REPUBLIC OF TURKEY
BAHCESEHIR UNIVERSITY

A CONTEMPORARY ANALYSIS OF INDUSTRY 4.0 FOR LOGISTICS, SUPPLY - CHAIN MANAGEMENT AND TRANSPORTATION

Master Thesis

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İSTANBUL, 2019

REPUBLIC OF TURKEY
BAHCESEHIR UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCE
MASTER OF BUSINESS ADMINISTRATION PROGRAM

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İSTANBUL, 2019

T.C.

BAHÇEŞEHİR ÜNİVERSİTESİ

SOSYAL BİLİMLER ENSTİTÜSÜ

BUSINESS ADMINISTRATION YÜKSEK LİSANS PROGRAMI

Tezin Adı: A Contemporary Analysis of Industry 4.0 for Logistics Supply-Chain Management And Transportation

Öğrencinin Adı Soyadı : Taylan Özgür ÖZKAN

Tez Savunma Tarihi : 25.4.2019

Bu tezin Yüksek Lisans tezi olarak gerekli şartları yerine getirmiş olduğu Sosyal Bilimler Enstitüsü tarafından onaylanmıştır.

Doç. Dr. Burak KÜNTAY
Enstitü Müdürü
İmza

Bu tezin Yüksek Lisans tezi olarak gerekli şartları yerine getirmiş olduğunu onaylarım.

Program Koordinatörü
İmza

Bu Tez tarafımızca okunmuş, nitelik ve içerik açısından bir Yüksek Lisans tezi olarak yeterli görülmüş ve kabul edilmiştir.

Jüri Üyeleri	İmzalar
Tez Danışmanı	.....
Üye	.....
Üye	.....

ACKNOWLEDGEMENTS

I would like to thank all the members of my family, especially my dear grandfather, who has never left us his support for 25 years and who passed away on the day I started my thesis. Without my family's support and understanding, I would not finish this thesis.

Especially, I would like to extend my deepest thanks to İbrahim Doğan, finance and accounting manager of SKF TURK, who has encouraged me since first day, contributed with his ideas in all respects and never spare his support.

I would like to express my gratitude to Erkan Kellekçi, one of the engineers of SKF TURK Solution Factory, Mehmet Ali Akman from Mercedes - Benz, and Aşır Tülek from Renault Turkey.

I would also like to express my special thanks and gratitude to Professor Doctor Sadullah Çelik and Assistant Professor Doctor Uğur Kaplancalı for his valuable suggestions, helps and supports.

I hope that this work serves as a good resource for future works and researches.

ABSTRACT

A CONTEMPORARY ANALYSIS OF INDUSTRY 4.0 FOR LOGISTICS, SUPPLY - CHAIN MANAGEMENT AND TRANSPORTATION

Taylan Özgür ÖZKAN

Master of Business Administration Program

Thesis Supervisor : Prof. Dr. Sadullah Çelik

February 2019, 114 pages

The fourth Industrial Revolution or Industry 4.0 concept is in demand due to the technologies it covers and its applications in different fields. In a way, this concept, which can be considered as a new generation industry concept, aims to reduce the overall costs by increasing the efficiency - effectiveness ratios by combining information technologies and production - supply chain processes. Among the most important components of the Industry 4.0 concept are: Internet of Things, Cyber - Physical Systems, Big Data. Combining the Cyber - Physical System components that will be used in the supply chain and logistics processes with the big data and analytical concepts will enable the autonomous structure in the processes to be performed. The processes that operate in autonomous structure, besides providing quality, productivity increase, will also provide flexibility to work - production activities and pave the way for action in the fastest way against changing conditions.

It is foreseen that the Industry 4.0 concept will create more new occupational groups than the professions to be destroyed. The new professional groups that will emerge with Industry 4.0 will be based on brain power rather than manpower. New occupational groups that can adapt to new technologies and flexibility gathered under the roof of Industry 4.0 will be at the top point in terms of education, technical skills, quality and income.

