early socio-economic revolution or a technological evolution. For both of the cases, the important questions of 'What will happen to the labour-force, existing jobs, workers' rights and unions during Industry 4.0 process' have become the centre of debates (Rüßmann, et. al., 2015).

Industry 4.0 has been embraced into the general vocabulary to allude to the digitization of production, which implies the accumulation of the virtual and physical universes to diminish unprofitability and expenses while expanding the adaptability. Industry 4.0, which is conjointly used with "Internet of Things", is generally identified with "smart factories". Smart factories are the production centers where highly developed technologies like machines working with embedded sensors, actuators and wireless connectivity are being used (Schreiber, Alt, Edelmann & Malzkorn-Edling, 2016).

With Industry 4.0, low-skill employees, especially those working in production lines, will be replaced by automated systems. It is expected that at certain points in the long-run value chain, the rate of impact from this change could be 20-30% unemployment of workers. Experts on Industry 4.0 state that while Industry 4.0 will increase productivity and efficiency, it will also create certain disadvantages for employees like job loss and increase in the length of service required prior to promotion at work (Karakaş, 2016).

With this transformation in industrial relations, the importance of blue-collar workers has decreased and unions have started to lose power. The labour market is also undergoing a structural change. Technologically unstoppable

developments, including the use of machines instead of manual power and the substitution of computers for brainpower, as well as production methods have been changing the standards of consumption and living standards. While technological developments create the substructure for globalization, intra-organisational relations are intensified because new technologies necessitate both the physical and intellectual participation of employees. Therefore, the technological developments associated with the changes in the economic structure have also brought about significant changes in the production process, workforce, workplace and workplace organisation (Yazıcı, 2007).

Technology has always created new jobs while destroying existing jobs, but nowadays it is observed that the technological job creation engine is almost broken. A study about the future of employment conducted by Oxford University shows that only 0.5% of today's US workforce is employed in sectors which have been created since 2000; as a comparison, 8% of industries established in the 1980s still exist (Frey & Osborne, 2017).

The effects of Industry 4.0 on employees will undoubtedly be significant in terms of economic and social sustainability. An examination of global assessments and published reports on this issue reveals the big picture more clearly. A summary of some of the determinations made in the ‘Future of Jobs Report’ prepared by the World Economic Forum sheds light on this issue (WEF, 2016). In the coming years, devastating changes in organizational structures will have a great influence on employment. The transformation that is influencing world industries today is forecasted to have a crucial influence over employment, becoming the main driving force in job creation and termination, as well as increasing labor productivity while also expanding the skill gap. In global industries, the most demanding professions or specialties of today did not exist years ago (e.i., 5 or 10), and the pace of change in this area has accelerated. According to one prediction, 65% of children starting primary school today will

begin working on entirely new types of jobs that are not currently available (Fırat, 2017).

Predicting future skill needs, job content and total impact on employment in such a rapidly changing environment are of cumulative importance for companies, states and individuals to fully capture the occasions offered by these inclinations and to alleviate undesirable results (Fırat, 2017).

A recent WEF Report states ‘We look forward to assessing the future labour market from the perspective of the world's largest employers, hoping to improve the available information stock around the foreseeable skills needs, employment patterns and professional requirements’ (p.3). This sentence demonstrates that large employers have the most influence in the shaping of employment. Furthermore, it is also mentioned that this knowledge may encourage and strengthen partnerships between governments, educators, education providers, workers, and employers to better manage the transformative effects of the Fourth Industrial Revolution on employment, skills, and education (WEF, 2016).

According to the study entitled "The Future of Employment", about 47% of US employment is in the high-risk group. It is anticipated that this group is consists of occupations/tasks that will lose their function with high-automation in twenty-thirty years. The study results show that employees in the manufacturing, logistics, and transportation sectors are more at risk in this group (Hnizdo, Sullivan, Bang & Wagner, 2004). These discoveries are steady with the most recent technical improvements found in the literature. What is even more surprising is that a significant portion of the jobs that has emerged in the United States in the service sector in the last decade has been found to be highly sensitive to computerisation. A fact that supports this finding is the latest growth and mobility in the service robots market. With a comparative advantage to human labour in some skill-related jobs, robots are becoming preferred. Finally,

evidence suggests that there is a robust negative relationship between the probability of computerisation, wages and educational attainment because of the decrease in the need of human intervention (WEF, 2016).

According to Ali Rıza Ersoy, Head of Siemens's Digital Factories Department, Turkey is trying to put the concept of Industry 4.0, defined as the digitalisation of production needs to be reflected in production policies. However, there is no precise information about the side effects of this process, including the future of blue-collar workers and their rights (Ersoy, 2017). According to Ersoy, individuals will be also affected by the developments of Industry 4.0 and their lives will change. Due to Industry 4.0, by 2020 there will be 16 new professions that we do not yet know about An increase of 6 % in employment, in short term, is anticipated as a result of Industry 4.0 implementations, and collaterally in long-term, increase in the need for the more qualified labour force, especially in information technologies, is expected come up. According to this evaluation, Industry 4.0 will leave people fewer areas to work. Therefore, there is no precise information about the future of workers lacking qualifications in general (e.g., the blue-collar workers), their working conditions or their future (Ersoy, 2017).

The first reflection of the concepts of Digital Industry and digitalisation can be observed in factories with large production. In 2016, General Electric's Power Transformers Centre in the Gebze district of Kocaeli replaced its traditional production methodology with a digitalised model; there are no humans currently working in the centre, only machines work in this 'Smart Factory'. This was the first fully realised implementation of Industry 4.0 in Turkey and the center is still working within this model (Çapa, 2016).

The Industry 4.0 Revolution encompasses new concepts and new formations that were unheard of five years ago. As producers and consumers, people are all affected by this new revolution. While the impact of some of these

ideas remains abstract, others are more concrete. Smart factories, cities and buildings are among the most understandable, tangible and visible outputs. From time to time, Industry 4.0 becomes a topic of public discourse on business platforms and the advantages and disadvantages of this new revolution are discussed (Schwab, 2016).

The development of technology and Industry 4.0 is an inevitable process for industries. However, the role and future of workers and unions are not clear. At this point, it would be beneficial to analyse the possible impacts of Industry 4.0 on labour/job protection and the employment of workers from the eyes of experts who are working on industrial relations and Industry 4.0. In this thesis, I aim to examine the possible impacts of Industry 4.0 on labour/job protection and employment from the perspective of worker unions, consultants, academicians, and experts. By employing an inductive qualitative inquiry approach, the findings and central argument of the thesis are based on ten semi-structured interviews, conducted with a sample of business worker unions, consultants, academicians and experts working on Industry 4.0 and digitalisation, as well as related online resources.

This study is presented in five chapters regarding its argument and conceptual modelling:

Background and Conceptual and Theoretical Framework provides information about the conceptual and theoretical base of the study as the literature review. The development of previous industrial revolutions and their impacts on the social and economic level is analysed in this chapter.

Method presents the methodological approach of the present study by explaining the sample structure and data analysis.

Findings contain the results of the study. The results are illustrated in sixteen themes with sub-categories, which were inferred from qualitative data.

Discussion section provides a general discussion of the findings. In this section, a general discussion is first presented. Secondly, a comparative study in which results are compared to a similar study conducted in the Netherlands is discussed. Thirdly, an argumentative model is suggested and a detailed explanation is presented.

Finally, in the *Conclusion*, I summarise the findings and the theoretical contribution in order to propose new avenues for further research while mentioning the implementations, limitations of the present study and future research.

1.1. CONCEPTUAL AND THEORETICAL FRAMEWORK

This section of the study provides a theoretical and conceptual framework of the study by pointing out the previous studies within the literature review. This literature review seeks to explore the related research on the main and sub-questions of the study. Firstly, elaborating on the concept of Industry 4.0 illuminates the conceptual framework of Industry 4.0. Secondly, a snapshot of the main components of the Industry 4.0 is provided. Third, theories on human resource management during Industry 4.0 developments are explained. Fourth, a multi-level theoretical base of the study on future employment and job-protection is established. Fifth, union relations and the future of unions under the conditions of Industry 4.0 are explained with a diverse group of theories. Finally, a summary of the literature research is done to show the aim of the study and research questions.

1.1.1. The Concept of The Industry 4.0

The world is changing. Whether people know it or not, the Fourth Industrial Revolution will affect humanity. Automation, mobile computing, and artificial intelligence are no longer futuristic concepts but the realities of today (Keywell, 2017). The first phase for Industry 4.0 was explained at the Hannover

Trade Fair in Germany in 2011. This new stage focuses on machines and new production systems that are operated autonomously, without the need for human power. With the Hannover exhibition, Germany has officially started this phase by establishing it as the official industrial policy. A working group formed by the German government regarding Industry 4.0 is tasked with preparing an annual report and presenting it to the German Ministry of Industry (Görçün, 2016).

The Fourth Industrial Revolution represents a convergence between information technology and operational technology. The First Industrial Revolution originated from the introduction of power forces (water and steam power), the Second Industrial Revolution emerged from the introduction of electricity and mass production, and the Third Industrial Revolution originated from the differences created by electronics, information and communication technologies to automate production. In the Fourth Industrial Revolution, the most important change is the 'intelligent machine', which can fulfill its particular duty in the availability of uncertainty and variability in its environment (Öztuna, 2017).

With the 'Industrial Internet of Things' approach, the Fourth Industrial Revolution offers intelligent and communication-ready products produced by smart factories (Banger, 2016). However, the Fourth Industrial Revolution is not limited only to intelligent and connected systems. From gene sequencing to nanotechnology to renewable energies, many offline technologies are intertwining and interacting in the physical, digital and biological fields (Schwab, 2016).

Industry 4.0 means that robots can communicate within a network where they can perceive their environment, complete tasks remotely and monitor large-scale production. In Industry 4.0, robots will create machines that can perform multiple tasks and can be adjusted to work in a diverse range of products and different production volumes within small- and medium-sized manufacturing

enterprises (Morgan, 2017). Moreover, Industry 4.0 will allow factory owners to also work outside of the workplace, for example at home or at a concert, where the robots that they own work in factories and the owners can observe the factory wherever they want. These opportunities will bring additional issues like the work-life balance and employment issues (Aksoy, 2017).

Industry 4.0 is the integration of information, communication, the Internet, and autonomous data collection technologies. According to the Scientific and Technological Research Council of Turkey (Tubitak), it is envisaged that in the foreseeable future, this industrial revolution will progressively be applied to additional areas (Tubitak, 2016). According to report, report on Industry 4.0 (2016), an increase in the usage rate of automated systems, the size of Internet, economic impacts, changes in the manufacturing processes, diversification in production and changes in income distribution are the main areas which are predicted to be influenced by Industry 4.0 developments. The foresight list of Industry 4.0 impacts is shown in Table 1.1.

Table 1.1. TUBITAK's Forecasts of Industry 4.0 (2016)

Year	Forecast
2018	The number of robots used in industry will be about 3 million The number of connected devices will increase from 13 billion to 29 billion
2020	The size of the Internet market will grow from 656 billion USD to 1.7 trillion USD
2025	The contribution of the industrial robots to local economy will be 0.6-1.2 trillion USD annually 15-25% of manufacturing processes in developed countries will be based on automation Through innovation in OECD economies, GDP growth will depend on increased productivity through robotics
2030	Digital technologies will have a substantial impact on productivity: Half of the global trading volume will use the interaction of intelligent objects

Earlier industrial revolutions have brought mass production and digital capabilities to the business world. And states were affected differently. States, which adapted their economy into new technologies brought by industrial revolutions, developed their economies while the others could not. And, this revolution isn't fundamentally different in that respect. In a sense, states that want to have a say in the world must participate in the Fourth Industrial Revolution (Kızıldere, 2016). The Fourth Industrial Revolution will not be limited only to concepts such as digitalisation, artificial intelligence, 3D printers, and nanotechnology. The Fourth Industrial Revolution is expected to affect many more areas, including working conditions, governance, new occupations, employment, social security, and trade unionism (Öztuna, 2017).

According to Dalmia and Sharma (2017), societies will be faced with questions that it has yet to answer; these questions need to be discussed. If precautions are not taken, there may be some risks. In the case of products and services, the majority of companies still depend on hourly work. A company could drastically reduce its use of human power by using only artificial intelligence, which means that less revenue will be delivered to employees.

It is anticipated that the Fourth Industrial Revolution will impact almost every aspect of life, from daily life to business, business administration to the employment rate, and from unions to labour law. The state, businesses world and trade unions are already required to take some measures (Prause & Weigand, 2016).

1.2. THE MAIN COMPONENTS OF INDUSTRY 4.0

Industry 4.0 includes countless technologies and booming paradigms. (Thames & Schaefer, 2016). Some of these emerging paradigms are the Internet of Things (IOT), Cyber-Physical Systems (CPS), Cloud-Based Manufacturing (CBM), 3D printers, Innovation, Artificial Intelligence and Smart factories. These properties are not only highly connected with Internet technologies and

developed algorithms, but also demonstrate that Industry 4.0 is a value-added information processing and industrial value-added process (Yang, 2017). Below, these paradigms are briefly summarized.

1.2.1. Cloud

Cloud computing is an Internet-based computing approach that enables large-scale server computers and software based on the Internet network to be shared within this massive network. Cloud technology is the simplest online storage service that provides operational convenience with web-based applications that do not require any installation. All the applications, programs and data we store on the Internet are stored in the cloud. This service is called Cloud Technology in all the services that we can easily access to these information, programs and data. A cloud system has a number of usage areas. Accounting, medicine, agriculture, the service sector, and manufacturing are just five of these areas (Banger, 2016).

1.2.2. 3D Printers

The use of 3D printer technology will result in the personalisation of the production. 3D technology offers free thinking and unlimited design possibilities (Korkmaz, 2014). By integrating 3D printing into the Internet of Things, everyone can be a manufacturer and have the opportunity to make their own products both for themselves and to share with others using open source software. The 3D production process uses one-tenth of the materials used in the traditional manufacturing process and requires minimal human effort. Small and medium-sized 3D businesses are increasingly producing more advanced products. 3D users are now business owners, and consumers are also producers (Yıldıran, 2016).

1.2.3. Cyber Security

In 1837, when Professor Charles Babbage at Cambridge University designed multiple machines; one was called a ‘difference engine’ and the other an ‘analytical engine’, it was not expected to come to today's computer standards. The evolution of computer technology did not only offer opportunities and benefits to humanity but also created problems (Collier & MacLachnan, 2000). The cyber world used by people and institutions is becoming increasingly dangerous. The words ‘cybersecurity’ and ‘cyber-attack’ have begun to be discussed more and more frequently (Öztuna, 2017). Developments in Information and Communication Technologies (ITC) have facilitated daily life while simultaneously bringing problems like cybersecurity (Tarhan, 2017).

Industry 4.0 is the integration of core technologies that uncover new generation industrial production systems. The use of industrial Internet systems, one of the critical elements of Industry 4.0, has security and privacy risks. Attacks on virtual and physical systems can damage both machines and employees. Existing security solutions are not yet suitable because they do not scale to the vast networks of cyber-physical systems (Banker, 2017).

Along with the Fourth Industrial Revolution, cybersecurity is in a far more critical position. With digitalisation and robots taking up more space in the workplace, the Internet of Things (IoT), artificial intelligence and the existence of smart factories, there are risks to businesses (Öztuna, 2017).

1.2.4. Internet of Things

It is called the Internet of Things (IoT), which makes it possible for objects to communicate with each other (Sinan, 2016). The Internet of Things is expected to provide a great number of economic occasions and also is regarded as one of the most up-and-coming innovative tools with a great devastating potential (Hofmann & Rüsch, 2017). A British entrepreneur Kevin Ashton

created the concept of “Internet of Things”. The idea was formulated in 1999 to describe a system in which the material world communicates with sensors (data exchange) everywhere. In this approach, not only objects, but also processes, data, people, and even animals or atmospheric phenomena - have been constructed as a variable (Witkowski, 2017). In the first decade of the 21st century, the "internet of objects" has become popular and is thought of as a technology that allows industries to move from Industry 3.0 to Industry 4.0 by adding information to the products and processes in the supply chain (Görkem & Bozuklu, 2016). From a technical point of view, Internet of Things is a combination of physical works comprising embedded systems of different production mechanisms that supply web-based communication and data flow (Trappey, et. al., 2016).

1.2.5. Innovation

Innovation is defined as changes occurring in the forms of products, services and work to create added value in economic and social areas. Today innovation has a crucial role, which is to determine the social welfare and quality of the country and the competitive advantage of the states (Schwab, 2016). In this sense, industrial policies are one of the strategies, which have most recently focused on industrialisation targets. With industry 4.0, the industrial policies of most countries have also begun to change. For example, most of the European Union members prioritized to put Industry 4.0 policies into practice with the intent of upgrading efficiency, competitiveness and enhancing digital and technological skills of their labor force. The Government of the Russian Federation issued a program called 'Development of the manufacturing industry and increasing competition power for the period up to 2020'. According to this program, labor productivity will be improved by modernizing the production process in which IT and Industry 4.0 technologies play an important role in robotics, 3D modeling and printing technologies (European Commision, 2017). Germany, for example, aims at transforming industrial and innovation policies

based on recommendations from a report prepared by Industrie 4.0 (German Industry 4.0 Platform), a platform created by representatives of the private sector, public institutions and universities (Vardar, 2016).

1.2.6. Artificial Intelligence

One of the topics discussed by different disciplines today is artificial intelligence, as technological developments are advancing rapidly. The purpose of artificial intelligence is to make machines more autonomous and intelligent. Artificial intelligence is a concept that aims to make devices capable of reasoning, exploiting past knowledge, learning, communicating, perceiving, playing objects, and being able to relocate (Kuşçu, 2015). Systems that simulate specific human behaviours and simulate the process of thinking about a challenge can be created with artificial intelligence (Hamutçu, 2017).

According to Schwab (2016), the positive impacts of artificial intelligence are: a) rational and data-driven decisions with less prejudice; b) innovation; and c) progress in removing malpractices in different manufacturing processes.

With day-to-day digitisation, artificial intelligence technology is affecting daily life more and more (Can, 2017). In the following years, artificial intelligence will lead to changes in company structures, such as determining the role of automation and will create changes in business models. In line with this new technology, business models, company organisation, structures and policies need to align accordingly (Goodwin, 2017). Industry 4.0 represents an essential transition period to individualized, customer-centered and Internet-based business models. With industry 4.0, service and data-driven business models are becoming even more important (Berman, 2012). With Industry 4.0, significant changes are expected in the structures of the companies. According to the research done by the Fraunhofer Institute for Industrial Engineering (2014), companies will have to accelerate their decision-making mechanisms. At the

same time, the consequences of decisions will be more far-reaching if the integration of value chains continues to gather pace. Some aspects of decision-making will also be transferred to intelligent systems.

It is predicted that artificial intelligence tools (systems) will be able to communicate meaningfully with each other in the future. Artificial intelligence technology, along with decision-making abilities, can be also used for the general recruitment of human resources. Skill acquisition tools may monitor score and interpret applications, which would provide extra seventy-five percentage more time for HR departments. This is a big advantage as it enables the HR managers/specialists to save more time to progress onward the assessment of executive applicants. In such circumstances, HR units are drastically increasing the quality of hiring decisions. In addition, firms can save a great amount of money, since they don't have to pay the cost of wrong decisions (Öztuna, 2017).

1.2.7. Smart Factories

In the traditional factory concept, production processes are interconnected. If one of the production processes fails, the production slows down and may even reach a stopping point. This means a waste of time and money for the factory. Now, smart factories are emerging. A ‘smart factory’ indicates an environment in which machinery and equipment can improve processes through automation and self-optimisation. Smart factories can control all processes of production, from supply, storage, production, quality control, and delivery to maintenance-repair, as well as reducing error rates occurring in the production processes. Additionally, they can minimise standby times and create procurement, production and shipment plans. As a result, productivity increases (Fırat, 2017).

One of the important places where objects communicate with each other in Industry 4.0 is "smart factories", equipped with "smart" technologies and also called dark factories because no one works. In the first dark factory in China,

which produces mobile phone modules, the use of robots has reduced the number of workers by 90%, while the rate of defective products has decreased from 25% to 5% (Aksoy, 2017).

1.3. THEORIES ON HUMAN RESOURCE MANAGEMENT DURING INDUSTRY 4.0 DEVELOPMENTS

In Industry 4.0 processes, an employee must have the creativity to be successful. Developing new products, new technologies, new working methods and creating successful change processes require creativity. In Industry 4.0, robots will be at the forefront, but robots are not creative as humans. That requires the recruitment of creative employees (Ünlü, 2016). Due to artificial intelligence and robots in this new era, changes in human resources processes are as inevitable as those in production processes. Industry 4.0 will affect productivity and decision-making processes in the contexts of entering candidate information into the human resources system, personnel recruitment, appointment and promotion (Öztuna, 2017).

According to Avşar (2016), in the Fourth Industrial Revolution, workers will be involved in production with their intellectual capacity instead of their muscle power. For this reason, the most considerable difficulty of Industry 4.0 is primarily related to human resources. It will require a new type of workforce; it is necessary to be flexible, creative, and have problem-solving skills in the use of technology. The department that will provide this employee profile is the unit of human resources. There is a growing need for employees with technological and cybersecurity skills, software programmers, and people skilled in the statistics and mathematics that can be applied to solutions that arise through the development of artificial intelligence. IBM defines such new generation professions as ‘new-collar’ jobs (Sözer, 2017).

