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INDUSTRY 4.0 CONCEPT AND APPLICATIONS ON DIFFERENT SECTORS

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ABSTRACT

After the three major industrial revolutions, digitalization in production has begun with the fourth industrial revolution with the great change effect of technology on production systems. Fourth industrial revolution or Industry 4.0 referring to literature, is aimed to integrate products, machines and production systems. This integration will be provided with the use of the Internet and new information technologies in production, and also with the implementation of Cyber Physical Systems (CPS), Internet of Things (IoT), Smart Factories and other Industry 4.0 components. For Industry 4.0, where developed countries started, it appears that goverment and industry collaborators have quickly prepared road maps and are beginning to apply some of the leading companies in their sector. If it is considered that strategic issues such as technological infrastructure, human resource policies, production digitization, technology levels of production systems, it can be said that implementing Industry 4.0 in our industry may be difficult by this time. However, the problems need to be resolved quickly and the manufacturing industry's Industry 4.0 pilot applications must begin. In this context, within the scope of the study, answers to the following questions will be taken in the questionnaire study conducted by our country's manufacturing companies; "What is the use of technology in the process from product and service design to production?", "What is the use of information systems in processes such as planning, production, estimation, supply chain?", "What is the intensity of analyzing and evaluating customer data in design, engineering and manufacturing processes?" and "What is the intensity of technology use in the process from production to delivery of products and services to the customer?". The results will be interpreted as whether the country's manufacturing industry is ready for transition to Industry 4.0.

Keywords: *Industry 4.0, fourth industrial revolution, cyber physical systems, internet of things, smart factories*

INTRODUCTION

Nowadays, production systems and technologies are in a rapid change. This change leads to the change of traditional production as well as physical change. Technology has become the most important topic of modern production systems. By this way, enterprises, governments and production policy makers have great roles in the development or renewal of existing production technologies.

All industrial revolutions have begun with technological developments in history. The discovery of water and steam powered machines, the division of work and the transition to mass production, the introduction of software and programmable logic control (PLC) into the production systems triggered the industrial revolutions before fourth industrial revolution. The new industrial revolution is triggered by the Internet and its rapid development. The Internet provides the communication between people and machines (Brettel et al. 2014). The widespread use of the Internet provides digitalization in all areas. Therefore, production systems also enter the digitalization process.

New technological systems, which have been used in production in recent years, change the industrial appearance. Beyond the traditional industrial systems, smart factories and smart machines reveal the concept of Industry 4.0. The concept of Industry 4.0 is a set of technological developments that affect and change products and processes, integrate the digital and physical world in production and enable the production of smart products. Product demands are changing rapidly, more functional and comprehensive products are being demanded by customers together with producing smart products (Nunes et al. 2017).

New emerging technologies also change the education system. Only the well-educated labors acoording to new production systems can use these technologies, so the human factor plays an important role in future production systems. For this reason, companies should pay attention to human resources management and strategies, and focus on the development of the qualified workforce (Benesova and Tupa, 2017).

Increasing data volume with new technologies also rise demand for the cloud system. If it is analyzed in information technology, there will be a need for expert personnel who will implement the cloud system in the enterprises. Also, cloud system engineers and experts providing technological integration for companies will be working in the management staff. It means that, after the transition to the cloud system, information systems personnel qualifications will change and they will have to be more qualified (Benesova and Tupa, 2017).

Purpose of this study is to figure out awareness of Industry 4.0 in Turkey's manufacturing industry. It can be said that industry of Turkey is not suitable to apply Industry 4.0 and its components right now. By this way, it is better to determine which problems can be faced while practicing Industry 4.0. Road maps for beginning to new production technologies can be prepared qucikly. The results of this article can be guide for exercising Industry 4.0 and its components.

Before the transition to Industry 4.0, the infrastructural lacks of the industrial companies will be determined according to their awareness levels, and the steps to be taken before the state policies together with the necessary technology, infrastructure and education investments that will be presented as a solution proposal in the study. Briefly, the main purpose of the study is to measure the awareness of Turkey's industrial enterprises Industry 4.0.