It is one of the most important requirements for organizations to properly manage the change and transformation processes they will undergo with Industry 4.0, to evaluate the advantages they can achieve in this way and to organize all the preliminary preparations and planning stages in order to ensure sustainability. In general, this study, the implementation of Industry 4.0 concept, new business models and design of business processes, sustainability and circular economy model Industry 4.0 processes are carried out on issues such as the implementation of the subject.

Key Words: Industry 4.0, Cyber - Physical Systems, Sustainability, Circular economy, Information Technologies

ÖZET

ENDÜSTRİ 4.0 KONSEPTİNİN LOJİSTİK, TEDARİK ZİNCİRİ YÖNETİMİ VE TAŞIMACILIK FAALİYETLERİNE YÖNELİK GÜNCEL BİR ANALİZİ

Taylan Özgür ÖZKAN

İşletme Yönetimi Yüksek Lisans Programı

Tez Danışmanı : Prof. Dr. Sadullah Çelik

Şubat 2019, 114 sayfa

Dördüncü Sanayi Devrim yada Endüstri 4.0 konsepti, kapsadığı teknolojiler ve farklı alanlardaki uygulamaları sebebiyle rağbet görmektedir. Bir bakıma yeni nesil sanayi anlayışı olarak düşünülebilecek yapıdaki bu konsept, bilişim teknolojileri ve üretim – tedarik zinciri süreçlerini birleştirerek verimlilik – etkililik oranlarını arttırarak genel maliyetleri düşürmeyi hedeflemektedir. Endüstri 4.0 konseptinin en önemli bileşenleri arasında, Nesnelerin İnterneti, Siber – Fiziksel Sistemler, Büyük Veri gibi unsurlar gösterilebilir. Tedarik zinciri ve lojistik süreçlerde kullanılacak olan Siber – Fiziksel Sistem bileşenlerinin büyük veri ve analitik konseptleri ile birleştirilmesi, ifa edilecek olan süreçlerdeki otonom yapının tesis edilmesini sağlayacaktır. Otonom yapıda işleyen süreçler, kalite, verimlilik artışını sağlamanın dışında iş – üretim aktivitelerinin esnekliğini de tesis ederek değişen şartlara karşı en hızlı biçimde aksiyon alınmasının da önünü açacaktır.

Endüstri 4.0 konseptinin yok edeceği mesleklerden çok daha fazla yeni meslek gruplarını oluşturacağı öngörülmektedir. Endüstri 4.0 ile ortaya çıkacak yeni meslek grupları, insan gücünden ziyade beyin gücüne dayalı çalışan bir yapıda olacaktır. Endüstri 4.0 çatısı altında toplanan yeni teknolojilere ve esnekliğe uyum sağlayabilen yeni meslek grupları eğitim, teknik beceri, nitelik ve gelir bakımından üst bir noktada bulunacaktır.

Organizasyonların, Endüstri 4.0 ile geçirecekleri değişim ve dönüşüm süreçlerini doğru biçimde yönetmeleri, bu yolla elde edebilecekleri avantajları değerlendirmeleri ve sürdürülebilirliği sağlamalarına yönelik tüm ön hazırlıkları ve planlama safhalarını doğru biçimde organize etmeleri en önemli gerekliliklerin başında gelmektedir. Genel olarak bu çalışmada, Endüstri 4.0 konseptinin implementasyonu, yeni iş modelleri ve iş süreçlerinin dizaynı, sürdürülebilirlik ve dairesel ekonomi modelinin Endüstri 4.0 süreçleri ile ifa edilmesi gibi konularla ilgili yapılan araştırmalara yer verilmiştir.