Despite the fact that there is a consensus on the requirement of technological progression of operational and management models in the regard

of Industry 4.0, the perceived complexity and abstraction constitute a major obstacle, which partially prevents rapid transformation to industrial practice. Challenges relate not only to the financial investment needed to acquire new technologies but also to the level of staff at all organizational levels who can cope with the increasing complexity of future production systems. Learning facilities, students and professionals should be addressed along with other competencies that enable managers of learning factories and their employees to cope with the challenges of an increasingly digitalized production system for future production scenarios in the sense of Industry 4.0. It has proven to be an indispensable tool for training production management principles to be implemented (Schumacher, Erol, & Sihn, 2016). For this reason, learning plants provide a great opportunity for training and for the preparation of employees for the use of Industry 4.0 (Prinz, et. al., 2016).

1.4. INDUSTRY 4.0 - EMPLOYMENT AND JOB PROTECTION

The biggest concern when it comes to artificial intelligence is the potential for unemployment. There are many different views on this topic. According to Brodie and Mylopoulos (2012), more workers will be needed to change, update and correct the robots and artificial intelligence technology while Aaronson and his colleagues (2014) state that there have already been noticeable declines in the number of labour force workers.

It is anticipated that the need for blue-collars will reduce from 400 thousand to 500 thousand in the manufacturing sector in the next decade. On the other hand, it is anticipated that at least 100 thousand digitally qualified employees in this sector will be needed. Also, it is believed that thousands of new job opportunities will arise as a result of the growth flow that the industrialists will bring out.

It is anticipated that the productivity-depended employment loss will be reimbursed by the annual 2-3% growth brought by Industry 4.0. In this sense, a

drastic rise of 5% in employment is expected to occur in the next 10 years. Likewise, Turkey is expected to have the know-how of this process, and highly qualified labour force (TÜSIAD, 2016).

The fourth industrial revolution can be described as the withdrawal of human hands from production. It is expected to increase the unemployment rate in technical staff and engineers in the short-term, while the need for skilled labor will increase. Reducing the rate of unemployment in the long run and even increasing the employment rate can only be achieved by providing vocational training appropriate to the types of jobs brought about by the digitalization process. In this context, the impact on employment in the industry is 4.0 in Turkey through education is the way to make it positive. Possible effects that have been mentioned so far are positively related. Limited the existence of the workforce, cheap labor costs, the presence of small-scale companies, to be limited to two years, but in Industry 4.0 this return is much longer the effect of the fact that it will be on investors is the expected adverse effects of this process (TÜSİAD, 2016).

A statement by Foxconn, one of the world's largest electronics manufacturing companies, indicating that they will employ one million robots in the place of workers reveals the extent of Industry 4.0-related workplace transformations (Tarhan, 2017). It appears that the Fourth Industrial Revolution will create fewer new areas of work in new sectors than did previous revolutions. According to an estimate by Frey and his colleagues (2016), today only 0.5% of the American workforce is working in sectors that did not yet exist at the beginning of the century.

Nevertheless, industrial revolutions have created new areas of expertise in emerging technologies. They have led to the creation of workers and a working class who understand the use of new machines and technologies. In Industry 4.0, it is expected that workers will be able to adapt to and communicate

with physical and cyber systems. Also, employees will be able to control both the software technologies and the physical systems used for production (Özdoğan, 2017). It is expected that robots' replacement of human muscle power will completely change employment and industry. Today, robots have become visible representatives of the digital transformation. However, while robots make some sectors obsolete, they also make a difference in jobs such as data management and computer management. Along with new business areas, the need for engineering will increase in return the need for qualified personnel to manage the machines (Can, 2017).

As stated in the Human Development Report of the United Nations Development Program (2016), there will be more demand for high-level jobs, and support is needed for inclusion of women to have an opportunity in science, technology, engineering, and mathematics. Flexible work arrangements and the availability of broader care options, such as day-care centres, after-school programs, elder care, and long-term care facilities can increase women's opportunities for employment (United Nations Development Program, 2016). According to a report published by the Institute of Spatial Economic Analysis (ISEA), the use of automation instead of a human labour force means that women will lose twice as many jobs as men. The reason for this is that many women work in positions that are subject to the highest automation demands (Taylor, 2017).

A study conducted by Oxford University predicts that robots will take over 50% of jobs in the US and Europe over the next 20 years. The machines also leave people unemployed in emerging economies like China (Fioramonti, 2017). In a survey conducted by researchers at Oxford and Yale University, a questionnaire was administered to 352 respondents (Artificial Intelligence researchers) that requested their opinions about when machines will take over various jobs currently performed by people. They found that group believes artificial intelligence could carry out more complex and creativity required tasks

like performing high-level math and writing books until 2051 and ultimately all human jobs until the year 2136 (Arntz, Gregory & Zierahn, 2016).

According to Facebook's former manager Antonio Garcia Martinez, many people will lose their jobs as a result of technological improvements, and there is no work on social policy to prevent this situation and subsequent misery.

According to Akin (2016), "Unmanned production" is an imminent phenomenon, even when using economic considerations in everyday life, given the dramatic consequences that might lead. However, "unmanned production" has become widespread not only in manufacturing industries but also in production processes involving complex decision-making processes and requiring intensive communication with people. There is no doubt that the complete transition of unmanned production will also be achieved in the near future. It can even be said that this has been partially achieved in many sectors. Many products and services that we use today are produced with a limited amount of labor that can be ignored, and many businesses generate significant output without using meaningful labor input. This trend is not limited to manufacturing industry and it is also valid in some service sectors. The integration of "the internet of things" and artificial intelligence into the machines and equipment used has replaced the communication and decision-making skills of people in the production processes of many goods and services, not only in industrial facilities.

As a result, it is anticipated that there will be intense competition between humans and robots in the future, but there is no definite prediction as to which sectors and groups will be involved in this competition (Kasriel, 2017).

1.5. INDUSTRY 4.0 AND WORKER UNIONS

How will unemployment be managed in the production and service sector when robots and 3D printers capture production? Robots have no unions, no

salaries, no social security, and no severance pay. With robotic systems and 3D productions, costs become very low and production capacities increase. How will the production and consumption imbalance in the system be resolved? What measures will unions take to protect the rights of the working class? It is envisaged that unions will have to spend more time to protect the rights of workers in the future, including wages and unemployment benefits (Kutlu, 2016).

In the business world, the power of workers' unions vis-à-vis employers will be reduced in an environment where robots will replace human power (Ansal, 2016). It is envisaged that income inequality between classes will increase even more, as a large part of the income will remain with employers because robots will not require expenses such as salary, social security premiums and severance pay (Öztuna, 2017).

According to a TİSK (Turkish Confederation of Employer Associations) report (2016), qualified and multi-faceted employees will be at the forefront in the Fourth Industrial Revolution. Concerning possible problems regarding required skills, it is of the utmost importance that the business world, labour market regulators and workers' trade unions develop the right skills and future-oriented policies for future skills.

Another issue concerning unions is the division of the working class with regard to flexibility in the working life. There is fear of a decrease in cohesion among workers and unions may struggle with the disintegration of the labour market. That’s why communication between members may be disrupted (Şenkal, 2003).

In conclusion, although unions will be impacted by the developments of Industry 4.0, there is no precise information on what they will or will not do in this regard (Kuleli, 2017). It is not yet clear what the unions will do if the need for workers diminishes due to the technological changes resulting from Industry

4.0. In this context, unions' nonpreparation for the future will have an impact on job protection and employment (Başaran, 2010).

1.6. AIM OF THE STUDY

The literature study shows that there is a current argument on the Industry 4.0 implications and its various impacts on human labour and the business organizations. According to the literature, highly autonomous and artificially intelligent systems with little human intervention will play important roles in production systems, and these autonomous and artificially intelligent systems will bring out new business models and changing industrial relations (Bonekamp & Sure, 2015). In the view of such information, it can be concluded that these technologically developed and interconnected systems may cause huge impacts on labour force like the less employability and unattractiveness for future jobs due to high-level usage of robots instead. On top of that, organizational structures, industrial relations and national industry policies are expected to change; digital-oriented management systems, changing focus of unions and Industry 4.0 adaptable national industry policies of governments would emerge (Bauernhansl, 2014). Therefore, all of these changing factors become a challenge for both parties including employees, companies, unions, and governments. In order to overcome these challenges, a holistic management strategy is essential, which is including all of the stakeholders of Industry 4.0 processes (Hecklau, Galeitzke, Flachs, & Kohl, 2016). Moreover, a comprehensive strategy model or plan including all of the steps of Industry 4.0 development and addressing the potential impacts, should be revealed in order to prevent from the potential impacts of Industry 4.0 on labour force and companies, and face those challenges mentioned above successfully.

In the view of such situation, this study firstly aimed to provide an overview of Industry 4.0 development process model and the potential impacts of Industry 4.0 on labour force and business organizations within this model, and

secondly contribute to future research by conducting interviews with business consultants, academicians and experts working on Industry 4.0 and digitalization, and utilizing from related online resources.

1.7. RESEARCH QUESTIONS

This study was undertaken to develop a comprehensive Industry 4.0 developmental process model and assess the impacts of Industry 4.0 on labour force and business organizations. Since there was no comparative study to rest on, this research utilized from simple and explicative questions planned to gain descriptive data to build a developmental process model. In order to meet the aim of the study, the following questions were interrogated:

a) What is the perceived understanding of Industry 4.0 and related-developments in Turkey?

b) What are the impacts of Industry 4.0 on both the economy, institutions as well as on the individuals?

c) How will Industry 4.0 impact workers in terms of working rights, working conditions, and job-protection?

d) How will Industry 4.0 impact local sectors?

e) How do unions regard Industry 4.0 concept and what type of cautions do they take or whether they take any action for it?

f) What are the merits, drawbacks and misdoubts of Industry 4.0

g) What are the problems existing during the Industry 4.0 development processes and solutions to these problems?

h) What are the expectations on the future of the business world, employees and the society?

CHAPTER 2

METHOD

This study aims to develop an Industry 4.0 developmental process model and figure out the potential impacts of Industry 4.0 on labour force and business organizations within this model. Hence, the qualitative deductive content approach was relevant due to the topic and the nature of this research project since it provides a detailed examination and understanding of the impacts and development process of Industry 4.0. I collected data from three different sources: face-to-face interviews, second-hand data (online interviews) and magazine articles. The sample consists of twenty-seven interviews: six face-to-face interviews, thirteen second-hand interviews, and eight magazine articles.

2.1. SAMPLES AND PARTICIPANTS

Participants in face-to-face interviews included three managers (two general managers companies and one manager of a union), two consultants, and one HR manager. Interviewees' fields of expertise are manufacturing (n=2), Information Technologies and Communication Management (n=2), unions (n=1) and cyber security (n=1). Six participants were recruited for the study. Two of them were female, and four of them were male. Their years of experience were minimum of ten and maximum twenty-eight years ($M_{experience}$ = 15 years).

Table 2.1. Demographic Information of Face-to-Face Interviewees

No	Sex	Age	Education	Years of Experience	Position	Sector
1	Male	41	Master	15	Consultant	ITC
2	Male	35	Master	10	Consultant	ITC
3	Female	40	Master	12	HR Manager	Manufacturing
4	Female	56	Master	30	General Manager	Manufacturing
5	Male	43	Master	15	Branch Manager	Union
6	Male	38	Master	10	Expert	Cyber Security
		42		15		

The second group consists of thirteen interviews available online (second-hand data). Overall, twenty-five online interviews related to Industry 4.0 were investigated, and twelve of these interviews were eliminated due to irrelevant context. The remaining thirteen interviews were included in the analysis. The criterion to select these thirteen interviews was the proximity of the interview questions to my research questions. Interviewees' fields of expertise are manufacturing (n=4), information technologies and communication management (n=4), foundations (n=4), management consultancy (n=3), academy (n=2) and journalism (n=3). Seven interviewees are general managers at companies investing in Industry 4.0 technologies; other interviewees are an engineer, an R&D manager, a vice president, marketing manager, business development manager, and academician. Three of the participants were female while eighteen of them were male.

The last data source consisted of online magazine news. Each article is written by an Industry 4.0 specialist. This group consists of eight articles. The criterion to select these eight articles was the proximity of contents to my research questions.

A detailed list of participants and data sources is presented in Table 2.1.2.

Table 2.1.2. Second-Hand Data

Data No	Gender	Profession	Field of Expertise	Company/Institution	Type of Data
1	M	Engineer	ITC	Ericsson	Online Interviews
2	M	General Manager	Foundation	TOSYÖV	Online Interviews
3	M	R&D GM	Holding	Borusan	Online Interviews
4	M	General Manager	ITC	Turkcell	Online Interviews
5	M	General Manager	Foundation	UTİKAD	Online Interviews
6	M	General Manager	Manufacturing	SCHUNK	Online Interviews
7	M	General Manager	Manufacturing	ÜÇGE	Online Interviews
8	M	Vice President	Manufacturing	Siemens	Online Interviews
9	M	General Manager	Foundation	ENOSAD	Online Interviews
10	F	Marketing Manager	Manufacturing	Siemens	Online Interviews
11	M	BD Manager	ITC	Blesh	Online Interviews
12	M	General Manager	ITC	infoTRON	Online Interviews
13	M	Academician	Academy	Istanbul Technical University	Online Interviews
14	M	Author	Journalism	Magg Magazine	Online Magazine Article
15	M	General Manager	Management Consultancy	Scheer	Online Magazine Article
16	M	Industry 4.0 Platform	Management Consultancy	Industry 4.0 Platform Turkey	Online Magazine Article
17	M	Industry 4.0 Platform	Management Consultancy	Industry 4.0 Platform Turkey	Online Magazine Article
18	F	Journalist	Journalism	Refleks Newspaper	Online Magazine Article
19	M	General Manager	Foundation	Foundation of Digital Transformation	Online Magazine Article
20	F	Academician	Academy	Bogazici University	Online Magazine Article
21	M	Journalist	Journalism	Tech-Inside Magazine	Online Magazine Article

2.2. INSTRUMENTS

In line with the literature review, firstly I did determine the aim of the study and my research objectives. Then by I identified the topics related with the aim of the study to investigate in detail. Based on existing studies and literature, I created an interview questionnaire with twenty-one questions under thirteen sub-topics. After the review of interview questions with my thesis advisor, I decreased the number of interview question from twenty-one to eighteen, and the number of sub-topics from thirteen to nine. Interview questions are shown in Appendix B. Nine topics that I asked questions are presented in Table 2.2.

Table 2.2. Sub-scales Questions of The Questionnaire

Sub-Topic	Question Number
1. The Definition Of Industry 4.0	1
2. Industry 4.0 Related Attempts In Turkey	1
3. Sectors To Be Influenced By Industry 4.0	2
4. Stakeholders Of The Industry 4.0 Process	2
5. Impacts Of Industry 4.0 On Blue-Collars And Companies	4
6. Impacts Of Industry 4.0 On Industrial Relations	1
7. Problems Emerging During Industry 4.0 Process	2
8. The Role Of Worker Unions In Industry 4.0 Processes	2
9. The Future Of Employment	3
Total Number of Questions	**18**

2.3. DATA COLLECTION AND PROCEDURE

I conducted six semi-structured interviews. In addition to the interviews, I used my interview notes from my interview visits. Additionally, online interviews and magazine articles were used as secondary data sources and coded in the same ways as the interviews.

Face-to-Face Interviews: Interviews took place over a five-month period between September 2017 and January 2018 and consisted of semi-structured questions. Three interviews were conducted face-to-face, two were conducted via Skype, and one was conducted via phone call. Interviews lasted approximately 30-45 minutes, with an average of 30 minutes. Three interviews were audio-recorded, while extensive notes were taken during the other three interviews (skype and phone-call). The semi-structured interview questions focused on twelve central points. These main points were the definition of Industry 4.0, the history of Industry 4.0, current Industry 4.0-related attempts in Turkey, impacts on employees, pros and cons for companies, impacts on unions, pioneering companies in Turkey, local stakeholders of the Industry 4.0 process, sectors that will be influenced, problems and solutions during the Industry 4.0 transformation process, emerging professions and perspectives on the future.

Second Hand Data (Online Interviews and Magazine Articles): I later added the appropriate online interviews and magazine-newspaper articles, coded them along with the face-to-face interviews. Based on this analysis model, I first determined my research questions and then decided on appropriate keywords for the literature review and online monitoring. At this step, I also conducted my interviews. Following my interviews, I determined the criteria for inclusion and exclusion within the research and selected the second-hand data to be evaluated.

Keywords used to find related second-hand data: Industry 4.0 and employment, Industrial revolutions, Impacts of Industry 4.0 on unemployment, national policies on employment, employee relations, Industrial relations and Industrial revolutions, Possible impacts of Industry 4.0, Disadvantageous groups and Industry 4.0, Jobs of Future, Pros and cons of Industry 4.0, Industry 4.0 and human resources, Intelligent manufacturing processes, Smart factories,

Industrial challenges, Industry 4.0 interviews, Industrial opportunities and artificial intelligent.

Google Search, Yandex, Yahoo Search, and Info.com were the search engines that I used to find related second-hand data. Also, I utilized form Research Gate, Academia.edu, BigFour's s (Deloitte, EY, PwC and KPMG) articles on their websites, Industry 4.0 Platform (Endüstri 4.0 Platformu) webpage and İstanbul Bilgi University Off-campus Library access to reach to the related literature research and second-hand data.

Inclusion and Exclusion Criterion for second-hand data: I had nine sub-topics in my interview questionnaire. The criterion for the second-hand data to be included into analysis was to have at least three questions or statement from my interview questionnaire.

All of the data was stored on my personal computer and shared with my advisor via Dropbox as a coded file for privacy.

2.4. DATA ANALYSES

According to Tokgöz (1983), content analysis is a research method developed to quantify patterns in communication content in order to deduce underlying themes, messages or ideologies. In mass communication, it is essential to focus on the quantity and quality of communication messages. In other words, when the content is being analysed, the communication message is resolved separately concerning quality and quantity. In this way, the characteristics of the signals may be determined. That is why I employed content analysis to investigate the impacts of Industry 4.0 on labour-job protection and employment. With the help of the content analysis theory approach, I used a deductive design in which I created themes and sub-categories by analysing perspectives, visions, ideas, and messages presented within the content. All face-to-face interviews were audiotaped, and then

transcribed verbatim with second-hand data, and all data were analyzed via MAXQDA software.

In this study, I employed a content analysis research design, which is suggested by Berelson (1952) to analyse the data. At first, I followed the analysis steps recommended by Berelson (1952):

Step 1: Determine the research questions.

Step 2: Determine the keywords appropriate for the subject of the study, literature review and online monitoring and conduct interviews

Step 3: Find resources (second-hand data), identify, review and evaluate them.

Step 4: Determine the inclusion and exclusion criteria of the research and select the studies to be evaluated.

Step 5: Analysis of the selected resources - determining central themes and sub-themes (categories) and open codes of sub-categories.

Step 6: Deductions by synthesising the findings obtained within the themes.

Step 7: A detailed report of the process and findings.

I added all of the data, including face-to-face interviews and second-hand data, into the analysis. This required that I first determine the main themes, then the sub-categories and open codes respectively. However, some of the excerpts have open codes, some of them do not and are just coded with the sub-categories and main theme. A table of the sample coding is presented in Table 2.4.; illustrating the quotations, open codes, sub-categories and main themes.

Based on the findings of this analysis, I came up with 17 primary themes within a conceptual framework covering the definition and history of Industry 4.0, current developments in Turkey, impacts on employees, companies, unions, and society, transformation problems and solutions, and perspectives on the future. The main themes and their sub-themes are covered in the *Findings Chapter* in detail.

Table 2.4. Illustration of Open Codes, Sub-Categories, and Main Themes

Sample Quotes	Open Code	Sub-Categories	Theme
Interviewee 3: 'For me, Industry 4.0 has six necessary parameters in 3 groups: mechanical and robotics, electricity and electronics, information and communication'.	-	Automation and Robotics	Definition of Industry 4.0
Interviewee 14: 'It can be software in a robot or machine, and the entire production flow can be digitally sustained without human need'.	Decrease in the Number of Employees	Adverse Impacts of Industry 4.0 on Manufacturing Sector	Industry 4.0 Impacts on Manufacturing Sector
Interviewee 17: 'Industry 4.0 can allow more prominent industrialists to grow, while smaller ones may face the risk of extinction'.	Orange Companies	Disadvantages of Industry 4.0 for Companies	Advantages and Disadvantages of Industry 4.0 for Companies
Interviewee 25: 'We need to look at the purpose of coding classes. It should not end with just writing code. The focus should be the end product. Which applications are being produced with that output (code)? Some people consider coding like learning a foreign language, but it's not like learning English. If we approach coding with this mindset, we invest a lot in it but we cannot get the desired results. If we deal with coding with the mindset, we only invest a lot in it, but we cannot get the desired results. What we need to do here is look at the output of this coding. What is the output of the coding? It is implementation. Also, another aim should be to train/have creative people with these coding classes. Otherwise, it would be a waste of time'.	Fetishisation of Coding Classes	Education Related Solutions	Solutions to Problems of Industry 4.0 Transformation Process

CHAPTER 3

RESULTS

This section outlines the findings of the content analysis of interviews and second-hand data. This section is divided into two sub-sections. The first section reveals the general finding of the data, and the second section explains the difference between face-to-face interviews and second-hand data. In the first section, as a result of the content analysis, sixteen main themes were obtained, and each theme includes at least two and up to fifteen sub-categories, which are also divided into open codes. Sub-categories and their open codes will be explained under each main theme, and findings will be analysed in relation to Industry 4.0. In the second section, it is revealed which main themes are taken from face-to-face interviews and second-hand date.