LITERATURE

Concept Of Industry 4.0

Announcing its name at the Hannover Fair in Germany for the first time in 2011, Industry 4.0 has been a considered subject by academics, practitioners, politicians and government officials worldwide since then. Kagermann (2013) defines Industry 4.0 as a new trend for automation and data transfer in manufacturing technologies. Cyber physical systems (CPS), internet of things (IoT), cloud systems and smart factories are the main components that make up the concept of Industry 4.0. To summarize the industry 4.0 system briefly; by using cyber physical systems in smart factories, digital copies of real objects are created in the virtual world. Products are in communication with each other and with users with internet of things. Also, they are coordinated. Thus, production and process monitoring in the cyber physical system will be made using the internet (Sung, 2017).

Industry 4.0 is seen as the most comprehensive industrial revolution. Because starting from the economic issues, including social and environmental issues that affect our daily life takes the field of new industrial revolutions influence (Garbie, 2016). Industry 4.0 can also be defined as a combine of every stage of production in enterprises in the traditional production processes with internet and information communication technology (Bortoloni et al. 2017). In other words, industry 4.0 is the linking of people and objects with any communication technology or service in every platform at all times (Wagner et al. 2017).

In 2013, Acatech defined Industry 4.0 as "The technical integration of production and logistics activities with the use of cyber physical systems, internet of things and internet of services" (Bartodziej, 2017).

After the application of Industry 4.0, the enterprises will be changed in accordance with the relevant articles:

- Functional and smart products will be produced by using internet of things and cyber physical systems.
- It will be ensured that customer oriented productions can be realized instead of mass productions.
- Real-time information and data transfer will be realized with smart factoris and smart products.
- As raw materials and resources are optimized, efficiency will be increased and alternative energy sources will be able to use.
- Smart systems, machines and robots will have more important roles in production.
- The need for unskilled labor will be reduced.
- Production errors will be reduced nearly to zero.
- Development of occupational health and safety practices will be considered.
- Flexibility of working hours with Industry 4.0 will change shift strategies.

- Customer requests that are individualized can be realized with 3D printers outside the factory with simple production processes.
- Global markets will grow with adapting companies to new systems.
- By combining physical objects with the virtual world, production and consumption processes will be associated with the virtual world (Yazici and Duzkaya, 2016).

The first industrial revolution took place in England. After occurence, the first industrial revolution spread to Western European countries and the United States right after England. With the industrial revolutions, many implementations in production have been changed and new rules have been started to be applied in industries. Industrialization can be defined as the transformation of nature parallel to human needs (Aksoy, 2017).

The history of industrial revolutions, some of the important inventions and technologies of industrial revolutions can be seen on Table 2.1 briefly.

Table 2.1 History of Industrial Revolutions

First industrial revolution (1760-1830)	Discovery of water and steam power machines
Second industrial revolution (1840-1973)	The discovery of electricity, division of labor and mass production implementations
Third industrial revolution (1974-2011)	Establishment of automation systems, development of information Technologies
Fourth industrial revolution (2011-…)	Cyber physical systems and rapid transfer of information in production

(Gabaçlı and Uzunöz, 2017)

Components of Industry 4.0

Selek (2015) classifies the basic technological components of Industry 4.0 as follows; Intelligent robots, simulation, horizontal / vertical software integration, internet of things (network of integrated sensors), cyber security, cloud, additive production such as 3D printing, augmented reality and big data and analysis are the core components of Industry 4.0.

Except main components of Indsustry 4.0, other applied Industry 4.0 technologies are as follows: wearable technologies (smart watches, goggles, gloves), virtual reality applications, autonomous vehicles (drones), data analysis programs (Hoffman and Rüsch, 2017).