Anahtar Kelimeler : Endüstri 4.0, Siber – Fiziksel Sistemler, Sürdürülebilirlik, Dairesel Ekonomi, Bilişim Teknolojileri

CONTENTS

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ABBREVIATIONS

3C	:	Competitor, Clients and Company
3PL	:	Third Party Logistics
5S	:	Sort, Set in Order, Shine, Standardize, Sustain
CAPP	:	Computer – Aided Process Planning
CE	:	Circular Economy
CNC	:	Computer Numerical Controller
CPS	:	Cyber – Physical Systems
CRM	:	Customer Relationship Management
DSS	:	Decision Support Systems
EHS	:	Environment, Health, Safety
ERP	:	Enterprise Resource Planning
FP7	:	European Commission Seventh Framework
GUI	:	Graphical User Interface
IMS	:	Information Management Systems
IoS	:	Internet of Services
IoT	:	Internet of Things
IS	:	Industrial Sustainability
IT	:	Information Technologies
MES	:	Manufacturing Execution Systems
MIS	:	Management Information Systems
MSS	:	Modeling and Simulation Systems
PLC	:	Process Level Control
PSL	:	Process Specification Language
RFID	:	Radio Frequency Identification
SAP	:	System Analysis and Program Development
SCADA	:	Supervisory Control and Data Acquisition
TPS	:	Transaction Processing Systems
VF Manager	:	Virtual Factory Manager
VFF	:	Virtual Factory Framework

1. INTRODUCTION

With globalization in the world, two important effects have emerged. The first of these effects is that the globalization and capital movements move more freely among the countries and the second one is the displacement of production. As a result of the increasing of globalization, capital was transferred to the where it would make the most money and accordingly production was started in the cheapest places. Also, with the shift of production to cheap places, countries with cheap labor power began to develop rapidly. Initially, only those producing countries developed their own sectors by adopting the logic of their work and eventually formed their own markets. China can be the best example of this situation. Since China is one of the countries where production is cheap, many European countries plan to reduce their costs by opening their production facilities in different regions of China.

The realization of factors such as the geographical location of the countries, the efforts to be effective and efficient in production and the provision of low labor costs are not sufficient for global competition. A profound change that will change the competition parameters and priorities in international markets will not be realized only by the efforts of private institutions. Recently, the concept of Industry 4.0 is among the most widely used concepts in the world. Industry 4.0 or the 4th Industrial Revolution can be thought of as a collective concept that includes many modern automation systems, data exchanges and production technologies. Thanks to the technologies covered by this concept, the collection and evaluation of data and information in the production environment will lead to more efficient business models.

With the emergence of Industry 4.0, the industry has pushed the developed countries to produce new strategies, discussions and new trends. The need for development and innovation, which is the continuation of the sustainability of the global system, should be continued with technological developments. The infrastructure required for effective and efficient use of the technologies covered by the Industry 4.0 concept is a necessity. With the implementation of the concept of Industry 4.0, production time, costs and the amount of energy needed in production stages will be reduced and quality will be

increased. Although Fourth Industrial Revolution may seem to have an impact on the production stages, it will also affect social life in the future. Globally, in order to realize this vision in a holistic approach, products, standards and practices are developed intensively. However, there are some negative opinions about some technologies and approaches related to the fourth industrial revolution. As an example of a negative view, increasing robot and artificial intelligence can lead to loss of jobs in some sectors. As a positive example, it is possible to eliminate the work accidents with the presence of increasing robot and automation technologies.

The priority of an organization that wants to work on the concept of Industry 4.0 should be related to the integration between information technologies and operational phases. Besides, thanks to evolving communication and information - management technologies, instant information flow and sharing enables organizations that are present in competitive markets to keep up with changing conditions. In particular, organizations operating in the industrial markets can make a difference with innovation-oriented work as well as gaining competitive advantage thanks to technology-based spurts. Continuously optimized and customer-centric manufacturing processes can provide rapid integration into production methods that vary according to need and can provide efficiency and effectiveness with regard to “process management”. Although the concept of Industry 4.0 seems to be a complex integrated structure at first glance, thanks to its technological concepts and approaches, a dynamic infrastructure in business processes, eliminating the negative factors in the demand chain, taking advantage of the benefits provided in real-time decision making through transparency will also change the way organizations and companies work.