Table 3.1. Main Themes

MASTER THEMES	Theme Number	Themes
DEFINITION & HISTORY & DEVELOPMENTS OF INDUSTRY 4.0	1	Definition of Industry 4.0
	2	The History of Industry 4.0
	3	Industry 4.0 Related Developments in Turkey
INDUSTRY 4.0's STAKEHOLDERS & IMPACT	4	Stakeholders of Industry 4.0 in Turkey
	5	Role of Public Institutions in Industry 4.0 Process
	6	Role of Unions in Industry 4.0 Process
	7	Sectors that will be Impacted by Industry 4.0
	8	Impacts of Industry 4.0 on Blue-Collar Workers
	9	Impacts of Industry 4.0 on Employment of Women
	10	Impacts of Industry 4.0 on Employees with Disabilities
TRANSITION TO INDUSTRY 4.0	11	Emerging Occupations
	12	Perspectives on Future
	13	Problems Occurring in Transition Process
	14	Solutions to Transformation Problems
	15	Advantages and Disadvantages of Industry 4.0 for Companies
	16	Misconceptions about Industry 4.0

3.1. DEFINITION & HISTORY & DEVELOPMENTS OF INDUSTRY 4.0

3.1.1. DEFINITION OF INDUSTRY 4.0

Each inquiry in the research began with the definition of Industry 4.0, and I asked interviewees what Industry 4.0 means for them. In-person and online interviews show that there is no single/unique definition of Industry 4.0. In this section, I will explain the definitions of Industry 4.0, which can be grouped under the sub-categories given in Table 3.1.1.

Table 3.1.1. Definition Of Industry 4.0

Sub-Category Number	Sub-Categories
1	Automation And Robots
2	Digitalization
3	Internet Of Things
4	More Beneficial Usage Of The Internet Infrastructure
5	Continuing Processes
6	Virtual Systems
7	Changes In Business Models
8	Machine Learning
9	Smart Factories
10	Integration Of Components Comprising Value Chain
11	The Connection Between Machines And Humans

Content analysis brings out eleven different sub-categories. I observed that even though there is no agreed-upon definition among interviewees and online interviews, they stress similar concepts and components. Based on the sub-categories, Industry 4.0 is a digitalisation process shaped by automation, IoT (Internet of Things), more or more complex technological infrastructure in

operational processes and the integration of components comprising the value chain.

3.1.1.1. Automation And Robots

> "For me, Industry 4.0 has six basic parameters in 3 groups: Mechanical and robotics, electricity and electronics, information and communication." (*Interviewee 3*)

A majority of the interviewees clearly mentioned automation and robots and their possible impacts on business processes, models and relations. These findings demonstrate that automation and robots are one of the specified characteristics/components of the definition of Industry 4.0. Interviewees' general opinions define automation as 'The work in the industry, in management, in scientific and technical jobs that will be done automatically and without human intervention'.

> "Robots are the essential components of Industry 4.0. Industry 4.0 cannot be imaged without robots" *(Interviewee 3)*

A high-level of automation is seen as one of the most essential characteristics of Industry 4.0 and is identified with robots. They do not differentiate between automation and robots from each other. This indicates that some respondents regard automation as general robot technology, while some of them disagree with this statement. When I asked about automation in detail, one of the interviewees said that robots are the main components in the production process while other respondents indicate that considering Industry 4.0 as just comprising robots is a misconception.

> "Factories in today's technology use automation systems in production processes starting from planning to sale. That is why, robot technology and high-tech automated systems enable this fast and reliable production process." (*Interviewee 5*)

The findings show that interviewees stress automation. That is to say that factories utilise automated systems in whole or in part, starting with planning the production process all the way to taking the final product to the warehouse with today's technology. In this manner, my conclusion is that the objective of industrial automation is the utilization of automated gadgets to fulfill production tasks. Since computerized systems or robots can complete repetitive works rapidly and efficiently, it is becoming progressively significant in this production procedure. Automated tools used for this aim can also complete ordinary tasks that employees cannot carry out.

3.1.1.2. Digitalization

Digitalization is another frequently mentioned component of Industry 4.0 to define it. The analysis shows that traditional working and production systems are no more capable in today's business world where technology is becoming more and more crucial for daily and business life. For this reason, many companies are innovating in order to keep up with changing technology and new working systems. Thus, companies/Interviewees consider digitalisation as the basis of Industry 4.0 developments.

In the business world, digitisation can be expressed in the simplest terms as the transfer of manually generated data or professional processes to a computer or digital environment. With the rise of the computer, the process runs faster, and access to data, and data management become wieldier.

> "We can briefly describe Industry 4.0 as the digitalisation of factories and businesses. This transformation, which is not limited to just one production line or activity, means that almost all the work processes of a company are digitised. This era, in which interconnected processes are in communication, aims to communicate over the Internet collect data and completely change the production process. Also, this period includes significant components such as big data, objects Internet, cloud

computing, augmented reality, intelligent robots, and cybersecurity." (*Interviewee 16*)

Since the Industrial Revolution, mechanisation led to significant reduction in the need of labour force while increasing productivity. Thanks to Industry 4.0 and the Internet of Things (IoT), digitalisation is starting a new era in business. Data and resource management of enterprises are now more systematically and easily accessible in the digital environment.

> "Digitization is not only a matter of production but an important element in human resources management. One of the most important elements of Industry 4.0 is that companies manage their human resources digitally." (*Interviewee 10*)

As the number of employees in the organisation increases, managing employees becomes a more complex duty for companies, so digitisation becomes even more critical. Therefore, keeping employees' data and managing these data are essential tasks for companies. Time is as precious as gold today. Hence, operating all data in the digital environment saves both time and human labour. At this point, the analysis demonstrates that digitalisation is another significant component of Industry 4.0.

3.1.1.3. Internet Of Things

> "When the percentage of the Internet used by the devices to communicate with each other is higher than the percentage of the Internet used by people, then the era of IoT will have begun." (*Interviewee 7*)

> "When I say Industry 4.0, Internet of Thinks is the first think come to my mind. Can you imagine, every tool wil be able to talk to each other without any human intervention." (*Interviewee 5*)

Interviewees articulate the Internet of Things (IoT) to define Industry 4.0. The IoT is defined as ‘a network that is universally formed around objects that can be addressed uniquely and where objects can intercommunicate with each other by way of a certain protocol’ (Anderson and Rainie, 2008). This concept is also more broadly defined as a device system that communicates with other systems' interior tools and establishes an intelligent network by sharing information and employing various communication protocols.

> “With the Internet of objects, a revolution will now take place in the production sector. All production will proceed without human intervention. So the Internet of objects is one of the cornerstones of this new era.” (*Interviewee 13*)

> “Along with the Internet of things, all internal systems and external systems will be integrated. So the moment your customer orders the machines in the factory will start production in accordance with this order. The product produced will then automatically reach the customer. That is the Internet of Things.” (*Interviewee 10*)

> “But after that, the Internet of Things also gestates for a self-control mechanism. For example, meteorology will not have to be interpreted; everyone and every system will know and prepare for how the weather will be. With smart urbanization systems, there will be no need for mechanics/drivers in busses just like in the metro. With artificial intelligence, a mobile phone will be discovered to the very finest detail of how it can be produced at a lower cost, and a phone that will be broken down will be detected in advance, and the new one will be produced at the factory without a worker and sent to the user. No one will ever need to repair the phone.” (*Interviewee 7*)

3.1.1.4. More Beneficial Usage of The Internet Infrastructure

Most of the technologies that form the basis and definition of Industry 4.0 are still in use today, according to interviewees. Production technology has been undergoing this transformation for several years. However, the difference in the new era is that these devices, which are not integrated with each other, can now communicate by speaking the same language. Findings show that the effects of this change will not only be reflected in productivity and traditional forms of production but also in positive relations between producers, intermediaries, and customers. At this point, it is necessary to look at the technology underlying the infrastructure of Industry 4.0. That's why infrastructure of the Internet is more important for innovative developments during the Industry 4.0 processes.

> "Industry 4.0, for us as a telecommunications company, means to use all existing or planned Internet infrastructures more effectively, especially 4.5 and 5G." (*Interviewee 7*)

The needs of the customers are now changing as fast as technology. Manufacturers have to keep up with these customer expectations. For producers to fully benefit from Industry 4.0, they need to target significant transformations instead of small changes. A new production period is beginning to answer customer needs faster; one that is less erroneous and less costly and that uses fewer resources.

3.1.1.5. Continuous Process

> "It is not possible to give an exact date as the starting point of Industry 4.0 technologies. That is because Industry 4.0 is a continuation of a long-lasting process. It has been penetrated into our lives with smartphones, digital platforms, and RFID systems, GPS's." (*Interviewee 11*)

Content analysis shows that it is not possible to state when the Industry 4.0 process exactly started or how long it will last since Industry 4.0 is seen as a continuation of a long-lasting process. Industry 4.0 has already become a part of our lives with new technological tools, and it will continue to bring out new ones. Therefore, Industry 4.0 required to be defined as a continuing process.

3.1.1.6. Virtual and Cyber-Physical Systems

> "It is not possible not to see the use of Industry 4.0 and virtual-physical systems (intelligent objects, CPSs, Smart Factory-internet) as an industrial revolution." (*Interviewee 12*)

Cyber-physical systems (CPSs) that connect the physical world with the world of imaginary processing through sensors and actuators are another dimension to define Industry 4.0. CPSs comprising of different constructor elements form affect global behaviors and the business organizations. These components frequently involve software systems, communication technologies, and sensors/actuators, including embedded technologies to communicate with the physical world.

> "Today, the physical and the cyber world are intertwined. Industry 4.0 is also the art of transferring the physical world into the virtual world with codes. There are many robotic structures available to carry out human movements today. In the near future, these simulations will develop even further." (*Interviewee 4*)

A CPS that combines the physical world with the virtual processing world consists of two essential elements. The first one is the network created by objects and systems communicating with each other on the Internet and within a designated Internet address. The second one is a virtual environment that is generated by a simulation of the objects and behaviours of the real world in the computer environment. In other words, interviewees intend to say that Industry

4.0 means visualisation of the real world in the computer environment with cyber-physical systems.

3.1.1.7. Changes In Business Models

> "Digital technologies change the supply chains, production processes, marketing and sales channels, human resources, R & D, finance, inventory, and logistics systems in the enterprises." (*Interviewee 13*)

> "For Turkey, it is necessary for all industrial companies to facilitate access to digital technologies, to create digital industry platforms, to provide appropriate solutions for the widespread adoption of smart industry, and to work with all stakeholders around a common country plan and target." (*Interviewee 13*)

The findings show that interviewees do not only define Industry 4.0 as technological developments but also as changes in business processes and models. Content analysis shows that changes in the business models through digital developments are seen as the components of Industry 4.0. That is to say, Industry 4.0 is also seen as a change in business processes.

> "Companies have to move to a new organizational structure with digitalization, which is the basis of new competition. Companies have to change their foreign relations and strategies in this direction. Changes made within the company must be integrated with external stakeholders. For example, your suppliers, dealers and distributors should adapt to your changing business processes." (*Interviewee 13*)

Moreover, Industry 4.0 is not only defined as a phenomenon influencing the internal processes of companies but also a concept affecting their external relations. It is regarded as a tool that forces companies to transform their organisational structure, creating a new basis of competition. Companies, which

are not converting to Industry 4.0 technologies and strategies, are considered companies that will disappear.

3.1.1.8. Machine Learning

> "Machine learning is software's and algorithms' measurement and interpretation of data in real-time without having to ask a human. Machine learning can be software within a robot or machine; it is the digital maintaining of the entire flow of production without human intervention." (*Interviewee 14*)

Since machine learning is expected to accelerate by using smart algorithms, findings show that machine learning is considered to be significant characteristics of Industry 4.0. Machine learning is a system, which focuses on the installment of algorithms that can be found out as basic functions and envisaged from data. Rather than alphabetically tracking static program instructions, these algorithms serve through the models making data predictions and taking decisions from sample data.

> "It is on the agenda that the machine can work on its own in Industry 4.0 or even communicate with other machines on the environment. So the machines, like people, will talk and even they are talking now. There will be machines that produce on their own, report what they produce, or even create solutions by analyzing them if there is a problem with the production that they will be made in the next stage. At present, developed countries have this way of production parts. Very few of the companies that use technology intensively have such productions." (*Interviewee 15*)

Machine learning is also believed to go beyond the role of accelerating production and financial calculations. Some of the interviewees state that machines will improve their communication capacity by talking/communicating with each other. That is to say; machines will be more holistic

mechanisms/algorithms that produce themselves, report their work, detect and analyse manufacturing defects, and find solutions to these defects.

3.1.1.9. Smart Factories

This new type of factory is called a 'Smart Factory' and is a combination of the imaginary and physical worlds via cyber-physical systems and the ending up a combination of operational and management processes. This new process, which has emerged thanks to Industry 4.0 and is shaped as the Smart Factory concept, aims to eliminate the problems of the production process caused by humans and to ensure the continuity of production. The goal at Smart Factories is to make full flexible production at the highest speed possible. However, interviews agree that while there are currently some examples of smart factories, there are too many steps to take for an entirely smart factory without any human intervention.

> "In short, we can summarize that this new structure, smart digital factories, aim to unite physical production and digital solutions. Companies that will adapt this concept to their production will better meet customer needs faster, more flexible, with better quality and more efficient manufacturing, and gain a competitive advantage in changing market conditions." (*Interviewee 18*)

The responses of interviewees stress that in the current business world the essential factor triggering the emergence of smart factories is a failure of manufacturing activities originating from human or instrument errors in companies/factories. As a result of this situation, the development process of the Smart Factory concept, which enables automation systems to move to the next stage, started to remove existing manufacturing problems.

3.1.1.10. Integration Of Components Comprising Value Chain

The concept of Industry 4.0 is further described as the integration of value chains beyond automation. The most significant characteristic of integration is the real and continuous communication within the entire value chain. This feature describes a rapid, agiler, and more productive industrial journey. Two kinds of integration are addressed: internal and external integration.

> "This integration cannot be done just in the factory because you digitize your fabrication as you like. You do not live alone, but you live in an ecosystem. So, your ecosystem has to transform; the raw material suppliers, the semi-finished products, your dealer, the distributor, and so on." (*Interviewee 14)*

Internal Integration: Interviewees state that there would be a fast integration between internal mechanisms such as labour, machines, materials, products, tools, and equipment. In brief, this integration meant to provide integrated communication between all of the components of the internal value chain.

> "For example, the automotive sector. Subcontractors, logistics, customs, from mining to metal, all of the sectors are bounded to the factory. Not to parse, but to combine them digitally is necessary." (*Interviewee 14)*

External Integration: The digital transformation of the company on its own is not seen as an appropriate move by interviewees. Because this integration process requires the involvement of other players, including suppliers, other competitors, customers, distributors and others associated with the production and distribution process. That is called the 'macro impact' of integration. Therefore, digitalisation does not mean dissociation from other players; in contrast, it is unification.

3.1.1.11. Interaction Between Machines And Humans

> "When we consider the major components that make up the Industry 4.0 such as objects of the Internet, big data, cloud computing, increased reality and cybersecurity, we see that most employees will work as colleagues with machines in the next decade." (*Article 22*)

As part of the Fourth Industrial Revolution, human-machine interactions are increasing and intelligent technologies are rapidly penetrating every aspect of our lives. Nowadays, it is natural for people to interact with each other at any time and place using smartphones and the Internet. With Industry 4.0, this situation will develop further, and the concept of the Internet of Things will be adopted in addition to the current Internet concept. Humans communicating with each other through machines give way to machines and systems that communicate with each other. The findings also show that high-tech machines will be colleagues with the human labour force, in contrast, to entirely replacing it.

3.1.2. HISTORY OF INDUSTRIALIZATION

Throughout history, humanity has witnessed many technological revolutions that have had a profound effect on the forms of production and social life (Acemoglu, 2012). In this content analysis, interviewees articulated similar statements about the history of Industry 4.0. The point they emphasise is that Industry 4.0 cannot be fully understood without analysing the previous industrial revolutions in detail. That's because the former revolutions did not only impact the forms of production but also socio-cultural life. Hence, the previous revolutions and their impacts can provide a basis to understand the possible effects of the current industrial revolution.

> "I need to go to a bit of history to get a better understanding of the concept of Industry 4.0. We cannot interpret Industry 4.0 without understanding the previous industrial revolutions. All of the industrial

revolutions are like a chain, so they impact each other born. That is why the history of industrialization carries importance to interpret current developments." (*Interviewee 14*)

According to the content analysis, the historical roots of Industry 4.0 can be divided into six different sub-categories: New Era, Factors Triggering the Fourth Industrial Revolution, Industrial Revolution, Taylorism, Invention of Automation and Social Impacts of Revolutions.

In this section, I will explain the historical roots of Industry 4.0 as they emerged in the current data set.

Table 3.1.2. History of Industrialization

Sub-Category Number	Sub-Categories
1	Factors Triggering Industry 4.0
2	New Era
3	1st Industrial Revolution
4	2nd Industrial Revolution
5	3rd Industrial Revolution
6	Social Impacts of Revolutions

3.1.2.1. Factors Triggering Industry 4.0

"Industry 4.0 was developed by Germany to compete against China. Developed countries such as the US, Europe, and Japan said, 'We do not have a chance to defeat China regarding labor,' and as a consequence, the concept of Industry 4.0 was born. The cost of physical labor is meager in China with a population of over a billion, and with this advantage, it is almost impossible to compete with China. Worker monthly wages are $

100 in China, while in Germany it is around 3-4 thousand Euros." (*Interviewee 15*)

The drive to upgrade forms of production triggered previous industrial revolutions; thus, countries and industries aimed to improve their production capacity. In contrast to previous revolutions, the primary driver in Industry 4.0 is the competition between Eastern and Western industries, and the main players are Germany and China. Interviewees interpret the primary driver of Industry 4.0 as Germany's desire to regain production supremacy from China. China's low-cost labour threats German markets, and Germany aims to improve its technological infrastructure to produce at a lower cost and without labour-force.

3.1.2.2. New Era: Industry 4.0

"With the development of the technology of interest, the steps of Industry 4.0 have been actually taken since the early 2000s, but the first declaration of the Fourth Industrial Revolution was made at the Hannover Industrial Fair in Germany in 2011." (*Interviewee 11*)

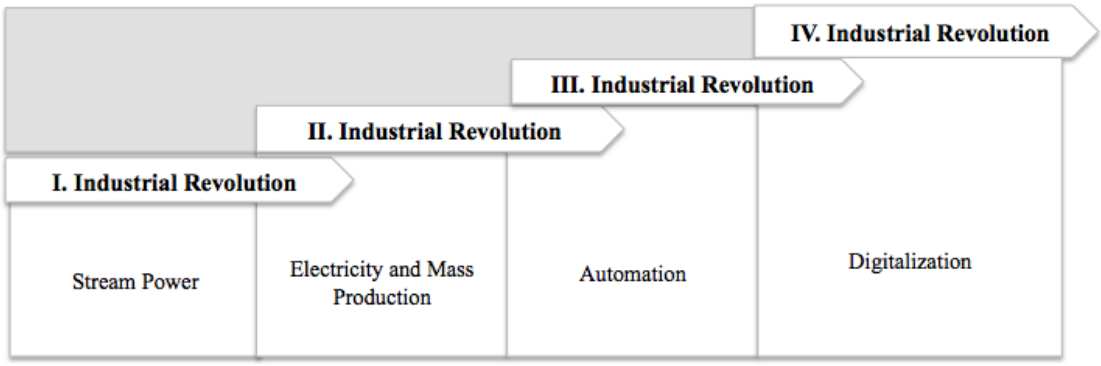
Interviewees interpret Industry 4.0 as a new era due to the emerging and developing technologies and their impacts on the business world and social life. Even though they do not offer a specific date as the starting point, they agree that the 2011 Hannover Fair in Germany was the first time Industry 4.0 was officially mentioned. Industry 4.0 subsequently figured in the German Federal Government's 2012 Fourth Industrial Revolution Proposal File.

"Industry 4.0 is a revolution, not being an entirely new entity, which occurred with the technological developments in the industrial sector, with next-generation scenarios." (*Interviewee 12*)

The findings show that Industry 4.0 is not a new entity, and it is beginning to show itself in a process that has been developing for several years.

Even though Industry 4.0 is not necessarily ‘new’, interviewees agree that it is a revolution.

Figure 3.1.2.2. Industrial Revolutions in Production



Based on the information gathered from the interviews, it can be concluded that every single revolution brings together a unique production style by combining progress made in former revolutions. The First Industrial Revolution brought steam power, the Second Industrial Revolution brought electricity and mass production and the Third Industrial Revolution brought this together with automation. It is apparent that Industry 4.0 is bringing a considerable digitalisation wave, which will entirely change the current forms of production.

3.1.2.3. 1st Industrial Revolution

> “In 1786, ’mechanical’ revolution started with steam machines, an era of Industry 1.0 began.” (*Interviewee 13*)

> “The essence of the Industrial Revolution was a machine, and man met the machine”. (*Interviewee 15*)

The First Industrial Revolution was born in England spread all around the world. In this Revolution, which started in the 1760s and lasted until the 1830s, production evolved from the labour force to machine power (Ashton, 1997). Steam-powered machine production began to take the place of the human labour

force as humanity met with machine technology. Large-scale factories gained power as small business facilities diminished slowly. That is to say, the products' variety, quality, and quantity increased, which influenced not only the economy but also the social structure (Ashton, 1997). Content analysis also shows similar findings in line with Ashton's statements as seen in the quotations below.