As it is mentioned, some of the significant components for Industry 4.0 can be identified as follow:

Cyber Physical Systems

Cyber physical systems, which are one of the main components of Industry 4.0 applications, are the systems that convey the physical movements of the objects with the help of sensors via the internet to the cyber system (Alçın, 2016). Cyber physical systems, as can be seen from the definition, form physical activities in virtual systems. Considering the production systems, all activities of production in cyber physical systems are transferred to the virtual world.

After exercising cyber physical system in production systems, it will be very crucial for production. Because, through cyber physical system, every level of production (smart products, machines, factories) will be connected to each other (Pereira and Romero, 2017).

Internet of Things

Internet of things allows all objects in production to communicate with each other through communication devices such as RFID, sensor, operating system, mobile phone. Also, it provides companies having reaction to common production targets in the same processes (Hermann et al. 2016).

Internet of things can be defined as connecting physical objects to each other with internet every day, communicating human, machine, information systems in this system with each other and applying smart factories in production systems. In addition, a different definition is made as “A world where physical objects are integrated with information technologies in the internet network and actively participate in business processes” (Pereira and Romero, 2017).

Smart Factories

Smart factories are a solution that is based on the principles of production to be able to respond quickly to the ever-changing customer expectations and to adapt to the required changes. When smart factories are installed, the complexities experienced in production are solved and production efficiency is increasing. Smart factory environment and scope are formed by the connection of the enterprise with human resources, machinery and smart products (Nunes et al. 2017).

Smart factories have smart devices and smart products that are integrated with IoT and CPS concepts. Smart devices have onboard processing, data storage, communication technology, sensors and actuators. Intelligent products can identify themselves, define their status, history and approaching processes (Mehami et al. 2018).

Production sequence is known systematically in smart factories. Also, machines and people are automatically directed according to production work plans (Hermann et al. 2016). Smart products can determine their production planning. By this way, production can be achieved automatically by smart production systems.

Advantages and Disadvantages of Industry 4.0

Industry 4.0 is precisely one of the most major subjects for the manufacturing industry in the years to come. Schmitt (2015) declared why Industry 4.0 is critical and revolutionizing information technology, marketing and sales processes with five items:

1. Industry 4.0 will decrease the responsibility of companies to adapt to new business trends. The rapid demand risings in the market, short life time products, complicated product structures, and supply chains working international are the subjects in which companies are thought to be forced.

2. Companies will be more innovative with Industry 4.0, and thus productivity will rise up. New trend technologies usage in production systems with digital and smart systems will rise the internet innovation speed in production systems and new business models will be achieved more quickly in production systems.

3. Customers are oriented at the center of production with Industry 4.0. The customization of the products will be made possible by digital systems, customer requests will be more critical in product designs.

4. The labor factor becomes the most critical subject with Industry 4.0. Productions can be made without labor, in the case of need in automation systems, workers will be in process, and employee will be needed mostly to solve complicated duties in production systems.

5. Important earnings in non-production subjects such as energy, raw materials and enterprise sources will be ensured. Environmental solutions, social and economic problems will be solved faster by using modern technologies in smart systems, and creative solutions will be introduced for production lines (Morrar et al., 2017).

With the application of Industry 4.0, it is necessary to mention the advantages that will be provided to the customers as well as the advantages that will be provided to the enterprises. Customers are an important part of the system in the supply chain. Industry 4.0 offers many advantages to customers. First of all, it will be easier for customers to communicate with every part of the supply chain in the digitalizing system. With the help of integrated technological systems and automations, customer requirements and additional requests will be delivered to the system instantly and appropriate solutions will be produced. Customer requests will be met quickly. Finally, open production and product information provided by smart products to customers will ensure more accurate usage information about the product and will be important in terms of tracking the life cycle of the product (Pereira and Romero, 2017).