In this thesis, considering the previous researches, the concept of Industry 4.0 was examined in a theoretical manner and the application and integration of the concept of Industry 4.0 were discussed.

According to the concept, in the first part of the thesis, the history of industrial revolutions and the effects of the new technologies created by these revolutions in the process from the past to the present are briefly mentioned. In the second part of the thesis, the emergence of Industry 4.0, its philosophy, different approaches to the potential, as well as the expected developments for the future of the industry and the

possible consequences. In the third and fourth part of the thesis, together with the technologies used in the Industry 4.0 and implementation action plan are mentioned with the help of examples. In the last part of the thesis, it is mentioned about discussion and future research topics.

2. INDUSTRY 4.0

The concept of Industry 4.0 can be explained in below subheadings. Each of subtitle is formed in a interpretive way.

2.1 HISTORICAL REWIEV OF PREVIOUS INDUSTRIAL REVOLUTIONS

In the thousands of years of human history, the first big leap of human beings is the becoming sedentary about 12 thousand years ago. From ancient times to the present, they have worked in many different production models and styles and witnessed the changes. Essentially, the production methods based on the manual method that human beings are involved in have changed the methods based on mechanization. The elements connected with industry and its other concepts, which are seen as the basis of economy, income and production resources, are always at the center of the process of change and transformation**.** When Europe crossed over the Middle Ages, from scholastic thinking to rationalism and into positive sciences, it entered a serious development and growth mode with a vertical jump. Geographical discoveries, renaissance and reform movements, the collapse of empires after the French Revolution, the establishment of nation-states and the presence of steam engines in the 18th century, the accumulation of capital and then the industrial revolution began.

The period, which started in the mid-1700s and lasted until the 1830s and was called the 1st Industrial Revolution, was the first step in transition from physical strength to mechanization. The country that is the pioneer of the first industrial revolution is the United Kingdom. The first industrial revolution started in the UK because of the iron and coal reserves they had. They played a pioneering role in industrial revolutions as they were in a structure with a continuity of colonization and politicity, apart from natural elements. With more machines and production options requiring less manpower, more raw materials and more products have emerged. In 1712 (18th century) in United Kingdom, with the realization of the invention of the steam engine, the power of steam and water was transferred to production. As of the 16th century, the population of Europe increased rapidly and there was no need for manpower needed in the agricultural sector. In the next period, these people migrated to the cities and formed the

working class of the first industrial revolution. The impact of new discoveries in the 18th and 19th centuries in Europe and the use of steam powered machines in production increased capital accumulation in Europe.

The essence of the Industrial Revolution was the use of different power sources, primarily steam, instead of man - handling as a source of power and the mass production. The steam engine was first used in coal mines and textile workshops. Then the steam train and the ship appeared. In the first industrial revolution, except for the textile industry, the production and processing of iron and steel and the logistics processes were positively affected. With the development of steel production, mechanization increased. With the development of textile machinery, mass production and factories began to emerge. This kind of changes in production methods caused many changes in economic, social and social terms. In this period, with the production of steam-driven trains, the products produced were shipped to different parts of the world. The average life expectancy and the population increased.

In addition, everyday life was greatly facilitated and thus increased quality of life. By facilitating the production of machines, a large increase in the number of products produced in Europe has been achieved. European countries turned to the Middle, Near and Far East territories, where they could obtain new raw materials to market their products. The industry has not only completed its first period, but has also re-drawn its borders by influencing international relations.