3.1.2.4. 2nd Industrial Revolution

> "At the beginning of the 20th century, we did get to know the production lines, the division of labor and the mass production concepts that made possible by electricity. We can also call this period the Ford Era." (*Interviewee 19*)

According to the content analysis, another vital period that set the groundwork for Industry 4.0 was the Second Industrial Revolution. This Revolution refers to economic and social changes between 1870 and 1914 and is also known as the Technology Revolution. The problem of transportation was nearly solved with the invention of steam-powered railways, which made access to materials and delivery of products to other countries easier and faster. Additionally, mass production emerged as a consequence of more technological machines.

3.1.2.5. 3rd Industrial Revolution

> "By the end of the 1970s, we were introduced to the concept of automation in manufacturing through advances in electronics and information technology. Also, we see the first uses of industrial robots in this period. So that Industry 3.0 developments prepared the environment for the Industry 4.0 to born. As you see, all of the revolutions are like a chain, they create the appropriate environment for the next one." (*Interviewee 19*)

The Third Industrial Revolution is also defined as the Invention of Automation or the Revolution of Electricity. The development of communication technologies was the core characteristic of this period according to the content analysis. Usage of computers in production enabled production to become much easier. While all sources (second-hand data, face-to-face interviews and magazine articles) agree on the existence of 3rd Industrial Revolution, there is no agreement on a specific start period for this Revolution in contrast to previous revolutions with exact start dates.

3.1.2.6. Social Impacts Of Industrial Revolutions

All of the interviewees who spoke regarding the history of industrial revolutions agree that all of the previous industrial revolutions did not only have an impact on economic structures but also on the social and cultural structures. Interviewee 19 mentioned that every industrial revolution is not only a form of production but also a phenomenon that also affects and changes the way people live. Therefore, industrial revolutions changed not only the forms of production but also the ways people live.

> "The 2nd and 3rd industrial revolutions have made the way of life incredibly difficult, and humanity has felt that they were born only to work." (*Interviewee 19*)

Content analysis also demonstrates that serious social impacts emerged with previous industrial revolutions. Interviewee 19 states that the First Industrial Revolution led to different developments in social life: prolongation of lifespan, increase in population, increase in the number of products, urbanisation, and more international market competition as well. Moreover, printing improved along with the industrial revolution, which led people to reach quickly to more paper-based scripts and books. Hence, an increase in the number of books drove changes in the cultural structure. On the other hand, the class of workers came

into existence as a result of the First Industrial Revolution because there was a need for people to operate the large factories for production.

According to the analysis, the most profound social impacts of The Second Industrial Revolution were increased individualism, easier access to information. Interviewee 19 explained the social impacts of this era: “The first visible social impact of the Second Industrial Revolution was a shift from a more collective society to an individual one. People who gained financial independence began to live alone and it gave rise to the nuclear family structure. On the other hand, this Revolution made daily life harder because people had to work more and could not find their jobs meaningful and fulfilling during Fordism period.”

The most profound effect of the Third Industrial Revolution was the abolition of human power in production. Since computers have started to perform most of the tasks previously performed by humans, humans' direct intervention in many tasks has diminished. On the other hand, easy access to information and increased individuality has caused a rise in general consciousness and inquiry.

> “Although working conditions improved over time, a large part of our life was based on work. Now in the 4th Industrial Revolution, it is aimed at the idea that 'people should work, not physically but mentally. Occupations to be made in the form of knowledge and mentality will be formed instead of physical professions. Briefly, new jobs will be created that we do not yet know.” (*Interviewee 19*)

It is expected that the new industrial revolution will have social impacts along with economic consequences. One of the interviewees emphasized examples from the previous revolutions and stated that people will no longer want to perform physical labor and will instead prefer mental labor. Thus, new jobs will be created, and some of the current occupations will disappear.

3.1.3. INDUSTRY 4.0-RELATED DEVELOPMENTS IN TURKEY

While there are many investments and developments around the world related to Industry 4.0, this project focuses on the current developments in Turkey. Thus Industry 4.0-Related Developments in Turkey became the third theme in my research, with five sub-categories. These sub-categories are given in the Table 3.1.3.

Table 3.1.3. Industry 4.0-Related Developments in Turkey

Sub-Category Number	Sub-Categories
1	Positioning of Turkey
2	Expected Time Schedule for Turkish Companies' Transformation
3	Digital Developments in Public and Private Sector
4	Inadequate Improvements in Organisational and Social Infrastructure
5	Industry 4.0-Oriented Companies in Turkey

3.1.3.1. Positioning Of Turkey

> "We always say that in the previous transformations we missed the printing, we missed the industrial revolution, we are not in the ranking where we have to be in the information society index. Now, Industry 4.0 is an opportunity for us. But we have fundamental problems." (*Interviewee 8*)

Analysis shows that local Turkish industries are still positioned between the Second Industrial Revolution and the Third Industrial Revolution, while developed countries are currently experiencing Industry 4.0. All of the sources agree that Turkish industries need to take additional steps to catch up to the level of international Industry 4.0 developments and opportunities. The findings also

indicate that respondents felt Turkey was a latecomer to the previous industrial revolutions, but that there is still time to participate in Industry 4.0.

> "Experts show Turkey's level of maturity for Industry 4.0 in somewhere between 'Industry 2.0' to '3.0 Industry'. However, our industry, at this level, is still rapidly making 'Industry 4.0 preparations." (*Interviewee 24*)

On the other hand, some of the interviewees felt that Turkey still needed to develop its infrastructure because Turkish industries are not mature enough for Industry 4.0 as compared to developed countries.

Awareness is another issue concerning current developments in Turkey. The findings demonstrate an increasing awareness of Industry 4.0 in both the private and public sectors. Interviewee 8 mentioned that there have been a number of trainings and conferences held by consultancy companies, private companies and the state; interest for these events is quite high. Also, many magazines have chosen Industry 4.0 as the main theme. Additionally, the Ministry of Science, Industry, and Technology also takes Industry 4.0 into account while developing strategic plans.

3.1.3.2. Expected Time Schedule For Turkish Companies' Transformation

> "You pack your solutions, you develop your applications, you prepare the infrastructure, but it takes 20 years to create human material that can handle it and carry it forward." (*Interviewee 25*)

Analysis shows that even though the Turkish private and public sectors are preparing for Industry 4.0, it will take at least 20 or 30 years to become fully ready for a digital transformation. The private and public sector have to collaborate to proceed in this process, package solutions, develop applications, prepare the technological infrastructure and train human resources. The most important reason for Turkey to fulfill Industry 4.0 process about 20 years is the time to create well-trained/qualified workforce.

3.1.3.3. Digital Developments In Public And Private Sector

The content analysis indicates that there have been initiatives taken by both public and private sector players to develop the services and opportunities for local industries. Interviewee 11 and 13, for example, mentined that the Ministry of Science, Industry, and Technology also took Industry 4.0 into consideration to create strategic plans, and some individual entrepreneurs established Industry 4.0 platforms to train companies and increase their awareness about Industry 4.0.

3.1.3.4. Insufficient Improvements In Organizational And Social Infrastructure

"It is an important advantage for you to be ready to take positions in such social changes with your infrastructure, level of education, and cultural transformation. If you have a shortage of these points I mentioned, I think you should fulfill these deficiencies very quickly, and do quick work to get rid of these problems. That is not very easy. It seems that our deficiencies will continue to prevent us." (*Interviewee 8*)

"Turkish companies crawl on all fours." (*Interviewee 3*)

The findings indicate that Turkish companies still have insufficient infrastructure to initiate Industry 4.0 applications; this is the most significant obstacle in front of them. Their corporate culture, technological infrastructure, human resources, and corporate relations are not sufficient for such a vast transformation. If they try to apply digital applications without being fully competent at these skills, they will fail and have to return to the starting point to solve any problems occurring during the transformation process.

3.1.3.5. Industry 4.0-Oriented Companies In Turkey

The participants believe that some Turkish companies are trying to develop their infrastructure and corporate culture to adapt to Industry 4.0 trends. These companies are Tofaş, Bulutistan, Vodafone Turkey, Turkcell, Koç Holding, Denizbank, Arçelik, Mercedes Benz Turkey, Siemens Turkey, and Bosch. Interviewees view these companies as the best examples of adapting their systems to Industry 4.0 requirements.

At a global level, Germany is leading in Industry 4.0-related initiatives, and Samsung, iPhone, General Electric, Volvo, and Schneider are excellent examples given by interviewees.

3.2. INDUSTRY 4.0's STAKEHOLDERS & IMPACT

3.2.1. STAKEHOLDERS OF INDUSTRY 4.0 TRANSFORMATION PROCESS

Stakeholder engagement is one of the cornerstones of a well-managed project (Güntekin & Küçük, 2004). The level of Industry 4.0 related developments in Turkey shows that there are urgent needs that must be met in order to reach the same level as developed countries in Industry 4.0 initiatives. Designating the stakeholders of this process and determining their roles in these initiatives is one important action for Industry 4.0 initiatives. Therefore, the designation of stakeholders and important players of Industry 4.0 in Turkey is necessary to prepare for the requirements of Industry 4.0-related implementations. As noted above, a company or a state cannot develop Industry 4.0-related initiatives alone. There must be internal and external integration not only for production but also for management of the general process. At this juncture, the analysis indicates that stakeholders are divided into two groups: internal and external stakeholders of Industry 4.0. The sub-categories of this theme are shown in Table 3.2.1.

Table 3.2.1. Stakeholders of Industry 4.0 Transformation Process

Sub-Category Number	Sub-Categories
1	Internal Stakeholders
2	External Stakeholders

3.2.1.1. Internal Stakeholders

To be able to prepare the infrastructure, production style, corporate culture and human resources, companies need to take steps and strengthen their internal departments. At this point, analysis indicates the importance of certain groups as stakeholders of the Industry 4.0 transformation process for local companies. These groups are listed as Innovation and Business Development Departments, Management Team, Employees, and Shareholders.

Table 3.2.1.1. Open Codes of Internal Stakeholders

Axial Code Number	Axial Code Title
1	Innovation Department
2	Business Development Department
3	Employers
4	Employees
5	Shareholders

3.2.1.2. External Stakeholders

The inclusion of companies' internal departments into the transformation process is not sufficient on its own to create a properly working system. Therefore, external stakeholders' inclusion in this transformation process is also a must. Collaboration with public institutions, suppliers, clients, universities,

NGOs, and trade unions is believed to support and accelerate this transformation process for companies.

> **"**The inclusion of companies' internal departments into the transformation process is not sufficient on its own to create a properly working system. Therefore, external stakeholders' inclusion in this transformation process is also a must." *(Inteviewee 4*)

Table 3.2.1.2. Open Codes of External Stakeholders

Open Code Number	Open Codes Title
1	Public Institutions
2	Suppliers
3	Clients
4	Universities
5	NGOs
6	Trade Unions

3.2.2. SECTORS TO BE AFFECTED BY INDUSTRY 4.0

In this section, the sectors expected to be impacted by Industry 4.0 are discussed. According to the findings, there will be no industry, which will remain unaffected by Industry 4.0 processes. It is estimated that the effects of Industry 4.0 will be observed earlier in sectors where the labour force is heavily used, the variety of products is not very high, and the structure of the product is not very often changed. The manufacturing, retail, and finance (banking) sectors in particular are expected to be deeply affected by recent technological developments. Other industries, which are listed in this section, are the logistics, automotive, agriculture, and service sectors.

"New consumer behaviours, which are affected by e-commerce systems, mobile payment technologies, virtual reality (VR) and increased reality (AR) applications, will challenge almost every aspect of retail to transform." (*Interviewee 13*)

"I think industrial 4.0 technologies can be used more easily in sectors where the variety of products is not so high and the structure of the product is not very often changed." (*Interviewee 4*)

"The biggest problem is that nobody realizes that the power of labor is gone in agriculture." (*Interviewee 3*)

Even though these sectors have started to experience transformation processes, the immediate impacts are not yet strongly felt. The elimination of the labour force in the agricultural sector, for instance, is being experienced but there is no awareness of this trend. However, this decreased demand for labour does not mean that there will no longer be a need for a labour force. According to some interviewees, this transformation process not only changes the structure of companies and business models but also changes the content of jobs as well.

3.2.3. IMPACTS OF INDUSTRY 4.0 ON BLUE-COLLAR WORKERS

Based on the findings of the content analysis, it is undeniable that Industry 4.0 will revolutionise production lines. This revolution will be realised through the idea of smart production with modern automation systems that transfer data. Also, research firm Gartner's report of "Predicts 2018: AI and the Future of Work" (2017) indicates that in the near future, 2.3 million robots are expected to be used in production lines. In particular, blue-collar workers constitute 75% of the work force in Turkey, and it seems that they have to revise their skills. That's why the impacts of Industry 4.0 are important to examine.

Table 3.2.3. Impacts of Industry 4.0 on Blue-Collar Workers

Open Code Number	Open Code Title
1	Impacts of Industry 4.0 on Employee-Employer Relations
2	Change in Blue-Collar Concept
3	Job-Protection Problem for Qualified Employees and Unemployment

The content analysis reveals three sub-categories of impacts of Industry 4.0 on blue-collar work, which are shown in Table 3.2.3. These sub-categories are: Impacts of Industry 4.0 on Employee-Employer Relationships, Change in Blue-Collar Concept and Job-Protection Problem for Qualified Employees and Unemployment.

3.2.3.1. Impacts Of Industry 4.0 On Employee-Employer Relationship

The content analysis indicates that the radical change that took place in the economic and production structures has undoubtedly impacted the industrial relationships between employees and employers like happened in previous industrial revolutions.

Employee-employer relationships during the Industry 4.0 transformation process also emerged as a critical theme, which includes: changes in employee-employer relations; emerging need for higher quality employees, changes in employment models; and changes in legal regulations.

> "Learning mentality/capacity of the employees have importance in this sense. I can define this as digital smart and futurist smart." (*Interviewee 5*)

> "For example, the already existing attorney profession will begin to analyze the code to examine the crimes of artificial intelligence products." (*Interviewee 7*)

Employers have to enable employees with digital skills and open to change. Therefore, companies have to take responsibility for the transformation of training. Employees with digital skills are needed in this transformation process, which will shape new types of employee-employer relations. As a result of the need for qualified employees, employers have to invent new strategies for employment because new highly qualified employees' will be selective in the employment process, unlike the current employment models.

> "There will be changes in individual and collective bargaining law. Employment patterns may vary. This effect can also reflect on the legislation in different working relationship areas. Multilateral changes will also have to be made in the area of collective labor law, permits, and shift regulation. For example, IT workers work from home, but according to legislation they have to go to work. Regulations must be made correctly." (*Interviewee 1*)

According to interviewees, new legal regulations have to be enacted due to changing contents of the jobs and new work conditions, which will affect the roots of industrial relations among employees, employers, and unions. Interviewees indicate that changes in business models reflect collective bargaining agreements, and this can also necessitate regulations in collective labour law. At this point, they remark that regulations must be made appropriately.

3.2.3.2. Change In Blue-Collar Concept

> "The concept of a typical blue collar will surely disappear, and grey-collars will appear." (*Interviewee 1*)

It is impossible not to expect any change in the concept of blue-collar work while many changes in production processes and forms are happening. Analysis indicates that changes will occur in the current conceptualization of blue-collar work, which will be transformed into a different model of employees

in the near future. The current conceptualization of blue-collar work includes performing heavy-force required tasks in productions lines but high-tech machines and robots will perform their tasks, and blue-collars will work on task requiring more mental abilities.

3.2.3.3. Job-Protection/Security Problem For Qualified Employees And Unemployment

> "I think Industry 4.0 and later will be a period of natural selection where only people with digital skills can find new fields for themselves." (*Interviewee 7*)

> "…for those with qualifications it may mean job security." (*Interviewee 4*)

The findings indicate that blue-collar workers have to gain new skills to adapt to the new digital age while white-collar workers have to protect their skills and improve to hold onto their jobs. That is to say, not only blue-collar workers but also white-collar workers are at risk of losing their jobs. While this means unemployment for blue-collar workers if they remain unqualified without any digital skills, it will increase the difficulty for white-collar workers to find a new job if they do not develop their digital skills. In conclusion, both blue- and white-collar workers have to gain new digital skills or expand their existing skills to protect their jobs.

> "Because I think robotics will do blue-collar jobs." (*Interviewee 8*)

> "With the more efficient use of technology in all processes, it is predictable that there will be an employment contraction in jobs requiring labor-force and jobs in logistics." (*Interviewee 11*)

> "If we think about the possibility that robots can dominate all areas where people are active, at the point where industry 4.0 is literally dominant in

the world's industrial world, this will be the biggest problem of employment." (*Interviewee 12*)

"Arçelik had 3,600 workers working in the electronics manufacturing plant in Istanbul, but the number of blue-collar workers decreased to 1,700 with this factory's transition into LCD." (*Interviewee 6*)

The most prominent risk concerning blue-collar workers in the digital transformation age is undoubtedly unemployment. All of the face-to-face and online interviews indicate that unemployment is the most significant problem for blue-collar workers stemming from Industry 4.0-related developments. High-tech machines, automation, and robots are shown as the underlying reason behind the unemployment of blue-collar staff.

Even though all of the interviewees discuss the possibility of unemployment for blue-collar workers, they do not consider this unemployment to be an unsolvable problem. Trainings on digitalisation-related skills are discussed as a solution to this problem. The problem of unemployment cannot be denied but can be resolved in the near future if companies or the state can provide the necessary types of training and education to blue-collar workers. Moreover, employees with digital skills may not continue to work in blue-collar jobs but may instead transform themselves into white-collar workers.

3.2.4. THE ROLE OF PUBLIC INSTITUTIONS IN INDUSTRY 4.0 PROCESS

According to this analysis, public institutions are one of the stakeholders of the Industry 4.0 transformation process in Turkey. In this section, the roles of public institutions expected by interviewees are explained. The roles expected of public institutions by interviewees are shown in Table 3.2.4.

Table 3.2.4. Role of Public Institutions in Industry 4.0

Sub-Category Number	Sub-Categories
1	Support to Educational Institutions
2	New Regulations
3	Supporting New Developments with Incentives
4	Training Employees and Employers for Emerging Needs

3.2.4.1. Support To Educational Institutions

> "At this point, I think that the industrial 4.0 revolution can be captured with the support given to scientific institutions, organizations, universities and R&D studies." (*Interviewee 12*)

Companies urgently need innovation to transform their business processes, and their Research and Development Departments' resources are not sufficient for such a huge transformation process. At this point, collaboration with universities is important. In Turkey, most of the universities are owned and financially supported by the state. Therefore, state support to universities and educational institutions would accelerate the innovations created by educational institutions.

3.2.4.2. New Regulations

> "As seen in the German example, one of the greatest tasks in the Industry 4.0 process falls on the states. It is of utmost importance that such great transformations are realized with state support. Governments are accelerating the development of Industry 4.0 strategies and processes through collaborations they have made with universities, industry representatives, non-governmental organizations and think tanks and legal regulations to protect private sectors. These collaborations and

> regulations will prevent possible economic, developmental and social problems and conflicts." (*Interviewee 5*)

This analysis further signals the importance of state regulations and support by the Ministry of Science, Industry and Technology for Industry 4.0 transformations. Even though the Ministry of Science, Industry, and Technology releases Annual Industry 4.0 Action Plans as official national strategy, it is not seen as sufficient support for recent developments by interviewees. According to them, companies and employees need more comprehensive plans and regulations. Interviewees believe new regulations will prevent potential social problems related to Industry 4.0.

> "Some industrial relations related and social problems may emerge during the transformation process due to juridical preparedness levels of the countries for Industry 4.0 developments. At this point, countries' national policies and future preparedness levels will reduce or increase potential social problems that they will face. Blue-collars are one the groups whose future is uncertain. Thus, Turkish Parliament should take some quick steps. However, the current agenda of Turkish Parliament does not regard this issue. " (*Interviewee 13*)

Employee rights, for instance, are seen as an area where new regulations are immediately required. According to existing law, employees have to be in their offices for a specified amount of time. However, most white-collar workers like designers and IT staff work from home, which is not mentioned openly in the current law. Additionally, the future of blue-collar workers is not clear and there has been no action taken by the government. According to *interviewee 8*, the German Parliament has discussed payments to blue-collar staff and other employees who are expected to lose their jobs. Some of the German deputies suggest levying an additional tax on companies that depend heavily on robots, and redistributing a portion of this tax to people expected to lose their jobs.

3.2.4.3. Supporting New Developments With Incentives

> "With the investments in the coming period, Turkey's Industry 4.0 roadmap may need to be supported by specific incentives." (*Interviewee 16*)

A program or incentive to encourage realistic investments in existing facilities for Industry 4.0 would accelerate factory managers' decision-making processes and solve the problem of production deceleration during some periods of the year. This incentive is also seen as critical for the Turkish industry. Serious investments have to be made to transform the traditional economy into an Industry 4.0 economy. Prioritized investments will require local production systems to adapt to the conditions of Industry 4.0.