In addition to the positive aspects of the implementation of Industry 4.0, there will be negative effects on the enterprises. It is important to identify and evaluate the economic impacts of digitalized production processes. Changes lead to significant difficulties in the enterprise. The challenges that businesses face when implementing Industry 4.0 are:

- Information technology security issues
- Reliability and stability in machine-machine systems
- Protection of integration of production processes

- Preventing systemic pauses due to information technology, which may lead to a delay in production or stopping.
- Protection of product know-how information
- To have adequate skills as an enterprise to prevent disruption of the Industry 4.0 processes.
- Unnecessary redundancies of information technology department to production processes
- Unwillingness to change the roles of the employees in the system with changes in the system
- Reductions in work groups requiring a low level of education, especially since many jobs with the new system will now be carried out through automation and computing processes (Sung, 2017).

Data security and cyber burglary are an important issue as Industry 4.0 will enable online connections in production. Management information security should be taken care seriously because transferring production data to out of enterprise can take them in difficult situations.

THE PROPOSED METHODOLOGY

Purpose Of Research

According to Industry 4.0 and digitalization in production, current situation of companies in manufacturing industry of Turkey and point of view of Industry 4.0 are evaluated within the scope of the study. Industry 4.0, which can be thought as an initial level in our country, needs to be understood well and correct strategies should be established. By this way, it was tried to determine the lacks of the manufacturing industry on Industry 4.0 with the survey questions used in the research and the hypotheses created in parallel with the survey questions in this study.

The concept of Industry 4.0, resulting from the use of cutting-edge technology in production, is therefore an industrial revolution that closely concerns all industries. Since Industry 4.0 can be applied in every sector where industrial production takes place, the sector has not been differentiated in this study. Sectors and enterprises have been examined in the light of the survey study, and the knowledge levels of Industry 4.0 and their readiness to the new industrial revolution have been tried to be determined.

The survey questions were sent by e-mail to production companies operating in Turkey. No sectors were chosen especially. Because, the idea was that Industry 4.0 can be applied in every sectors related to its technological advantages. Senior executives working in these firms and employees in production, production planning, quality, R&D, marketing departments and managers answered the survey questionnaire. A total of 202 return surveys were obtained from the firms.

The significance levels of the hypotheses were analyzed by SPSS 22 data analysis program. Consequently, specific hypotheses have been established and examined by taking into account sectoral differences and Industry 4.0 knowledge levels of the participants.

It is important to select the correct sample size in order to ensure statistical significance of the survey results. According to the literature, if the number of variables is not high, between 100 and 200 variables can be selected (Tabachnick and Fideli, 2001). By this way, 202 of participants were selected for the survey.

Findings Regarding Participants

The sectoral classification of the participating companies to survey is shown in Table 3.1. Between 202 participants, 199 of them stated the sector they worked for and evaluated within the scope of the study. The survey with the highest participation of 28.14 percent consists of metal, machinery and equipment sectors. Rest of the participants can be seen on Table 3.1.

Table 3.1 Grouping the Companies by Sectors

Sector	Total	Percentage
Metal, machinery and equipment	56	28,14
Food, tobacco and alcohol	50	25,13
Automotive and electronics	37	18,59
Chemical, plastic, pharmaceutical, cleaning	27	13,57
Paper production and printing, wood and furniture, construction	15	7,54
Others	14	7,04
Total	199	100

The firms participating in the study according to the number of employees are grouped in Table 3.2. Small and medium-sized companies (SMEs) are defined as firms that employ less than two hundred and fifty employees and do not exceed the annual net sales revenue or financial balance of 40 million Turkish Liras (Council of Ministers Decision, 2012).

Table 3.2 Grouping of Companies Participating in the Study by Number of Employees

Number of Employees	Number of Participants	Percentage
SME companies	130	59,41
Large scale companies	82	40,59
Total	**202**	**100**

The research was conducted in the manufacturing sector. The participants of the survey were asked to be engineers or specialists in production, production planning, quality, R & D, marketing departments or senior management. The distribution of the participants by departments is shown in Table 3.3.

Table 3.3 Grouping of Survey Participants by Departments

Departments	Number of Participants	Percentage
Production	98	48,51
Research and Develpoment	33	16,34
Quality	29	14,36
Production Planning	17	8,42
Marketing	13	6,44
Strategy	9	4,46
Purchasing	3	1,49
Total	**202**	**100**

Participation in the research was mostly from the production department, then from the R & D, quality, production planning, marketing, strategy and purchasing departments respectively. Department managers are listed in their departments and business executives are evaluated within the scope of strategy department in Table 3.3.

Findings Related to Survey Questions

The average of the responses of the participants to the survey questions are shown in Table 3.4. The survey questions are prepared according to the 5-point Likert scale.

Table 3.4 Answers of Participants to Survey Questions

Survey Questions	Average	Scaling
What is the use of technology in the process from product and service design to production?	3,653	1- Manual planning and design, low automation 5- Full automation and information systems (ERP, MRP etc.)
What is the use of information systems in processes such as planning, production, estimation, supply chain?	3,219	1- Manual, experience-based operations 5- Operation-specific information system use
What is the intensity of analyzing and evaluating customer data in design, engineering and manufacturing processes?	3,218	1- Data analysis not performed 5- Design and production changes are made regularly by evaluating customer specifications
What is the intensity of technology use in the process from production to delivery of products and services to the customer?	3,109	1- Manual operations 5- Integrated customer management, distribution, supply chain automation

As can be seen in Table 3.4, the participants have positive answers to the questionnaires related to the Industry 4.0 awareness and Technologies in this study.

Hypotheses

Before transition to Industry 4.0 applications, it is necessary to be aware of Industry 4.0 technology levels and production knowledge, skills and capabilities. In line with the survey questions, sectors that are ready to implement Industry 4.0 or think that Industry 4.0 applications are necessary for the country's industry have been categorized. Then, it is predicted that the implementation of certain Industry 4.0 technologies and information technology infrastructures will be answered at variable rate in sectoral basis. In this context, the following hypotheses were formed.

H_1: There is a difference between sectors in the intensity of analyzing and evaluating customer data in design, engineering and production processes.

H_2: There is a difference between sectors in the intensity of using technology in the process from product and service design to production.

H_3: There is a difference between sectors in the intensity of the using information systems in the processes such as planning, production, prediction and supply chain.

H_4: There is a difference between sectors in the rate of technology usage in the process from production to delivery of products and services to the customer.

Evaluation of Hypotheses

H_1: There is a difference between sectors in the intensity of analyzing and evaluating customer data in design, engineering and production processes.

One-way ANOVA (one-way analysis of variance) was used to test H_1 hypothesis. Table 3.5 shows the homogeneity of variance test. Since sig. value is greater than 0,10 (0,743), it can be said that the variances are homogeneous. In this case, the basic assumption of one-way ANOVA analysis is provided.

Table 3.5 Homogeneity of Variances for H_1

LeveneStatistic	df1	df2	Sig.
,544	5	193	,743

Table 3.6 shows the one-way ANOVA test for H_1. H_1 is accepted because sig. value (0,005) is not greater than 0,10. According to the test results, the established alternative hypothesis is accepted. That is, there is a difference between sectors in the intensity of analyzing and evaluating customer data in design, engineering and production processes.

Table 3.6 Analysis of Variance For H_1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	17,485	5	3,497	3,485	,005
Within Groups	193,651	193	1,003		
Total	211,136	198			

The average of the responses of the survey participants to the "What is the intensity of analyzing and evaluating customer data in design, engineering and manufacturing processes?" question is shown in Table 3.7.

Table 3.7 Evaluation of Analyzing Customer Data in the Design, Engineering and Production Process of Sectors

Sector	**Total**	**Percentage**
Metal, machinery and equipment	56	3,09
Food, tobacco and alcohol	50	2,90
Automotive and electronics	37	3,64
Chemical, plastic, pharmaceutical, cleaning	27	3,14
Paper production and printing, wood and furniture, construction	15	3,20
Others	14	3,79

H_2: There is a difference between sectors in the intensity of using technology in the process from product and service design to production.