3.2.4.4. Training Employees And Employers For Emerging Needs

> "In the area of Industry 4.0, initiatives are also being carried out to train human resources with expertise, but accelerating these processes, establishing the digital world, and obtaining the competent workforce must be brought to the Turkish industry as soon as possible." (*Interviewee 16*)

> "If we cannot prepare human resources today, we can not adapt to the industry 4.0 process. Private organizations and companies should also follow policies to ensure that their employees can adapt to the new era with in-house training programs." (*Interviewee 13*)

Interviewees stressed the importance of training and education in the transformation process. They believe that training/educating people would solve potential problems in this process. In this sense, public institutions have to share education and training responsibilities with companies. Public institutions like ministries and IŞKUR (the Turkish Employment Agency) might prepare plans and trainings. These trainings are expected to help current employees adapt to

conditions of Industry 4.0 technologies. The findings of this analysis show that if the present employee groups cannot be well prepared for the new Industry 4.0 era, they will be useless.

3.2.5. THE ROLES OF UNIONS IN INDUSTRY 4.0

The Labor Union concept emerged after the First Industrial Revolution as an organisation that protects the rights of employees against the employer and the state. It was created to remove the power imbalance between the labourers and the employer that started after the industrial revolution. The union was established to protect and develop the interests and rights of the labourer (Özkiraz, 2018). In an environment where unemployment of blue-collar workers is being discussed, it is impossible to exclude unions from the discourse of Industry 4.0. My analysis demonstrates that unions are one of the important players in the Industry 4.0 transformation process. The findings in this section explain the roles of unions during this transformation process according to face-to-face and online interviews. Sub-categories of this theme are presented in Table 3.2.5.

Table 3.2.5. The Roles of Unions in Industry 4.0

Sub-Category Number	Sub-Categories
1	Increasing Awareness of Employees
2	Enlarging Target Population
3	Industry 4.0 is not on the Agenda
4	Adaptation to New Digital Circumstance

3.2.5.1. Increasing Awareness of Employees

> "In this regard, it may be good to organize training to raise awareness of the blue-collar." (*Interviewee 1*)

Interviewees state that employees are not aware of Industry 4.0 and its impacts. Unions, as advocates for employees, should help provide training and raise employee awareness about Industry 4.0. That is necessary because no one is working to educate or raise awareness of employees about Industry 4.0. Companies and unions are expected to move collaboratively to prepare employees, especially blue-collars employees, for the coming transformation process and changes.

3.2.5.2. Enlarging Target Population

> "It is obvious that if the number of blu-collars will decrease, the number of union members would obviously decrease in the same direction. However, unions have still a chance. A new type of workers will emerge, which is grey-collars. Thus, they can target the new-born grey-collar and white- collar workers." (*Interviewee 1*)

Interviewees suggest a new target population for union membership because they believe that blue-collar workers will lose their jobs or upgrade their qualifications during Industry 4.0 transformation processes. They believe that targeting white-collar workers and the emerging type of new-collar workers (gray-collars) would solve unions' potential membership problem. The member numbers and the representative powers of the unions have begun to decline or become stagnant in recent times, and these new target groups would help unions regain their strength.

3.2.5.3. Industry 4.0 Is Not On The Agenda

> "The union renewed its own sub-structure. All the data is kept digitally, but only the union administration can access to data. There is no specific precaution or attempt to include our members in this system because we do not have such a need." (*Interviewee 6*)

I conducted one interview with a union manager from Turkish Metal Union (Türk Metal Sendikası). During the interview, I found that the Union is not aware of Industry 4.0 and they are not taking any action in this context. When I asked the union manager what digitalisation means for the union, he talked about their intranet and limited access to the Union's database. When I requested him think about digital developments in factories, he remembered the decline in the number of blue-collar workers in Arçelik's factory. Even though the Union is aware of the increasing tendency to use high-tech machines and robots in production lines, they do not feel responsible for taking any action.

> "Such types of subjects are not on the agenda unions, they do not pay attention on Industry 4.0 or similar developments. They just focus on how they can get more fee from their members, and they are mostly busy with political issues." (*Interviewee 3*)

Other interviewees think that unions are not aware of Industry 4.0 developments and its potential impacts, and they claim that Industry 4.0 is not on the agenda of unions.

3.2.5.4. Adaptation To New Digital Circumstance

> "It is obvious that blue-collars are not aware of Industry 4.0 related developments. At this point unions have to improve themselves and learn more about ındustry 4.0 and then inform their members. It is not only the duty of companies, but also the unions'. Both parties have to inform employees about the changing needs of employers. Therefore, they have to learn about Industry 4.0 and its impacts and take precautions against new industrial circumstances. Then, they can inform their members and protect members' rights." (*Interviewee 4*)

Interviewees also indicated that unions need to change their current functions; they have to adapt to new industrial circumstances stemming from digital developments. Technological developments influence operations and

production processes; this influence leads to changes in industrial relations. In the end, unions, as advocates of employee rights, are expected to improve employee functionality and perspectives for new industrial requirements. As stated above, one of the roles of unions is to inform members (blue-collar workers) about their rights in Industry 4.0 era. For this purpose, unions have to first become informed about Industry 4.0 and then train employees about the new work conditions.

3.2.6. Industry 4.0's Impact On Employment Of Women

In the analysis, I observed that some of the interviewees pay attention to the expected increase in employment of women. Analysis indicates that in an environment where identities and genders become insignificant, women's work will become increasingly prominent. However, interviewees do not expect an immediate increase. In this section, I investigated the impact of Industry 4.0 on employment of women under six sub-categories as shown in the Table 3.2.6.

Table 3.2.6. Sub-Categories of Industry 4.0's Impact on Employment of Women

Sub-Category Number	Sub-Categories
1	Current Situation of Women's Employment in Turkey
2	Positive Discrimination
3	Encouragement of Women's Involvement in Business
4	Genderless Business Environment
5	Coding Capacity of Women

3.2.6.1. Current Situation of Women's Employment in Turkey

Three million women are expected to lose their jobs over the next five years, according to the Industrial Sex Discrimination Report, which was debated

at the 2016 World Economic Forum conference and examines how the Fourth Industrial Revolution will affect women's participation in the labour market.

The report indicates that gender inequality in the business world will become even more complicated and argues that women have a much lower chance of attaining leadership positions in business than men.

Unfortunately, these predictions also supported by the situation in Turkey; there is a big difference between the numbers of female and male employees in the workforce. The official data of 2016 shows that the proportion of salaried male employees in Turkey was 69%, and the percentage of salaried women employees was 30% (TÜİK, 2017). However, unlike these reports analysis showed that Industry 4.0 is not seen as a reason for women's unemployment but an opportunity for employment.

3.2.6.2.Positive Discrimination

> "Siemens Turkey, which developing various policies to increase the percentage of women employees and engineers in its own organization, is preparing to take a step to raise the percentage of female managers to 30% until 2023. Absolutely, this aim includes also the company's Industry 4.0 vision. Turkey is rapidly continuing the initiatives to include more women into information technologies." (*Interviewee 23*)

> "Unlike the adverse scenarios, many volunteer companies find women's talents to be crucial for future workforce strategies and want to include more women in their team during the digitization process." (*Interviewee 23*)

The findings indicate that some of the companies operating in Turkey and paying attention to Industry 4.0 believe that Industry 4.0 will bring women into the forefront. These companies have changed their employment strategies incentivise the employment of women. Some of them even operate specific

programs to train women and give priority to women in employment. Siemens Turkey, for example, utilises such a program of positive discrimination.

3.2.6.3. Encouragement of Women's Involvement in Business

> "Siemens Turkey, as a technology and engineering company, aims to increase the number of female engineers and pays great attention to this topic. The work carried out for this purpose is about to add a new one on 8 March this year. The company signed a protocol with Turkish Education Foundation (TEV) to establish a scholarships program. In this framework, scholarships were delivered for the young girls who are studying engineering at bachelor or master level." (*Interviewee 23*)

In order not to lag behind in Industry 4.0 transitions, which are still in their infancy, there should be investments in infrastructure and technology, as well as employment and training. Interviewees stated that to become a country that influences the global arena as well as the region, Turkey should promote technology and science and especially encourage girls to get an education.

3.2.6.4.Genderless Business Environment

> "But I think that in an environment where identities and genders become insignificant in the Internet environment, women's work will become increasingly important." (*Interviewee 26*)

A World Economic Forum report in Davos predicts that there will be measurable gender inequality in jobs lost to automation. A Future of Jobs for All report says that by 2026, 1.4 million jobs will be transferred to automation in the United States. It is predicted that women will experience 57% of this loss. However, some interviewees believe that Industry 4.0 developments and advanced technology will provide a genderless work environment, which would lead to increases in women's employment.

3.2.6.5. Coding Capacity of Women

> "Unfortunately, one of the most important shortcomings of female labor is that they cannot contribute enough to the economy because of low-level employment. That's why it is extremely critical for women to develop software skills in the industry 4.0 period." (*Interviewee 26*)

One of the interviewees stated that in engineering, in general, men dominate the field. But in a recent research, it was revealed that women's software codes in a place where codes were created by both males and females were accepted more. In this sense, to encourage women and develop their coding skills is necessary to provide equal employment conditions.

3.2.7. Industry 4.0 and Employees With Disabilities

The findings show that one of the essential uses of the Internet of Things is the development of autonomous tools that thousands of different sensors communicate with millions of times. Autonomous devices are one of the technologies, which the Internet of Things is used. Different autonomous tools offer those with disabilities mobility that was not previously possible, which means that those with disabilities can find jobs more manageable. Using such devices, the missing skills of the disabled will be complemented by technology, and handicapped people will actively act in the same way as other people.

> "We will surely hear the effects created by the Industrial Revolution even more severely in the coming days. Years ago, computers first came out and saved us from long calculations and some of the problems that could not be solved, and now technological innovations like IoT seem to change the lives of human beings all over again. In the meantime, what we see today as obstacles can be transformed into problems that can be seen as children's games soon." (*Interviewee 20)*

Some of the interviewees believe that new technological developments will create more opportunities for individuals with disabilities. Individuals with disabilities will be more mobile and active in business world.

3.3. TRANSITION TO INDUSTRY 4.0

3.3.1. EMERGING PROFESSIONS

There are eight new professions mentioned in this section. Many of these are in departments that have started operations abroad. In fact, many of these occupations already exist in the market, but they are new business lines specialised for Industry 4.0. The 8 professions discussed here should be viewed as only an idea of potential future positions, not a limitation of them.

Table 3.3.1. Emerging Occupations

Sub-Category Number	Sub-Categories
1	Citizen Developers
2	Data Logistician
3	Data Mining Engineering
4	Autonomous System Controller
5	Data Analysts
6	Software Developers
7	Embedded System Developers
8	Design Engineers

Citizen developers: *Interviewee 4* explained that a citizen developer is a type of software developer combining existing software to create new business applications and models, and this occupation will be more visible in near future.

“Data logisticians currently exist but the need for them will increase more and more through the increase in the number of smart factories.” (*Interviewee 4*)

Data logisticians: General production planning and production management departments do not exist in smart factories. Instead, there is an integrated approach for machines to share information, make predictions, and identify the next steps in the process of production among themselves. Information must flow in real time between devices so it can affect continuous production. That is where data logistics plays the most critical role (Jablonski, Lay & Müller, 2004).

> “Data mining engineering and autonomous system controller are also the occupations that will emerge soon. Everything in the factories will depend on data and autonomous systems, so there must be someone to control and lead these data accordingly.” (*Interviewee 4*)

Data mining engineering: Data mining is the process of accumulating vast amounts of information and screening of useful information by decomposition. This can be used to predict future customer behaviour and define the models in customer information (Marbán, Segovia, Menasalvas & Baizán, 2008).

Autonomous system controller: In the near future, the systems will have their place in the lives of people; many jobs will be handed over to systems that can decide for themselves, adapt to changing environmental conditions, act according to their goals and responsibilities, and interact with other systems. Such systems are generally referred to as Smart Autonomous Systems. People who are responsible for setting up these systems are autonomous system controllers (Schinas, Vovos & Giannakopoulos, 2002).

Data analysts and software developers: *Interviewee 6* mentioned that even though these two occupations already exist in business life, the need for them would drastically increase.

> "Embedded systems in the vehicles we use in daily life are getting more complex and interconnected. Thus, it is inevitable not to control all of these data flowing among our vehicles, so a controller for these data and to design these systems will be needed. Hence, embedded system engineers and design engineers will take more place in business life in near future." (*Interviewee 4*)

Embedded system developers: The embedded system is a system that carries out functions in everyday items like refrigerators, washing machines, printers based on a small command given by the user. The most prominent difference from the software in our computers is that they perform a single task and indirectly interact with the user. It is possible to see this system in almost all of the products we use in our daily lives, including personal computers, printers, scanners, calculators, mobile phones, television cameras, dishwashers, electronic toys and so on (Bakır, Turhan & Bener, 2010).

Design engineers: Design engineering is the system creating and including all of the processes above. Design engineers are already actively working in companies, but it is expected that the need for this occupation will dramatically increase in the near future.

Even though interviewees mentioned the expected new occupations, they did not discuss any potential new occupations for blue-collar workers. All of the occupations expected to emerge are related to white-collar jobs (especially ITC). In my opinion, this situation stems from the uncertainties of the future. Even interviewees, who were consultants and experts on digital transformation, could not predict potential future occupations for blue-collar workers.

3.3.2. Perspectives on Future

Futurism is an art movement that emerged in Italy in the 20th century and then spread throughout Europe. Futurism is the positive future design for work and life, and futurists are the ones who adopt this point of view. It is also known as a movement that advocates continuity, variability, and mobility in the art (Novaka, 2000). Inspired by this definition of futurism, I investigated the futuristic aspects of Industry 4.0 in my analysis. I intended to learn about what Industry 4.0 will bring us the futuristic context in future. In the analysis, I divided this theme into seven different sub-categories. Sub-categories are presented in Table 3.3.2.

Table 3.3.2. Sub-Categories of Perspectives on Future

Sub-Category Number	Sub-Categories
1	Increase in Leisure Time
2	Society 5.0
3	Industry 5.0
4	Longer Human Lifespan / Slowing the Aging Process
5	Non-Physical Workplaces
6	Grey-Collar Concept
7	Taxation of Robots

3.3.2.1. Increase in Leisure Time

The analysis shows that people will have more leisure time with the increase of automation in business processes, and one of the interviewees (*Interviewee 7*) supports this idea with his words: “In both cases, there will be much more time for people to socialize”.

3.3.2.2. Society 5.0

One of the interviewees discussed the new Japanese term ‘Society 5.0’. The Japanese, using the latest technology on every platform, responded to Germany's Industry 4.0 initiative from another point of view and brought 'Society 5.0' to our agenda. The Japanese study conducted by Japan Business Federation (2016) distinguishes the process from the birth of the first man to the present times: ‘Hunter/Gatherer Tribe’, ‘Agricultural Society’, ‘Industrial Society’, ‘Knowledge Society’ and ‘Smart Society’. Society 5.0 originates in the latest one, Smart Society. That is to say, not only industry is evolving but also society is changing alongside various revolutions. This study argues that the Japanese believe that all the technological developments will create big societal changes. They do not specifically signal the direction of this social change, however (Fenn & Raskino, 2008).

Society 5.0 is simply a study that aims to contribute to the development of a smart society that will manage technological power properly. Society 5.0 actually brings some concerns. The most important of these concerns is the possibility of creating an ‘employment problem’. Increasing automation can create the risk of unemployment, especially for blue-collar and white-collar workers. While some sources think unemployment may occur, some other sources think that it will have the opposite effect, meaning that more employment gates will be opened. Because they think that a smart manager is needed for each robot and the data they obtain (Japan Business Federation, 2016).

3.3.2.3. Industry 5.0

One of the interviewees mentioned the next industrial revolution and claimed it would happen in the usage of energy. The usage of wireless electricity has become possible and will be essential for industry in the future. Immediately

after this, irradiation will be started by the molecular decomposition and the ability to recombine them. That will be Industry 5.0.

3.3.2.4. Longer Human Lifetime / Slowing the Aging Process

> "There are big dreams and plans about the future. We are trying to create a world where people do not physically work. Such years will come that no one will work, human beings will live for 150-200 years, aircrafts do not fall, electronic systems are installed on roads, there are no accidents, and even surgeries will be bloodless." (*Interviewee 15*)

Some of the interviewees believe that human life will be extended to 100-150 years with the help of developing technology in the health sector.

3.3.2.5. Non-Physical Workplaces

> "They are trying to create a world where people do not physically work." (*Interviewee 15*)

In a new world full of digitalised business processes, it is possible to work outside the office. Even today, many people work from their homes and rarely go to their offices. In this sense, non-physical workplaces should not sound crazy.

3.3.2.6. Grey-Collar Concept

Analysis indicates that interviewees expect a new movement in the business world: the grey-collar work concept. Wıth the increasing use of autonomous systems, it is obvious that there will be a decrease in the number of blue-collar workers. However, as previously discussed, blue-collar employees are expected to gain new skills via training and education and become employed in new emerging occupations. That means a new type of 'collar'. This concept is not official or commonly used, but the findings directed me to name this new worker formation 'grey-collar work'.

3.3.2.7. Taxation of Robots

> "The taxation of the robot workforce and the delivery of this new income resource to people are being talked about in the world." (*Interviewee 5*)

Germany, the pioneer of Industry 4.0, is discussing taxing the use of robots in the near future. Some Parliamentary members claim that robots will create unfair economic gains to company owners and if people lose their jobs, these taxes can be redistributed in the form of assistance to them.

3.3.3. EXISTING AND POTENTIAL PROBLEMS IN INDUSTRY 4.0 TRANSITION PROCESS

Turkey is experiencing a transition period and every transition period is painful. Even though there have been improvements for some companies and actual implementation trials, such as Tofaş's automotive factory in Bursa, problems will continue to occur during this transition period. I observed three essential problems occurring during this transition period in Turkey. These problems are Readiness of Technological Infrastructure, Lack of Capacility in Human Resources Departments and Oppression from Bosses for Transformation.

3.3.3.1. Readiness of Technological Infrastructure

The learning process of machines in Turkey is not yet completed, which means any attempt to transit into the implementation phase would fail. In this content analysis, I detected two crucial reasons for the lack of infrastructure technology, which are Lack of Cognitive Players in Turkey and Standardized IT Process for Every Company.

> "We have not finished machine learning yet. Cognitive part of the industrial revolution is still missing, and it does not seem to be finished in the short run. No player in Turkey can work on the cognitive part. 5

companies in the world have been implementing artificial intelligence appropriately." (*Interviewee 3*)

No player in Turkey for cognitive part of Industry 4.0: Machine learning does not only depend on technological tools but also on inserting cognitive processes into machines. However, there are no reliable players in Turkey for these types of cognitive initiatives. Companies have to transfer cognitive technology from abroad.

> The main point in Cloud technology is to provide service standards. Not every company has a large Information Technologies (IT) capacity. In Cloud, this service (IT) will be standardized for all of the companies. All processes will be standard for every company. (*Interviewee 3*)

Standardized IT process for each company: Industry 4.0 aims to standardise all of the IT processes for each company. That is to say, all of the companies' systems have to interact with each other. This is one of the characteristics of cloud technology. However, every company's IT processes are different, as are their IT capacities. These unbalanced IT capacities of local companies complicate the standardisation process.

3.3.3.2. Lack of Management Capacity in Human Resources Departments

Content analysis shows that one of the most critical responsibilities during these transformation processes falls to Human Resources Departments. That is because there is a lack of a qualified labour-force, and this group of people has to be trained and ready for the future. In addition to hiring and benefits management, the Human Resources Department is often responsible for training and transforming white-collar workers inside companies.

It can be said that the transformation of Generations X and Y will be one of the most challenging parts of this transformation. Millennial and Generation Z

will be trained/educated at schools but Generations X and Y will have to be educated by their companies or public institutions.

> "The only problem is the generation that is now in its thirties and forties and will undergo this transformation. If, as a whole country, we can enable this generation to gain digital skills, and if we can transform the journey from labour-force to brainpower through digital training in the middle of the claim of 4.0, we can achieve success." (*Interviewee 14*)

The generation Z is also bringing new problems for companies. This new generation will come to the companies as overqualified employee candidates, and their requests may cause difficulties for companies. In other words, to recruit and keep these qualified employees in such a competitive market would not be easy.

3.3.3.3. Pressure from Bosses for Transformation

> "In Turkish companies, owners of the companies are forcing other managers to transform the company. The actual reason for most of the Turkish companies to fail is this pressure from bosses on low-level managers. This is because everyone in the company is not aware of Industry 4.0 and cannot understand the importance of the subject." (*Interviewee 3*)

Some interviewees believe that local companies, especially family companies, want to experience digital transformations and are experiencing pressure from bosses or owners of the companies. That is to say, top management is eager for change, but low-level executives resists initiating transformation process. Therefore, transformation process moves slowly.

3.3.4. Solutions To Problems Of Industry 4.0 Transformation Process

According to this analysis, there are existing and potential problems for Industry 4.0 transformation processes, but there are also solutions. I have divided

solutions into three sub-categories: education-related solutions, business processes-related solutions and cyber security-related solutions. In this section, I explain these sub-categories with their axial codes in detail.

3.3.4.1. Education-Related Solutions

The open codes of Education-Related Solutions are listed in this section.

Table 3.3.3.5. Open Codes of Education Related Solutions

Open Code Number	Open Code
1	New Learning Methods
2	The Fetish of Teaching Coding
3	Changing the Structure of Vocational Education
4	Revising Bachelor's and Master's Degree Programs
5	Establishing Interdisciplinary Programs
6	Training Qualified Human Resources

> "We need to adopt a new educational model by taking the actual basic values of education and synthesizing it with the motives of this new generation. Here they will be successful in Industry 4.0 and the Internet of Things. Both production and service sectors will provide both productivity and added value, which will provide international competitiveness globally. This added value will return to the country as beneficial culture and wealth assets." (*Interviewee 25*)

New learning methods: To get a qualified labour-force, the easiest and healthiest way is to create new learning and teaching methods. The existing Turkish education system is not seen as adequate by interviewees. The new education system is expected to include Industry 4.0-related concepts to make

younger generations familiar with these concepts in the coming years. Digitally oriented generations can be created via new learning and teaching methods.

> "We need to look at the purpose of coding classes. They should not end with just writing a code. The focus should be the on the end product. Which applications are being produced with that output (code)? If you consider coding like learning a foreign language, it does not work because coding is not like learning English. If we deal with coding with this mind-set, we only invest a lot in it, but we cannot get the desired results. What we need to do here is look at the output of this coding. What is the output of the coding? The expected output should be an implementation. Also, another aim should be to have creative people with these coding classes. Otherwise, it would be a waste of time." (*Interviewee 25*)

> "Fatih project should be done like this. So first you have to ask the basic questions of the project... After that, you have to think about the outputs of the last version of Fatih Project. Afterword, the measurement of the project should be done from a broader perspective. If you made mistakes, the way you are going is not right, but you have to turn from there and go into a different vision. Failing directions must be corrected. Looking at all of this from a more macro perspective, we need to know where we are going." (*Interviewee 25*)

The fetish of teaching coding: Interviewees criticize coding classes in schools because they have no specific purposes. Also, interviewees claim that trainers/teachers are not qualified to conduct these classes. Therefore, classes will not produce the expected results and students may be confused. All of these concerns related to coding classes should be resolved, and then courses should be initiated. The purpose of these coding classes should be to create a new generation who can think creatively, criticize and create products as a result.

> "Vocational schools of the old industrial age should now be replaced with the vocational schools of the 21st century." (*Interviewee 25*)

Changing the structure of vocational education: Interviewees claim that current vocational schools serve the needs of previous industrial revolutions. Students learn how to work in blue-collar jobs in current vocational schools. However, the future is full of technology and high-tech machines and automatons will perform existing blue-collar work. That is to say, vocational high schools' current curriculum does not train students to meet the needs of Industry 4.0 requirements. Therefore, vocational high schools need a transformation as well.

> "Bachelor and postgraduate programs should be revised according to the needs." (*Interviewee 25*)

Revising Bachelor's and Master's degree programs and establishing interdisciplinary programs: According to Interviewees', Bachelor's and Master's degree programs at universities also need to undergo a transformation process similar to vocational high schools. Current programs at universities do not meet the needs of Industry 4.0. There are no specific programs related to Industry 4.0, so existing Bachelor's and Master's degree programs must be revised; some of the programs can even potentially be merged.

Training qualified human resources: While subsequent generations can be educated in schools with new learning and teaching methods or new programs at high schools and universities, the existing situation is a little bit more complicated for Generations X and Y. In this sense, the most significant responsibility falls on Ministry of Education, Ministry of Labor and Social Security and companies.

3.3.4.2. Business Related Solutions

Business-related solutions are divided into 13 axial codes, which are shown in Table 3.3.3.6.

Table 3.3.3.6. Open Codes of Business Related Solutions

Open Code Number	Open Code
1	Defect-Prevention Production System
2	Getting Support from Universities
3	Need for Research & Development
4	Using Local Resources instead of Transferring from Abroad
6	Need For More Senior Executives
7	State's Misdirected Incentives for Factory Employment
8	Changes in Corporate Traditions

Defect-prevention production system: The analysis shows that setting up a preventive production system for manufacturing defects can be realised through setting up a well-working IT infrastructure. Existing systems should be examined and ready for new technologies. In this sense, the monitoring of companies' systems by experts could be the first step to create a deterrent system.

Getting support from universities: Interviewees emphasise the importance of collaboration with universities for innovation. Collaboration with universities, especially technology development units, would provide companies new innovative and creative ideas and applicable Industry 4.0 implementations.

> "If companies do not think innovatively and do not perform Research and Development, then these firms sink." (*Interviewee 15*)

The need for research and development: Since innovative ideas and applications will carry companies into the future, innovation is one of the cornerstones of the Industry 4.0 transformation. In this sense, research and development departments of firms are truly significant. They have to be the dynamo of the transformation process and encourage other departments to be ready for change with innovative ideas.

> "Findings indicate that the use of technology is not a distinctive feature showing the level of development but technology production is the driving component for that. If Turkey desires to catch recent innovative and technological developments in the world and become a big player, she has to focus on her own technology production. Big global companies operating in Turkey bring Industry 4.0 implementations to Turkey, and there is no a problem for them but there is trouble for us. Instead of getting technology from abroad, Turkey needs to be a country that produces and develops her own Industry 4.0 implementations and technologies. Then, Turkey can become a big player in the world economy and sustain innovative developments." (*Interviewee 15*)

Using local resources instead of transferring technology from abroad: The analysis suggests that the simple use of technology will not be significant in the long run because establishing sustainable resources will be more important for subsequent initiatives and attempts. In order to create sustainable resources, the essential component will be to generate the appropriate technology. In this sense, local resources can be a basis for future initiatives. Therefore, using local resources to create new technologies would create added value and economic development for local companies.

> "There is lack of qualified executive managers in Turkey for such a huge and important transformation process." (*Interviewee 3*)

The need for more senior executives: Companies' management capacity is insufficient to fully capture the importance of creating and maintaining Industry 4.0 developments, according to interviewees. Generally speaking, bosses or company owners are the centres of the decision-making mechanisms in companies, and they usually force low-level managers to change. However, most of the low-level executives are not aware of the severity and importance of this transformation. In addition, existing senior managers are not sufficiently familiar with Industry 4.0 concepts. In this sense, there is a need for more senior executives who are aware of Industry 4.0 developments to be involved in this transformation process.

> "The age of the white and blue collar is almost over. Artificially intelligent robotics and machines can replace them. However, the state is still acting absurdly and encouraging the factories to hire blue and white collars." (*Interviewee 3*)

States' misdirected incentives for factory employment: There is a common belief among interviewees that the blue-collar and white-collar worker differentiation (distinction) is almost gone. Therefore, the state should pass new legislation, but this is not happening. Instead, the state is giving new incentive to factories to employ more blue-collar workers. High-tech machines and automated systems have started to replace the labour-force in production lines. Namely, these incentives will be waste of money. Instead of these incentives, the state must construct new incentives to transform existing human resources.

> "There is no white collar and blue-collar differentiation in the world, so we have to change or traditions." (*Interviewee 1*)

Changes in corporate traditions: Changes in corporate habits and traditions are expected to be more beneficial for Industry 4.0 transformations rather than changes in corporate culture. Since changes to corporate culture can take a significant amount of time, the focus should be on altering corporate

habits and traditions. This is because habits and traditions constituting the corporate culture are more flexible to adapt to new circumstances, which can accelerate the change of corporate culture. This change would enable all of the employees and processes in companies to transform more readily.

3.3.4.3. Cyber Security Solutions and Private Data Protection

> "Big data holds all data, and this information is important both for personal sense and for company security." (*Interviewee 2*)

Cyber security comes to the forefront in an environment in where all information and data is stored and can be mined. It is logical to expect some data privacy violations in such a digitalised world. In this sense, interviewees believe that privacy legislation by the government would be a solution to breaches of personal and corporate data.

3.3.5. Advantages And Disadvantages Of Industry 4.0 For Companies

Industry 4.0 is a concept that can be perceived as a revolution when considering its advantages and disadvantages. In this sense, the analysis shows that Industry 4.0 brings both advantages and disadvantages for companies. In this section, the disadvantages and advantages of Industry 4.0 for companies are presented.

3.3.5.1. Disadvantages Of Industry 4.0 For Companies

> "Companies and organizations that have never existed in the sector will be established and will bring new dimensions and value to the industry with their new business models. For this reason, organizations, which do not set the Industry 4.0 strategies and fail to implements their strategies, will have difficulty in surviving because they will lose their competitive advantage." (*Interviewee 21*)

"Industry 4.0 can help bigger industrialists to grow, while smaller ones can face the risk of extinction." (*Interviewee 17*)

Table 3.3.4.1. Disadvantages of Industry 4.0 for Companies

Open Code Number	Open Code Title
1	Orange Companies
2	Difficulty in Retaining Qualified Employees
3	Increase in Investment Costs
4	The problem of Managing Transformation Process

Orange Companies: Industry 4.0 developments are actually not as easy to initiate as it is imagined. First of all, the most significant problems concerning the future of companies are the risk of collapse and the conflicts that may arise among company partners due to the level of understanding of Industry 4.0. These troubles are actually the biggest problems of the Industrial 4.0 revolution for companies. At this point, companies, which cannot keep step with industrial developments, will collapse. These companies have been termed 'Orange Companies'. Well-prepared production infrastructures and Industry 4.0-oriented strategies help prepare companies for upcoming competition in their market. However, companies, which are not well prepared, will disappear from the market. The idea of an 'orange' company originated from liquidation: rivals will liquidise unprepared companies like an orange. Small-scale companies are at risk of becoming orange companies because developing and adopting new technologies are more difficult for compared to larger companies.

"Companies will have to develop different initiatives to employ more qualified personnel and retain their personnel." (*Interviewee 4*)

The Difficulty Of Retaining Qualified Employees: Another disadvantage of Industry 4.0 for companies will be the difficulty of retaining qualified employees. There will be a massive need for qualified employees when the digital transformation process demonstrates its impact. That's because companies will need employees who have well-developed digital skills and they will have to develop new strategies to keep their qualified employees.

> "Companies will manage less staff, and they will be less affected by turnover and absenteeism. However, investment costs will increase, and companies will have to develop different initiatives to employ more qualified personnel and to retain them." (*Interviewee 4*)

Increase In Investment Costs: Employing more qualified employees, investment in new technologies and research and development initiatives cause companies to spend a significant amount of money, which is seen as a disadvantage by interviewees. That is to say, investment costs will increase and companies will have to develop different initiatives to attract and retain more qualified personnel and to pursue digital developments and initiatives.

> "The potential number of industrial companies in Turkey to integrate IoT technologies is rather less compared to other countries." (*Interviewee 17*)

> "If the Turkish companies desire to adopt a Industry 4.0 oriented company strategy, they have to first improve their digital infrastructure and develop their employees to get understand the importance and core of this process. Otherwise, they face with managerial problems to manage the digitalization process due to lack of digital infrastructure and theoretical capability." (*Interviewee 5*)

The Problem Of Managing The Transformation Process: Interviewees articulate that many companies entering the transformation of Industry 4.0 process do not have sufficient digital infrastructure and they perceive Industry 4.0 as merely a software program. This situation causes

companies to fail in transformation attempts. The potential number of companies that can integrate their processes into IoT technologies is not high in Turkey compared to developed countries like Germany. Moreover, most local companies have initiated Industry 4.0 transformation processes merely because of its popularity. Briefly, the findings indicate that local companies have to prepare their technological infrastructures, learn more about Industry 4.0, and then create their Industry 4.0 strategies respectively. This is because the transformation process requires a detailed strategy and management to be properly managed.

3.3.5.2. Advantages Of Industry 4.0 For Companies

Table 3.3.4.2. Advantages of Industry 4.0 for Companies

Open Code Number	Open Code Title
1	Self-Deciding Production Units
2	Decreased Environmental Impact Damage to Nature
3	Innovative Business Processes
4	Increase in Productivity
5	Increase in Customer Satisfaction
6	Low Costs
7	Competitive Advantages
8	Fewer Employee-Related Problems

> "With Industry 4.0, production processes will have not only the capability of independent decision making and flexible production but also integration with other production modules." (*Interviewee 21*)

Self-Deciding Production Units: With Industry 4.0, objects are organised around intelligent links and distributions, and they try to reduce the human error rate. Objects can make smart decisions through integrated

communication capabilities, stay in touch with their surroundings and keep track of all stages of production. All of these technologies enable companies to produce goods quickly with fewer manufacturing defects and control production more easily.

> "With Industry 4.0, industrial enterprises will be able to use natural resources more efficiently and the carbon footprint, i.e., the damage to nature, will be reduced." (*Interviewee 21*)

> "Future logistics will be a green-focused sector. Transport and storage activities will continue with less damaging methods in the world. In the green warehouse, the energy store will start to be produced and consumed by itself. Work on solar energy panels and energy-saving vehicles has started. In many places in Paris, electric vehicles are used for delivery." (*Interviewee 21*)

Decreased Environmental Impacts: Pollution and waste management are two major issues concerning enterprises in terms of environmental sustainability. For instance, when enterprises use more input than predicted, the surplus damages the environment. But when the inputs will be used more analytically and create less waste, the damage to the environment will also be significantly reduced. Similarly when we look at the automation of buildings, serious steps will be taken to save energy. Unnecessary use of electricity will be eliminated, for example, which will reduce environmental harm.

Innovative Business Processes: Analysis indicates that Industry 4.0 forces companies to create innovative business models that will enable them to compete with other international and local companies. These innovative business models, which are articulated by interviewees, are customer-centred production, transparent business processes and flexible and fast production.

Customer-centred production: Small-scale production can be realised with customer-centred production. Prototypes or new products can be produced

quickly without the need to install a new production line. Moreover, customers will feel they are part of the production process.

> “With Industry 4.0, it will be possible to develop customer-centered products, and include the customer in the production process.” (*Interviewee 21*)

Production speed: The speed of production will also improve. Visual modelling of the digital design and production process can reduce the time between products' design, production and transport.

> "With Industry 4.0, it will be ensured that processes are simpler and more transparent. This is necessary”. (*Interviewee 12*)

Transparent business processes: A simple and transparent business process is a requirement of this transformation process, according to the analysis. Ensuring transparent and constant communication prevents problems that may arise, helps to ensure that the right things are done at the right time, and eliminates re-produce.

> “With increased data analysis capabilities, organizations can provide more services related to their products.” (*Interviewee 21*)

Flexible and fast production: Flexibility in production is increasing due to intelligent factories. A variety of different products can be produced at the same rate thanks to the automation of the production process, the conversion of the data and the use of robots.

Increase In Profitability: Productivity can increase with various Industry 4.0 applications. Using advanced analytical techniques in foreseeable maintenance programs, manufacturing companies can avoid machine faults in their plants and increase in production can be achieved. *Interviewee 1* mentioned that business processes would be more profitable. That is because, some companies will be able to build factories that continue to produce the same

amount, but with fewer employees. These factories will need a smaller labour force, and existing workers will be able to work more efficiently because they will be more qualified for digital work and have more time to work.

Increase In Customer Satisfaction: Smart factories will enable customers to design their products and access them easily. Customers will be able to take a more active role in product design and will be able to supply their own models quickly and inexpensively. Customers can also choose the design and type of production. They will be able to select a specific type of product. That is because factories will be able to produce different types of product with the same production line.

Low Costs: Industry 4.0 focuses on the best use of productivity, time and cost in production. In Industry 4.0, an artificially intelligent robot will be able to think and can initiate a process. *Interviewee 15* mentioned that Namely; automation will reduce the costs of products manufactured with Industry 4.0. If there is a problem with the robot, the task is shifted to another robot. If necessary, the robot will repair its own problem. That will be reflected in both product prices and the cost of production.

Competitive Advantage: Interviewee 18 mentioned that Companies will be able to achieve significant global competitive advantage, prestige and cost savings by using 'big data', 'cloud and analytical algorithms' subtopics of Industry 4.0.

Fewer Employee-Related Problems: Automation and advanced technology will enable companies to work with fewer employees, which means fewer employee-related problems for companies. In the analysis, I categorised this topic into three different sub-topics (open codes), which are Managing Fewer Employees, Lessened Absenteeism Problems, and Lower Employee Turnover.

Automation and advanced technology will decrease companies' dependency on employees in all of business processes, even though there will still be a need for workers. However, it cannot be denied that companies will manage fewer employees. That will lead to a decrease in absenteeism and a lower turnover rate, which are two of the main issues in employee management. Fewer employee means less absenteeism and turnover.

> "Companies will have to manage less number of staff, and so they will be less affected by employee turnover and absenteeism." (*Interviewee 4*)

3.3.6. MISCONCEPTIONS ABOUT INDUSTRY 4.0

Turkey is currently experiencing a peak point of inflated expectations, which means there are many misconceptions about this process, its impacts and results. In this section, I present the misconceptions about Industry 4.0 that interviewees highlighted (Table 3.3.5.).

Table 3.3.5. Misconceptions about Industry 4.0

Sub-Category Number	Sub-Categories
1	Immediate Impacts/Changes
2	Dark Factories
3	Artificial Intelligence is not Robot Technology
4	PR & Marketing-Oriented Industry 4.0 Perspective in Turkey
5	Social Media is not Industry 4.0
6	No Strict Transition Timeline for Industry 4.0
7	Neo-Luddism Effect
8	Unemployment of Blue-Collar workers

3.3.6.1. Immediate Impacts/Changes

> "The effects of Industry 4.0 will not completely and immediately change all sectors today, including production but people are expecting a magical touch to change everything suddenly." (*Interviewee 11*)

There is a period in which people expect magical results from innovation, and findings show that this is currently the case in Turkey regarding Industry 4.0. According to interviewees, people are waiting for sudden changes in production and transformation, which are not expected by digital transformation consultants.

3.3.6.2. Dark Factories

A dark factory is one in which there is no need for any human intervention for any process. *Interviewee 1* mentioned that the dark factory is an urban myth. According to him, it is not meaningful to think about a factory operating without any human intervention in the near future. The idea that human intervention in production will become unnecessary has concerned people before every industrial revolution but it has never happened. The findings show that despite automated and integrated business processes, there will still be a need for a human workforce.

3.3.6.3. Artificial Intelligence Is Not Robot Technology

> "On the other hand, people think that artificial intelligence just consists of robotics." (*Interviewee 3*)

The findings show that artificial Intelligence and robots are frequently considered the same thing, but are totally different concepts. However, people still confuse the two. The findings indicate that robots do not have to be artificially intelligent but artificial intelligence tools are inserted into some of the robots. These robots are artificially intelligent robotics. Artificially intelligent robotics is the junction point of robotics and artificial intelligence.

3.3.6.4. PR & Marketing-Oriented Industry 4.0 Perspective in Turkey

> "Industry 4.0 or digitalization is PR and Marketing-oriented in Turkey. Most of the companies look like they are too much into Industry 4.0 but indeed they just want to look interested in order to be seen as a digitalized company." (*Interviewee 3*)

Interviewees state that different perspectives and ideas occupy people's minds about what Industry 4.0 is. While some of these ideas about Industry 4.0 are true, some of them are not. For instance, according to the analysis, some companies in Turkey use Industry 4.0 as a marketing and PR tool, which is not one of the purposes of Industry 4.0.

3.3.6.5. Social Media Is Not Industry 4.0

> "People think social media is Industry 4.0. However, social media is just a small piece of it" (*Interviewee 3*)

According to interviewees, there is an understanding among some companies and people, which regard Industry 4.0 equal to social media. Active usage of social media is considered a tool of the Industry 4.0 transformation process, which is inaccurate.

3.3.6.6. No Exact Transition Timeline for Industry 4.0

> "Industry 4.0 is described as Windows Setup in Turkey; it cannot be said that we as a company have exactly transited into Industry 4.0. It is not realistic. We cannot mention about a specific transition timeline." (*Interviewee 3*)

A specific timeline (exact date) for the transition into Industry 4.0 cannot be determined according to interviewees. However, some companies in Turkey claim that they have already transitioned into Industry 4.0, which is not possible. Companies can create strategies for their Industry 4.0 transformation and initiate

certain innovations and applications, but Industry 4.0 is not a process with exact timelines.

3.3.6.7. Neo-Luddism Effect

> "In the future, it is predicted that there will be a tight competition in employment between robots and people. Those who are unemployed because of robots are thought to be hostile to robots. The machine breaking action, ludism, is one of the already debated topics that may be against robots in the future. But I do not believe it will happen. On the contrary, people will become more efficient with robots."(*Interviewee 14*)

> "There is an opinion that the increase in productivity, fast and flexible production and the reduction of production defects will adversely affect employment. That was also the case in past industrial revolutions; but in every industrial revolution, employment has given a new direction." (*Interviewee 16*)

> "They thought that people would be unemployed when the steam-powered machines came out, but it did not happen." (*Interviewee 3*)

This timeline refers to the First Industrial Revolution, and it can be said that Luddism was based on the fear that machines would supplant workers in the factories (thus making the direct connection to fear of unemployment). A similar phenomenon could occur due to Industry 4.0 because of the potential for unemployment. I investigated whether such a backlash is expected for Industry 4.0. However, interviewees do not expect such a movement in the Turkish community. In contrast, they believe that new occupations will emerge to employ people who have lost their jobs as in previous industrial revolutions.

3.3.6.8. Unemployment of Blue-Collar Workers

> "At the point where we come today, suspicions have begun again that artificially intelligent robotics will replace humans' role in the production.

> My opinion is that there will not be any problem with employment or control over the spread of it." (*Interviewee 9*)

According to the article of Dünya Newspaper (2017), about 50 billion devices are anticipated to correspond to each other in three years. It is forecasted for the next 25 years that digitalized production systems will be defragmented with all of the digital tools used in daily life. Also, individual production will constitute the 46% of global trade volume. All these developments mean that Industry 4.0 technologies (artificial intelligence, IoT, cloud, communicating devices and so on) will dominate every part of our lives. This situation heightens people's fear of unemployment. That is why I investigated the unemployment aspect of Industry 4.0 in my research.