One-way ANOVA (one-way analysis of variance) was used to test the H2 hypothesis. Table 3.8 shows the homogeneity of variance test. Since sig. value is greater than 0,10 (0,870), it can be said that the variances are homogeneous. In this case, the basic assumption of one-way ANOVA analysis is provided.

Table 3.8 Homogeneity of Variances for H_2

LeveneStatistic	df1	df2	Sig.
,368	5	193	,870

Table 3.9 shows a one-way ANOVA test for H_2. The H_2 hypothesis is rejected because its sig. value (0,218) is greater than 0,10. According to the test results, the established alternative hypothesis is rejected. In other words, there is no difference between sectors in the intensity of using technology in the process from product and service design to production.

Table 3.9 Analysis of Variance for H_2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,279	5	1,256	1,422	,218
Within Groups	170,485	193	,883		
Total	176,764	198			

According to the sectors examined, the average value of the responses of the participants to the survey question "What is the use of technology in the process from product and service design to production?" is shown in Table 4.8.

Table 3.10 Evaluating the Intensity of Technology Usage in the Process of Sectors from Product and Service Design to Production

Sector	**Total**	**Percentage**
Metal, machinery and equipment	56	3,71
Food, tobacco and alcohol	50	3,52
Automotive and electronics	37	3,86
Chemical, plastic, pharmaceutical, cleaning	27	3,40
Paper production and printing, wood and furniture, construction	15	3,53
Others	14	4,00

H_3: There is a difference between sectors in the intensity of the using information systems in the processes such as planning, production, prediction and supply chain.

One-way ANOVA (one-way analysis of variance) was used to test the H_3 hypothesis. Table 3.11 shows the homogeneity of variance test for H_3. Since sig. value is greater than 0,10 (0,516), it can be said that the variances are homogeneous. In this case, the basic assumption of one-way ANOVA analysis is provided.

Table 3.11 Homogeneity of Variances for H3 Test

LeveneStatistic	df1	df2	Sig.
,850	5	192	,516

One-way ANOVA test for H_3 is shown in Table 3.12. H_3 alternative hypothesis is accepted because sig. value (0,013) is less than 0,10. According to the test results, it can be said that there is a difference between sectors in the intensity of the using information systems in the processes such as planning, production, prediction and supply chain.

Table 3.12 Analysis of Variance for H_3

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13,915	5	2,783	2,987	,013
Within Groups	178,858	192	,932		
Total	192,773	197			

According to the sectors examined, the average of the answers of the participants to the question of "What is the use of information systems in processes such as planning, production, estimation, supply chain?" is shown in Table 3.13.

Table 3.13 Evaluation of Sectors for the Intensity of Information Systems in Processes such as Planning, Production, Estimation and Supply Chain

Sector	**Total**	**Percentage**
Metal, machinery and equipment	56	3,14
Food, tobacco and alcohol	50	3,00
Automotive and electronics	37	3,69
Chemical, plastic, pharmaceutical, cleaning	27	3,00
Paper production and printing, wood and furniture, construction	15	3,26
Others	14	3,57

H_4: There is a difference between sectors in the rate of technology usage in the process from production to delivery of products and services to the customer.

One-way ANOVA (one-way analysis of variance) was used to test the H_4 hypothesis. Table 3.14 shows the homogeneity of variance test for H_4. Since, significance value is less than 0,10 (0,053), it can be said that the variances are heterogeneous.

Table 3.14 Homogeneity of Variances for H_4 Test

LeveneStatistic	df1	df2	Sig.
2,224	5	193	,053

One-way ANOVA test for H_4 hypothesis is shown in Table 3.15. H_4 alternative hypothesis is rejected because sig. value (0,162) is less than 0,10. According to the test results, it can be said that there is not difference between sectors in the rate of technology usage in the process from production to delivery of products and services to the customer.

Table 3.15 Analysis of Variance for H_4

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6,240	5	1,248	1,600	,162
Within Groups	150,544	193	,780		
Total	156,784	198			

According to the sectors examined, the average of the answers of the participants to the question of "What is the intensity of technology use in the process from production to delivery of products and services to the customer?" is shown in Table 3.16.