> "In the nineties, our generation argued, 'Computer is here, are we going to be unemployed?' What happened? It was the exact opposite. So today, only the number of occupations performed under the title of computer, software, and hardware, is more than fifty. It means millions of employees. Fifteen-twenty years ago, there were no employees on these areas. The only change will be in the shapes and contents of the occupations. Trainings will play an important role to adapt easily in this change of shape and content." (*Interviewee 14*)

The analysis shows a different picture of employment. Even though a majority of the interviewees accept the idea of potential unemployment stemming from technological improvements in every part of business processes, they do not worry about this potential threat. That is because they believe that if the people/employees are trained on new technologies that enable them to work collaboratively with the new technologies, and then unemployment will not pose a threat.

> "In the First Industrial Revolution, automobiles and trains replaced horses; production lines replaced the vast majority of people producing

cars in the subsequent industrial revolution. Then, when the machines began to understand the commands, people were able to talk to reprogrammable machines, so the number of people in the production of the cars decreased. It is said that when the machines would start talking to each other, there would be no need for people anymore and that there would be a problem of industrial unemployment. But I think this is not true". (*Interviewee 7*)

Another example given by interviewees to disprove the claims of potential unemployment is the impact of previous industrial revolutions. According to interviewees, people always thought that new technologies would replace the labour-force and people would wind up out of work. However, the reverse happened after each industrial revolution, and the employment rate increased.

3.4. CONTRIBUTIONS OF FACE-TO-FACE INTERVIEWS AND SECOND-HAND DATA TO ANALYSIS

I employed the content analysis theory approach by conducting six face-to-face interviews and analyzing thirteen second-hand data (online interviews) and eight online magazine articles. As a result of analysis of these interviews and second-hand data I figured out sixteen themes, sub-categories. However, some of these themes and sub-categories appeared just in face-to-face interviews, some of them appeared just in second-hand date while some of them appeared in both. I did combine of all the findings and generated the main themes table. In this section, I will display the distribution of these themes and sub-categories in the sample.

3.4.1. Themes Taken From Face-To-Face Interviews And Second-Hand Data

Nine main themes were found in both face-to-face interviews and second-hand data. All of these nine themes are presented in Table 3.4.1.

Table 3.4.1. Mutual Themes

Mutual Themes
Definition of Industry 4.0
Industry 4.0 Related Attempts in Turkey
Sectors To Impacted by Industry 4.0
Advantages and Disadvantages of Industry 4.0
The Role of Public Institutions
Emerging Occupations
Impacts of Industry 4.0 on Disadvantageous Groups
Problems and Solutions
Perspectives About Future

3.4.2. Themes Just Taken From Second-Hand Data

Four main themes and two sub-categories were just detected in second-hand data. The reason for these themes and sub-categories' appearance in this group is that interview questionnaire did not include any question on these themes. Themes just appeared in this second-hand data are presented in Table 25. These themes are discussed in the Future Research section.

Table 3.4.2. Themes Just Taken From Second-Hand Data

Themes Just Taken From Second-Hand Data
History of Industry 4.0
Positioning of Turkey
Triggering Factors (Sub-Category)
Impacts of Industry 4.0 on Disadvantageous Groups
Misconceptions About Industry 4.0

3.4.3. **Themes Just Taken From Face-to-Face Interviews**

Two main themes and two sub-categories just appeared in the data taken form face-to-face interviews. Even though the detail research on these themes and sub-categories, I could not find any related discourse or argument about them. Especially there was no clue about the roles of the unions during Industry 4.0 process. The list of themes just appeared in Face-to-Face interviews are presented in Table 3.4.3.

Table 3.4.3. Themes Just Taken From Face-To-Face Interviews

Themes Just Taken From Face-to-Face Interviews
Industry 4.0 Oriented Companies In Turkey (Sub-Category)
The Role of Unions During Industry 4.0 Process
Problem of Managing Industry 4.0 Process (Sub-Category)
Stakeholders of Industry 4.0 Development Process

CHAPTER 4

DISCUSSION

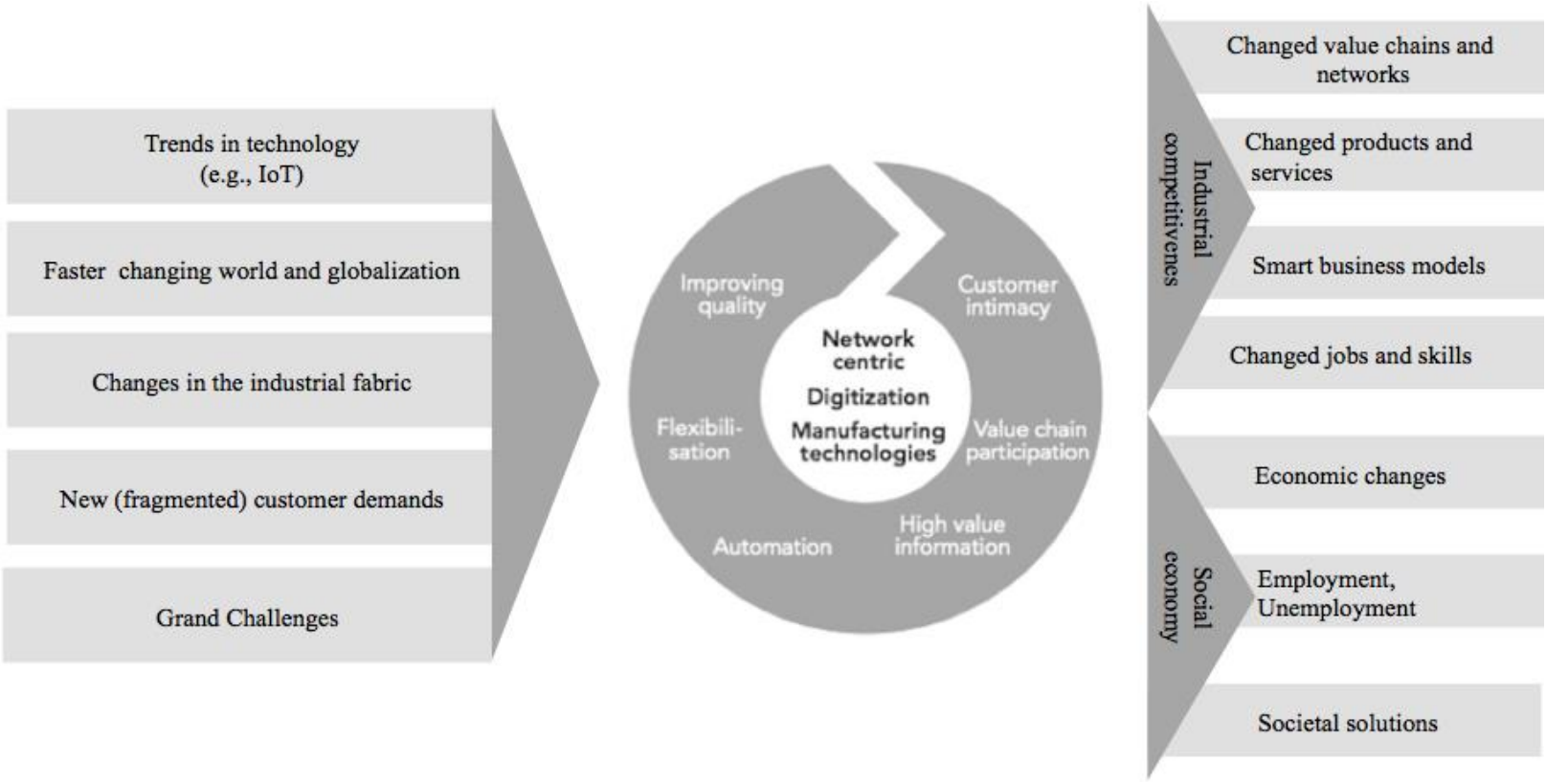
The primary driver of this study was to investigate the potential impacts of Industry 4.0 on labor force and business organizations. Since the results showed that impacts of Industry 4.0 on labor force and business organizations in a variety of areas, findings enlarged my investigation area, leading to a more comprehensive analysis, including additional areas like historical roots, current local developments, misconceptions, solutions to potential and existing problems, women and disabled employees, and futuristic perspectives. To summarize, all of the findings are based on twenty-seven interviews (Six face-to-face, thirteen from second-hand online data and eight magazine articles) I conducted and located during four months in 2017 and 2018.

The business world and business relations have begun to take an entirely different form along with the initiation of Industry 4.0 processes, which was first officially introduced in Hannover, Germany in 2011. This new process can be defined as being less dependent on human power combined with the presence of artificially intelligent and autonomous machines in production systems (Pfeiffer, 2017). Results of the analysis indicate that Industry 4.0 discussions should not be limited only to concepts such as digitalization, artificial intelligence, 3D printing, and nanotechnology. The Fourth Industrial Revolution is also influencing working conditions, governance, new professions, employment, social security systems, trade unionism and many other areas.

A similar study, ‘Smart Factories: Dutch Industry Fit for the Future’ (2015) was conducted collaboratively by TNO (The Netherlands Organization of Applied Science and Research), the Ministry of Economic Affairs, VNO-NCW (Confederation of Netherlands Industry and Employers) and the Chambers of Commerce and FME (Dutch Employers’ Organization in Technology Industry) in the Netherlands to investigate the future of Industry 4.0. The findings of this

study were similar to the current study. At the end of the study, the authors suggest a network-centric approach, which explains the components of the Industry 4.0 transformation process in the Netherlands. Their approach is illustrated in Figure 2. Based on this network-centric approach and my findings, I created my own Industry 4.0 impact model of Turkey.

Figure 4. A Network-Centric Approach (2014)

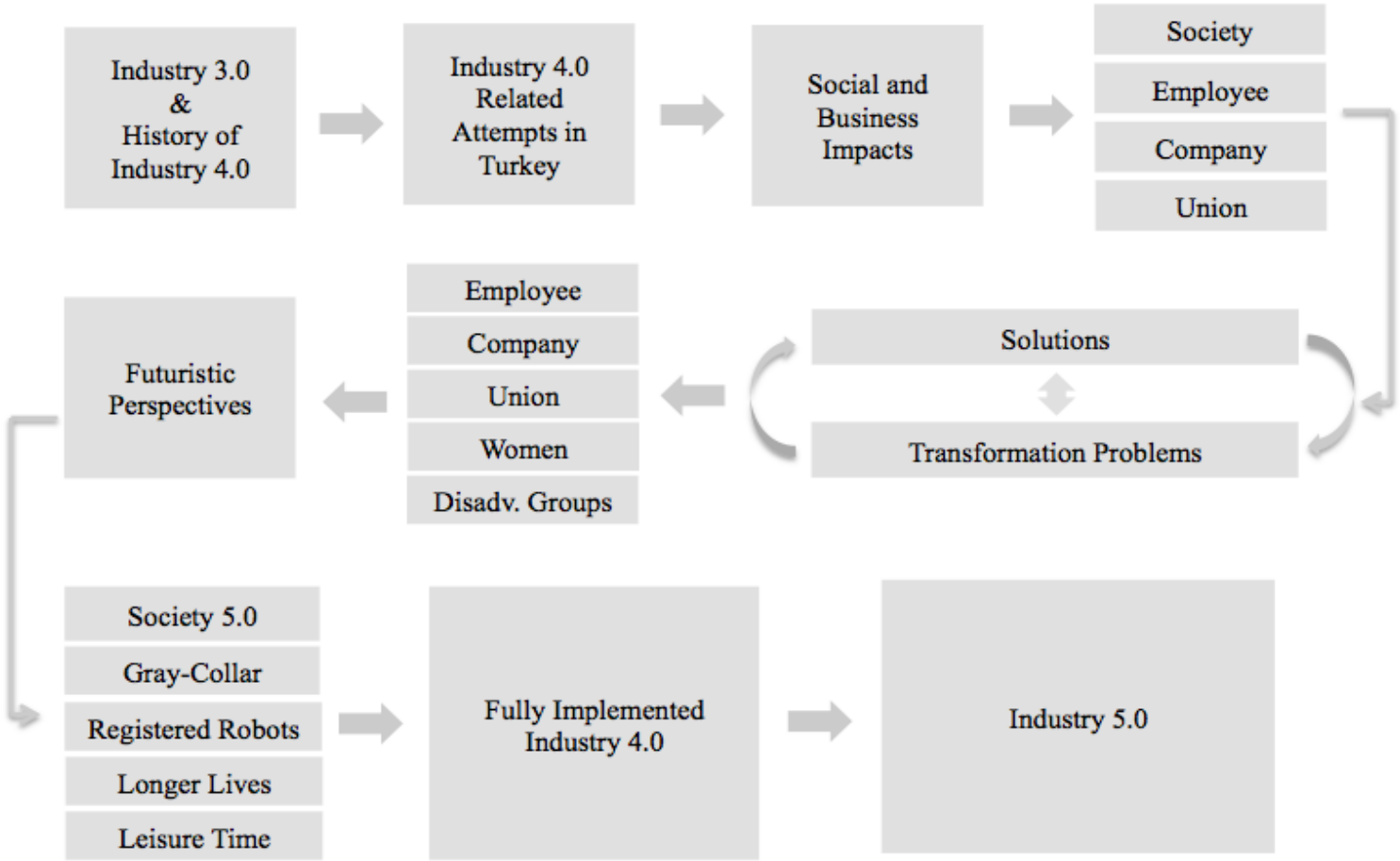


This network-centric approach argues that there is a specific flow in Industry 4.0 transformation processes. It starts with new technological developments, new customer demands, and grand challenges, and all of these factors force industries into a transformation process, which is digital and automated-centric. Then by, these digital and automated-centered transformation processes bring out economic and social impacts on industries and society. Economic impacts like changed value chains, modified products and services, smart business models and jobs/skill changes and social impacts like employment and unemployment are expected. In the current study, findings infer a similar table with The Netherlands. Even though The Netherlands is at the top of the list of innovative countries (Pot, 2014), and Turkey is the 36th country in the list and Turkey is seen as positioned somewhere between Industry 2.0 and Industry 3.0 by interviewees, I can claim that Turkey's transformation processes shows similarity with the Netherlands. The similarity between 'Smart Factories: Dutch Industry Fit for the Future' research and the current study results led me to draw a similar Industry 4.0 development process for Turkey. Therefore, I suggest an Industry 4.0 Developmental Process Model in the Argument section.

4.1. ARGUMENT: INDUSTRY 4.0 DEVELOPMENTAL PROCESS MODEL

This study proposes a process model explaining the directions of impacts and relations among each main theme in the process of Industry 4.0 transformations. This model claims that like previous industrial revolutions, the Industry 4.0 transformation process follows a specific flow, which begins with the impacts of the former industrial revolution (Industry 3.0) and results in another industrial revolution (Industry 5.0).

Figure 4.1. Industry 4.0 Developmental Process Model



This model presents the milestones of the Industry 4.0 development process within seven main themes. The pillars/main themes of this model are Industry 3.0 and Historical Roots, Industry 4.0 Related Attempts in Turkey, Social and Business-Related Impacts (employees, companies, unions, and disadvantageous groups), Transformation Problems and Solutions, Futuristic Perspectives, Fully Implemented Industry 4.0 Processing and Industry 5.0.

4.1.1. Industry 3.0 and Historical Roots of Industry 4.0

The first pillar of this model is the Industry 3.0 and Historical roots of Industry 4.0. This pillar aims to explain why and how the Industry 4.0 revolution started.

When we look at the history, it is apparent that every industrial revolution brings political, social, technological and economic changes, which mean social and business-related changes and impacts, will occur in this new era as well (Bahar, 2009). The findings indicate that all of the processes of Industry 4.0 are similar to previous industrial revolutions' developmental process. Since each industrial revolution influences and triggers subsequent revolutions, they show similar roots and developmental processes. Every industrial revolution has created similar concerns as well. Similar concerns were raised before and during previous industrial revolutions, but most of these concerns were not realized. Unemployment was always at the heart of these concerns for the general public, while main concern for business was inter-company competition. Unemployment has been the most controversial issue in all of the previous industrial revolutions, as it is today. During the First Industrial Revolution, workers even destroyed the machines in factories due to their fear of unemployment. However, their fears of unemployment were not realized, and in contrast, the need for workers increased.

In other respects, all of the industrial revolutions provide a basis for the next revolution. Technological and social developments force industries to be

innovative. These enforcements lead a new revolution. Based on the findings, it can be said that the developments of Industry 3.0 caused the birth of Industry 4.0.

In conclusion, this pillar clarifies the historical roots of Industry 4.0 and provides the basis for the next revolution. It also shows the cycle of industrial revolutions.

4.1.2. Industry 4.0 Related Attempts in Turkey

Turkey's implementation of Industry 4.0 technologies remains at a crawl while other developed countries like Germany, China, and Japan are drawing away from other nations regarding innovation and Industry 4.0 technologies. Based on the findings, it can be concluded that Turkish industries still stand on somewhere between Industry 2.0 and Industry 3.0. However, some public and private institutions have taken responsibility and initiated measures to assist Turkish industries in adapting to Industry 4.0 initiatives. As a public institution, the Ministry of Science, Industry, and Technology, for instance, prepares and releases an Annual Industry 4.0 Strategic Plan. Also, some entrepreneurial managers and consulting firms have established the Industry 4.0 Platform as private sector players to inform companies that want to improve themselves in this area.

4.1.3. Social and Business-Related Impacts (Employees, Companies, Unions, and Society)

The social and business impacts of Industry 4.0 can mostly be observed on four different groups: employees (primarily blue-collar), companies, unions and disadvantaged groups (women and individuals with disabilities). The most prominent effects of Industry 4.0 for employees are the possibility of unemployment and disappearance of some professions and jobs. As discussed in the results section, the use of high-tech machines, automated production and operation systems and artificially intelligent systems will increase, so there will

be a reduced need for labor, resulting in redundancies. That will also cause the disappearance of some professions and jobs. Some large technology and manufacturing sector companies have initiated the operation of smart factories in Turkey. Tofaş and Arçelik, for example, have opened their smart factories and decreased the number of blue-collar workers in factories in Istanbul and Bursa.

It would appear that companies occupy an advantageous position during Industry 4.0 processes. However, there are both pros and cons of Industry 4.0 for companies. A majority of Turkish companies' technological infrastructure is not sufficient for such a huge transformation process, which causes this transformation process to progress slowly. When companies try to invest in innovations and new technologies, they are confronted with high-costs. Additionally, the management capacity of local companies is not sufficient to manage transformation process; most executive and low-level managers do not possess Industry 4.0-related qualifications and skills. Thus, there is the need for qualified executives to manage this transformation process in local companies. Even though there is a need for such a qualified management team, some company owners have embraced Industry 4.0 developments in their companies, pressuring reluctant lower management executives to oversee the transformation process. On the other hand, companies may benefit from Industry 4.0 transformation and convert their firms to Industry 4.0 technologies. These benefits are innovative business models, decreasing environmental damage, gaining a competitive advantage, fewer employee-related problems and increases in customer satisfaction.

Worker unions are another group to be affected from Industry 4.0. They are accepted as a stakeholder of the Industry 4.0 transformation process, but do not seem aware of Industry 4.0. Unions are currently more engaged in problems related to workers, companies and collective bargaining agreements; Industry 4.0 is not on their agenda. However, as the findings indicate, they have to be

included in Industry 4.0 transformation processes and take the role of informing employees.

Industry 4.0 is also expected to bring changes for women and disabled individuals in the workplace. New technological developments are expected to bring differences such as non-physical workplaces, a genderless business world and high-tech tools, which can help to remove barriers that create discrimination toward women and physical obstacles for disabled individuals (Wada, Shibata, Saito, and Tanie, 2004). This is to say, women and disabled employees will be able to take more responsibility/role in the business world. The genderless business atmosphere can encourage companies to employ women and women's capacities can be seen without discrimination. Also, new technologies will enable disabled employees to work more comfortably with new technological tools.

If these potential impacts explained above cannot be deal with accordingly with solutions, then anxiety on these stakeholders is possible to occur. Even an organizational trauma would appear. Organizational trauma is a process by which organizations and their units may experience trauma, which is revealed through dysfunctional patterns of individual, group, inter-group, and organizational behavior. Companies can experience this trauma as being an orange company, employees as being unemployed and unions as unions without any member.

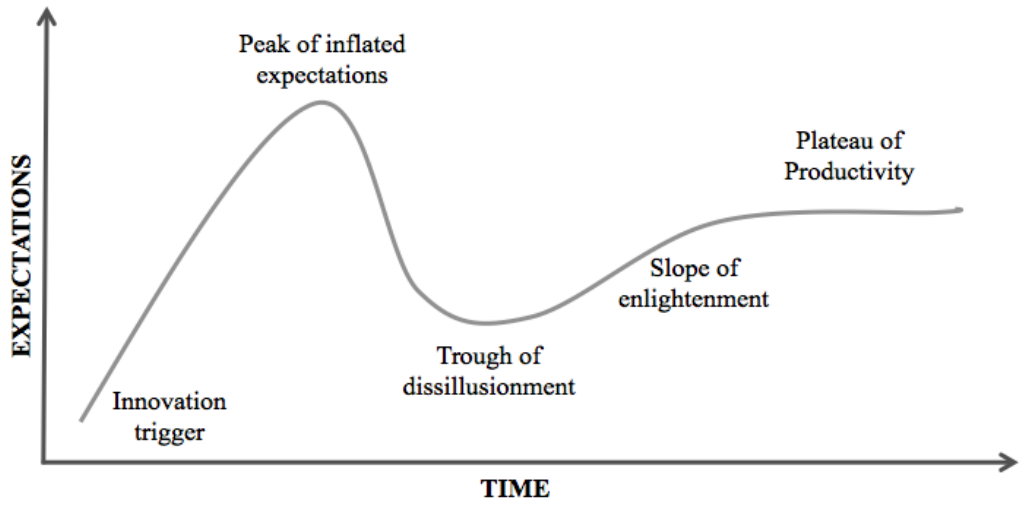
4.1.4. Transformation Problems and Solutions

This study aims to investigate the potential impacts of Industry 4.0 on employees, companies, and unions, and in this sense, the findings show that current technological and digital developments in Turkey have lead to changes in industrial and social relations of employees, companies, and unions. While companies are endeavoring to adapt their business processes and corporate culture according to Industry 4.0 process requirements, some problems related to

business processes and industrial relations have been observed, as previously mentioned. Insufficient technological infrastructures, lack of capacity of internal departments and lack of qualified human resources are the biggest challenges that companies face during the Industry 4.0 transformation process. On the other hand, unemployment, personal data security and social changes are the primary concerns of the public.

The findings also show that there are solutions to the problems observed in this transformation process. Educational reforms, new types of business models, incentives from the state and privacy legislation are shown as leading solutions for these issues. If companies and public institutions apply these solutions, the emergence of new professions seems inevitable. Citizen developers, data logicians, data mining engineers, embedded system developers and design engineers are among the jobs expected to emerge.

Figure 4.1.4. Gartner's Hyper Cycle Model (2011)



In addition to the transformation problems and related solutions, I also observed that there are a number of misconceptions about this transformation process. However, according to Gartner's Hyper Cycle Model (2011), most of these misconceptions are temporary concerns and concepts. According to the model, as shown in Figure 4.1.4., immediately after the emergence of a new

technology or technological concept, a thrill is created. That technology or concept is first seen as a magic wand. The new technology is spoken and written about in a common but superficial way and this marks the Peak of Inflated Expectations. Expectations collapse after a short while and fall into the Trough of Disillusionment. Later, a process begins with the realization of technology, leading to the Slope of Enlightenment. Those who have completed the enlightenment process implement efficient applications at the Plateau of Productivity (Linden & Fenn, 2003). The cycle of this process in Turkey is similar to Gartner's Model for Industry 4.0 transformations as well. Based on the findings, it is apparent that Turkey is currently at the Peak of Inflated Expectations. There are many misconceptions apparent in perception of Industry 4.0 in discourse and the media at this point. The immediate impacts or changes, dark factories without a human workforce, equating artificial intelligence with robots, the unemployment of blue-collar workers and Post-Luddism are the most common misconceptions in Turkey. In 1758, British workers dismantled the first mechanical wool mowers. Supposedly, in Nottingham, a worker named Ned Ludd destroyed a sock-knitting machine. Protests like this spread all over England, giving rise to Luddism. The first law in England including capital punishment for the destruction of machinery and factories was prepared in 1769. However, this law could not prevent Luddism's spread (Orhan and Savuk, 2014). Results show that there will not be post-luddism effect during Industry 4.0 development process if the necessary precautions are taken to prevent unemployment.

4.1.5. Future Perspectives

Industry 4.0 is an inevitable process, which all of the sectors and countries will experience at different levels, based on recent technological developments and innovations (Soyak, 2017). Innovation began with the first tool used by primitive man in the prehistoric age and it continues to progress. Every day, new technologies and technological tools enter our lives. It is difficult

to know what new technologies or innovations bring into our lives, but estimations can be done (Yaralı & Kırık, 2017). In this sense, for Industry 4.0, there are not only concerns but also futuristic ideas and opportunities. Increases in leisure time, grey-collar work, Society 5.0 and the taxation of robots are the outstanding futuristic expectations, which are believed to impact humanity socially and economically in the future.

4.1.6. Fully Implemented Industry 4.0 Processing

If the world has completed the previous industrial revolutions, it will surely complement the 4th industrial revolution with technology, which is continuously, and rapidly developing. The key question at this point is how this process will be completed and what will happen (Schumacher, Erol & Sihn, 2016). Resolving technological, managerial, economic and social problems that will arise during the industry 4.0 development processes will produce positive results for all stakeholders. If these problems are not solved, the big companies, states and employees who do not invest will be the concepts that will be affected the most negatively.

4.1.7. Industry 5.0

Technology is developing without restraint and the use of robots and autonomous systems are rising, which means the era of robotics and high tech is beginning. All of these improvements have initiated a new discussion: is this sign of a new industrial revolution, Industry 5.0? (Demir & Cicibas, 2017) General arguments focus on whether this new revolution will be about the collaboration of automation and humans or not (Demirtaş, 2017). Current developments lead this forecast, which was also articulated by interviewees. Even though the literature and interviews signal the coming of an anticipated revolution, the point of origin is still uncertain and contradictory.

The Industry 5.0 pillar of this model is the last component of the suggested model. In this pillar, it is expected that a new industrial revolution will

occur: Industry 5.0. The previous pillars are steps toward triggering a new revolution by preparing industries and technology.

Taking every pillar into consideration, it can be concluded that every industrial revolution process is a transformation cycle, which provides a basis for a new revolution. This model, the Industry 4.0 Developmental Process Model, demonstrates that all industries are currently experiencing an Industry 4.0 cycle. At the end of this cycle, a new industrial revolution will born, which will also follow the same steps to create another revolution. Even though the conditions, requirements and problems of all industrial revolutions differ in terms of their form, the actual reason for the revolutions remain the same: to change and develop.

4.2. IMPLEMENTATIONS OF THE STUDY

This study aimed to scrutinize the impacts of Industry 4.0 on job-protection and employment. Even though the employment and job-protection is a hot topic regarding Industry 4.0 development process, literature reviews shoed that it is an understudied topic (Firat, et. al., 2017). This study analyzed the possible negative and positive impacts of Industry 4.0 developments on job-protection and employment.

This study also did bring out a general development process perspective on Industry 4.0 in Turkey. Industry 4.0 development process components were explained in detail.

This study explained the futuristic perspectives regarding Industry 4.0 for Turkey and which type of expected social and industrial developments and their impacts on society and business world were analyzed.

This study also contributed to literature by analyzing the future of women and disabled individuals in business world and impact of Industry 4.0 on these groups' employment status.

4.3. LIMITATIONS OF THE STUDY

The current study was conducted with a limited number of interviewees. At the beginning of the study, I aimed to conduct interviews with a diverse group consisting of unions, company owners, managers, consultants and academicians. Unfortunately, however, most of these people were not available to conduct interviews.

Another limitation of this study is that it does not include employees' opinions about Industry 4.0. Even though, most of the interviewees spoke on their behalf, their statements, ideas and claims may not reflect the exact thoughts of employees.

Another limitation of this study is that it does not investigate the situation of women and employees with disabilities in more detail.

4.4. FUTURE RESEARCH

The findings of this study shed light on three topics to be investigated in the future. These topics are ethical issues and emotional bonds with robots, employees' and unions' perception of robotics and a more detailed study on employment of women and disabled employees during the Industry 4.0 process.

First, ethical issues and emotional bonds with robots should be investigated in more detail. A qualitative study of this topic can be conducted to learn the moral dimension of robotics and what kind of emotional bonds between humans and robots can occur.

Secondly, employees' and unions' perception of robotics can be analyzed in more detail. In this study, employees' perceptions were not included and the judgments and comments of only one union representative were analyzed. That means a study with employees and unions can be conducted in the future.

Thirdly, employment of women and disabled employees during Industry 4.0 development processes can be analyzed in more detail. These subjects were included in this study, but a more detailed review with a sole focus on these groups can be conducted in the future.

CONCLUSION

In the view of such situation, this study firstly aimed to provide an overview of Industry 4.0 development process model and the potential impacts of Industry 4.0 on labor force and business organizations within this model, and secondly contribute to future research by conducting interviews with business consultants, academicians and experts working on Industry 4.0 and digitalization, and utilizing from related online resources. From an inductive perspective, I employed the content analysis theory approach by conducting six face-to-face interviews and analyzing thirteen second-hand data (online interviews) and eight online magazine articles. Consequently, I found sixteen themes and an Industry 4.0 Developmental Process Model as primary arguments. The findings demonstrated that Industry 4.0 developments would impact employees' employment and education, companies' business models, industrial relations and society. Beside these impacts, the findings also suggested some solutions to decrease the intensity of these impacts, which are education-related, business-related solutions and cyber security precautions. These results led to the creation of an Industry 4.0 Developmental Process Model, which presents the development process of Industry 4.0 with six main milestones. Furthermore, this study suggests three research topics to be investigated in the future, which are ethical issues and emotional bonds with robots, employees' and unions' perceptions toward robotics and a more detailed study on the employment of women and disabled employees during Industry 4.0 processes. The findings of this study contributed to a general understanding of Industry 4.0 development processes with its impacts, transformation problems and solutions, and futuristic perspectives.

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APPENDICES

Appendix A: The Letter of Ethics Committee

ETİK KURUL DEĞERLENDİRME SONUCU/RESULT OF EVALUATION BY THE ETHICS COMMITTEE

(Bu bölüm İstanbul Bilgi Üniversitesi İnsan Araştırmaları Etik Kurul tarafından doldurulacaktır /This section to be completed by the Committee on Ethics in research on Humans)

Başvuru Sahibi / Applicant: Mehmet Çakmak

Proje Başlığı / Project Title: Impacts of Industry 4.0 on Labor-Job Protection and Employment: A Qualitative Analysis of Consultants, Experts and Unions' Introspection

Proje No. / Project Number: 2018-20024-13

1.	Herhangi bir değişikliğe gerek yoktur / There is no need for revision	XX
2.	Ret/ Application Rejected Reddin gerekçesi / Reason for Rejection	

Değerlendirme Tarihi / Date of Evaluation: 19 Ocak 2018

Kurul Başkanı / Committee Chair
Doç. Dr. Itır Erhart

Üye / Committee Member
Prof. Dr. Aslı Tunç

Üye / Committee Member
Prof. Dr. Hale Bolak

Üye / Committee Member
Prof. Dr. Turgut Tarhanlı

Üye / Committee Member
Prof. Dr. Koray Akay

Üye / Committee Member
Prof. Dr. Ali Demirci

Üye / Committee Member
Doç Dr. Ayhan Özgür Toy

Appendix B

Informed Consent Form

(in Turkish)

Gönüllü Katılım Formu

Değerli Katılımcı,

Bu çalışmanın amacı, Endüstri 4.0 uygulamalarının çalışanlar (iş güvencesi ve istihdam) ve şirketlerin iş modelleri ve stratejileri üzerindekinin araştırılmasıdır. Katılımcıların; Endüstri 4.0, organizasyonel dönüşüm, dijital dönüşüm veya sendikal ilişkiler üzerinde uzmanlaşmış şirketlerde çalışmaları ve en az 6 ay veya daha uzun süredir çalışıyor olması beklenmektedir.

Çalışma, İstanbul Bilgi Üniversitesi Örgütsel Psikoloji öğrencisi Mehmet Çakmak tarafından Yüksek Lisans Tezi kapsamında Yrd. Doç. Dr. İdil Işık danışmanlığında yürütülmektedir.

Katılımcılardan, adı-soyadı ve iletişim bilgileri talep edilmemektedir. Çalışma kapsamında vereceğiniz tüm bilgiler gizli tutulacak ve sadece bilimsel amaçla kullanılacaktır. Görüşmeden elde edilen veri tekil olarak kullanılmayacak, tüm katılımcılardan alınan cevaplar bir veri havuzunda bir araya getirilecek ve analizler bu toplam veri üzerinde yapılacaktır.

Görüşme sorularının doğru veya yanlış cevabı yoktur. Araştırmada yer alan soruların katılımcılar açısından olumsuz etkileri olması beklenmemektedir. Çalışmaya katılım tamamen gönüllülük esasına dayanmaktadır. Uygulama sırasında istediğiniz anda ve gerekçe belirtmeden bırakabilirsiniz. Tüm soruları cevaplamanız yaklaşık 20 dakika sürecektir.

Çalışma hakkında daha fazla bilgi almak isterseniz Mehmet Çakmak (mehmet.cakmak@stratejico.com) ile iletişime geçebilirsiniz.

Desteğiniz için teşekkür ederiz.

Yukarıdaki çalışmanın amacını ve içeriğini belirten bildiriyi okudum, anladım ve araştırmaya katılmayı,

○ Kabul ediyorum

○ Kabul etmiyorum

Appendix C

Informed Consent Form

(in English)

Dear Participant,

The objective of this study is to examine the possible impacts of Industry 4.0 labour force (labour-job protection and employment) and business models. Expected participants of this study are the ones whose companies' specialized in organizational transformation, digital transformation or trade union relations and working for at least 6 months or longer.

The study is caried out by Mehmet Çakmak, an organizational psychology student at Istanbul Bilgi University, within the scope of Master Thesis under the supervision of Dr. İdil Işık.

Name-surname and contact information are not being asked from the participants. All information that you give within the scope of the study will be kept confidential and data collected will only be used for the scientific purposes. The data collected from participants will not be used individually, they will be combined in a data pool and analysis will be conducted on this anonymous database.

Interview questions have no right or wrong answers. There will be no harm expected from this study for the participants. It is voluntary to participate in this study. Your participation is completely voluntary. You can quit answerring the interview questions any time without mentioning an excuse. Answering the questionnaire will take about 10 minutes.

You can contact with Mehmet Çakmak (mehmet.cakmak@stratejico.com) if you have any further questions on the study.

Thanks for your participation.

I have read and understand the explanation provided to me, and I voluntarily agree to participate in this study.

○ I accept

○ I don’t accept

Appendix D

Interview Questions

(in Turkish)

Cinsiyet:

Meslek:

İş Yeri/Sektör:

Deneyim Yılı:

Sorular:

1. Endüstri 4.0 hakkında bilginiz var mı? Varsa kısaca bahsedebilir misiniz?

2. Türkiye'de üretimin dijitalleşmesi ve değişimi üzerine ne tür ilerlemeler var?

3. Hangi sektörlerde daha çok veya daha hızlı değişim (transformasyon) göreceğimizi düşünüyorsunuz? Türkiye'de sizce üretimde teknoloji ne ölçüde kullanılıyor?

4. Sizce imalatı sanayi sektörü Endüstri 4.0 veya başka bir deyişle üretimin dijitalleşmesinden nasıl etkilenecek ya da etkilenecek mi?

5. Genel olarak Endüstri 4.0 sürecine baktığımız zaman sizce bu işin paydaşları kimlerdir?

6. Bu süreçte hükümetin rolü ne olacak? Endüstri 4.0 ve gelecekte mavi yakalı çalışanlar için herhangi bir aksiyon alıyorlar mı?

7. Endüstri 4.0 iş verenlere ne tür avantajlar ve dezavantajlar getirecek sizce?

8. Son günlerde yerli-yabancı basında izlediğimiz tartışmalar genellikle yapay zekânın insanlık için tehlike arz edebileceğine dikkat çekiyor ve hayli spekülatif yorumlar içeriyor. Son olarak Facebook'un geliştirdiği iki Yapay Zekâ'nın kendi aralarında özel bir dil geliştirmesi sonucunda Facebook'un bu projenin fişini çekmesiyle konu yeniden gündeme geldi. Öncelikle ''Yapay Zekâ tehlikeli mi tehlikesiz mi'' tartışmasında sizin görüşleriniz nelerdir?

9. Özellikle tehlike boyutu düşünüldüğünde teknoloji açısından akla ilk gelen sürücüsüz arabalar oluyor. Nitekim bu tür arabaların çok basit yollarla 'hack'lenmesi artık önemli bir güvenlik meselesi halini aldı. Hatta iş öyle bir boyuta ulaşmış durumda ki, Youtube'da sürücüsüz arabaları hackleme yolları üzerine videolar yayınlanabiliyor. Bu boyutuyla Yapay Zekânın sınırları ne olmalı sizce, bu konuda ne düşünüyorsunuz?

10. Çalışanlar için (özellikle mavi yaka) bu tür gelişmeler ne demek, onları nasıl etkileyecek sizce? Süreç onlar için nasıl ilerleyecek? Endüstri 4.0'ın mavi yaka çalışanlar için avantajları/dezavantajları neler olacak sizce?

11. Üretimde artan teknoloji kullanımı çalışan-işveren ilişkilerini nasıl etkiler / etkiler mi?

12. Türkiye'de Tuzla Elektrik Santrali, 2016 yılı itibari ile insansız çalışmaya başladı. Türkiye'de üretimin insansız boyuta oluşması hakkında ne düşünüyorsunuz? Üretim sektörünün şu anki imkanlarına baktığınız zaman böyle bir dönüşüm bizim için mümkün mü? Ya da böyle bir dönüşüm için atılması gereken adımlar nelerdir?

13. Tuzla Elektrik Santrali projesine benzer projelerden haberdar mısınız?

14. Sizce Türkiye'de sendikaların ve çalışanları bu konuda bir farkındalığı var mı? Varsa ne tür çalışmalar yapıyor? Yoksa sizce neden henüz haberdar değiller?

15. Endüstri 4.0 ve teknolojik gelişmeleri göz önünde bulundurursak, çalışan-işveren ilişkilerinde sendikaların rolü nasıl olacaktır? Endüstri 4.0 geçiş sürecinde bu ilişkiler nasıl değişecektir?

16. Google, Facebook, Amazon, IBM ve Microsoft gibi şirketler Yapay Zekânın toplum yararına olması yönünde aralarında işbirliği anlaşması kaleme aldılar. Amerikan Hükümeti de 2016'da sürücüsüz arabalar için kurallar standardı yayınladı. Şirketler ve hükümetler arasında Yapay Zekânın denetim altına alınması konusunda böyle bir konsensüs ortamı mevcut ancak temel eleştiriler ve sorular tüm bu düzenlemelerin nasıl uygulamaya konulacağında yoğunlaşıyor. Bir robotun bir insana zarar vermesi halinde suçlu kim olacak? Robotu üreten şirket mi, yazılımcı mı, tasarımcı mı? Yakın bir tarihte Yapay Zekâ polisi, Yapay Zekâ yargıcı gibi yeni tanımlarla, mesleklerle mi tanışacağız?

17. İş güvencesi açısından baktığımız zaman yeni çıkacak olan meslekler için kalifiye olmayan kişileri nasıl bir gelecek bekliyor sizce? Özellikle işveren, kamu ve sendika boyutunda düşündüğümüzde bu kişiler için nasıl çalışmalar yapılmalı?

18. Son olarak, Sanayi 4.0 çerçevesinde geleceğe yönelik beklentileriniz nelerdir?

Appendix E

Interview Questions

(in English)

Gender of the interviewee:

Occupation of the interviewee:

Workplace/Sector of the interviewee:

Year of experience of the interviewee:

Questions:

1. What do you know about Industry 4.0? Can you please explain briefly?

2. What types of developments are recently done about industrialization and digitalization of production in Turkey?

3. Which sectors do you think will digitalize more easily? To what extent do you think digitalization is being used in production in Turkey?

4. How do you think Industry 4.0 in Turkey will impact the manufacturing sector?

5. In a general perspective, who do you think are the stakeholders of the Industry 4.0 process?

6. What will be the role of the government in this process? Do they take any action regarding Industry 4.0 and job protection of blue-collars in future?

7. What type of pros and cons will Industry 4.0 will bring for business owners?

8. In recent days, the discussions we have watched in the national and international press usually point out that artificial intelligence can pose a threat to humanity and it contains highly speculative interpretations. Finally, the two artificial intelligences developed by Facebook developed a special language among them, and the issue came to the fore again as Facebook gave up this project. First of all, what are your views in the discussion "Is Artificial Intelligence dangerous or not dangerous?"

9. Especially when the danger dimension is considered, driverless cars come to mind firstly in terms of technology. As a matter of fact, 'hacking' of such cars in very simple ways has become an important security issue now. In fact, the business has reached such a size that videos are posted on YouTube on ways of hacking driverless cars. Should we limit Artificial Intelligence to prevent dangerous situations to happen, what do you think about it?

10. How will Industry 4.0 in Turkey impact the workers' rights and job protection? How will these affect blue-collar workers? What type of advantages and disadvantages will be there for them?

11. How will the increases of the use of technology in manufacturing impact employee-employer-union relations?

12. When you look at the present opportunities of the manufacturing sector, is it possible for us to make such a transformation? If so, what are the steps to take for such a transformation?

13. Do you know any similar projects about digitalization of the factories like Tuzla Power Plant in Turkey?

14. Do you think workers and unions have awareness about Industry 4.0 in Turkey? Do they take any actions, precautions or preparation?

15. When we consider Industry 4.0 and technological developments in production, how will the role of the union change or what position will they take? In the transition process, how will the relations between unions, employers and employees change?

16. Companies such as Google, Facebook, Amazon, IBM and Microsoft have made a collaborative agreement about Artificial Intelligence and the public interest. The US government has also published standards for driverless cars in 2016. There is an atmosphere of consensus among companies and governments about the control of Artificial Intelligence, but the main criticisms and questions concentrate on how to implement all these regulations. Who would be guilty if a robot hurts a human? Is it the company that produces the robot, the developer, or the designer? Will we meet with professions with new definitions like Artificial Intelligence Police, Artificial Intelligence Judge in near future?

17. When we look at job protection, what kind of future do you expect for the people who do not qualify for new jobs? What should we do for these people, especially when we think in terms of employers, government and unions?

18. Finally, what are your expectations for future in the framework Industry 4.0 in general?