Table 3.16 Evaluation of Technology Usage Density in Sectors from Production to Delivery of Products and Services to Customer

Sector	**Total**	**Percentage**
Metal, machinery and equipment	56	2,94
Food, tobacco and alcohol	50	3,04
Automotive and electronics	37	3,35
Chemical, plastic, pharmaceutical, cleaning	27	3,07
Paper production and printing, wood and furniture, construction	15	3,00
Others	14	3,50

CONCLUSION

The concept of Industry 4.0 is becoming increasingly popular today. The technological revolution, which started under the leadership of developed countries, undoubtedly makes itself felt in every field of society as well as the production sector. It is not possible to follow this process as a country and not to take the necessary steps and to realize the technological transformations. It is seen that the state policies developed for the transition to the fourth industrial revolution in our country industry have been developed. In addition to the state policies, the aim of the study was to create an awareness of Industry 4.0 in the private sector. In this respect, a questionnaire study was conducted and hypotheses were prepared and examined in parallel with the questionnaire questions.

Before implementing Industry 4.0, Tupa et al. (2018) discussed the risks that may occur in transition to the implementation of Industry 4.0. These risks; cyber attacks and the loss of large data stored. Considering this issue, necessary studies should be done by both goverments and companies.

Salkın et al. (2018) stated that, based on the experiences of industrial enterprises, in the future, monitoring processes of smart products integrated into production, control and cyber systems will be carried out with automation instead of manpower.

Kağnıcıoğlu and Özdemir (2017) examined Industry 4.0 awareness in their study and concluded that enterprises make technological investments in the long term. They stated that since technological investments would be difficult to realize by the enterprises themselves, financial, knowledge, experience sharing and strategic assistance should be provided to enterprises. Similarly, Kağnıcıoğlu and Özdemir (2017) stated in their study that as a result of the Industry 4.0 awareness, the Industry 4.0 knowledge level of the partıicipants is high, but the Industry 4.0 knowledge level is low in the management sense.

As a result of this study, some aspects of transtion to Industry 4.0 on Turkey's manufacturing sector are examined. In the H_1 hypothesis, in the intensity of analyzing and evaluating customer data in design, engineering and production processes between sectors were examined. One-way ANOVA test was performed for H_1 hypothesis. According to the results, H_1 hypothesis was accepted. In this respect, it is said that there is a difference between sectors in the intensity of analyzing and evaluating customer data in design, engineering and production processes.

In the H_2 hypothesis, the differences in the intensity of using technology in the process from product and service design to production were examined. One-way ANOVA test was performed for H_2 hypothesis. According to the evaluation results, H_2 hypothesis was rejected. According to the data, it can be said that there is no difference in the intensity of technology usage in the process from product and service design to production.

In the H_3 hypothesis, the differences in the intensity of using information systems in the processes such as planning, production, estimation and supply chain between sectors were examined. One-way ANOVA test was used for H_3 hypothesis. According to the evaluation results, H_3 hypothesis was accepted. In other words, it can be said that there is a difference in the intensity of using information systems in sectors such as planning, production, estimation and supply chain.

In the H_4 hypothesis, the differences in the rate of technology usage in the process from production to delivery of products and services to customers were examined. One-way ANOVA test was performed for H_4 hypothesis. According to the evaluation results, hypothesis H_4 was rejected. In other words, there is no difference between the sectors in the rate of technology usage in the process from production to delivery of products and services to the customer.

When the firms participating in the research were categorized by sectors, the results indicate that the knowledge level of Industry 4.0 is higher than others in the automotive and electronics sectors. Because of that, starting from the automotive or electronics sectors where the priorities of the Industry 4.0 awareness level are high, on behalf of the country's manufacturing industry are seen as an important step in the integration into the Industry 4.0 process.

Participants considered the transition to Industry 4.0, but stated that existing knowledge, information and technological infrastructures in the transition to new technologies would not be sufficient.

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