In the second industrial revolution (known as Technological Revolution, 1850 – 1914), similar to that in the first industrial revolution, new machinery and production methods based on these machines were developed. With the new production methods developed, a distinction emerged based on qualifications within the working class. In this period, the use of technological elements also positively reflected on the development of the industry and accelerated globalization. In addition, with the emergence of electricity and electricity operated machines during this period, besides the significant increases in the mass production time and capacities, the product variety and quality increased and the costs decreased. The production of fossil fuels, petroleum and petroleum derived is also a work of the second industrial revolution (Mokyr 1998).

The second industrial revolution has also important socio - economic impacts. In the second phase of the industrial revolution, there have been great developments in many countries in terms of production. For example, the United Kingdom had a share in production with 24% and the United States with 19%. In addition, 62% of the world's production was made on the European continent (Kander et al. 2017). The greatest economic growth in world history was recorded at the end of the 1800s. In this period, living standards have increased in countries that have the advantage of industrialization and improvements in service-oriented areas such as transportation, health and so on have been observed.

In the time of the second industrial revolution, factory owners and raw material producers made a great fortune. In addition, the products produced by innovations in production methods, advances in technology and have been sent to different regions of the world by logistics. However, considering the fact that workers are employed for long hours at low wages and their working environment is insecure, the concept of worker health and safety is not considered in this period.

The period after the second world war, which started with the rapid developments towards the end of the 1970s, and the information technologies intensively improved, is called the third industrial revolution or digital revolution. Synthetic goods, computer technology, microelectronic technology, fiber optics, telecommunication, biogenetics, biotaration, laser technology are the determining elements of this period. The globalization of industry and trade also took place during this period. Information technology products provided flexibility because they can be reprogrammed according to changing conditions. It was the first time that transistors and computers were used in state institutions. In addition, Computer Numerical Controller (CNC) tools have been integrated into many different technological concepts. With the developments in the concept of computerized design, the variety of designs in industrial sense has increased and the production of individual products started slowly. In the third industrial revolution, studies on programming and coding have been made and new generation equipment has been produced to ensure the effective functioning of the new software and codes developed.

Different industrial revolutions, which had been experienced in different periods until today, had many important effects on the life of society. It is witnessed as a process of development from steam engines to electrically driven machines, coding theory and programmable concepts. Now, it is era of the fourth industrial revolution or the concept of Industry 4.0, which incorporates concepts such as modern production automation, intelligent readers, the Internet of Things (IoT), sensor technology. Years later, it will be a characteristic that will be used to express the era of technology.

2.2 FRAMEWORKS OF INDUSTRY 4.0

Production and sales-oriented organizations and structures have to keep up with changes in multiple forms. Thanks to flexible planning, self-managing robots and machines, sensor technologies and the like, production methods, product diversity, product quality and similar concepts undergo significant changes. Besides, increased internet connectivity, data collection techniques that have become more sophisticated than ever, and the analytical capabilities that are possible with the IoT bring about a change in the knowledge based economy. For the first time, in 2011, the definition of Industry 4.0 was presented by the Industry 4.0 working group established by the German Federal Government at the Hannover Messe Trade Fair. In 2012, Robert Bosch GmbH and Henning Kagermann created the working group and presented the 4th Industrial Revolution proposal file to the German Federal Government. On 8 April 2013, the working group presented the Industry 4.0 report at the Hannover Fair.

With the emergence of Industry 4.0, the industry pushed the developed countries to produce new strategies, arguments and new orientations. Industry 4.0 is a revolution with future scenarios, although it is not a completely new formation, which has taken place with the advancement of technological developments in the industrial field to date.

Industry 4.0 is seen as an approach to completely reverse conventional and known production techniques and methods. At the core of this different approach lies the fact that industrial production machinery no longer only processes the product, but the product communicates with machines and tells them exactly what to do. As information technology and operations technology integration develops, manufacturers need to

assess not only where they are, but also where they want to be. This leads to decisions about the types of data that they need to collect, analyze and take action.

Accurate acquisition and evaluation of information will not only affect business operations positively, but also enable companies to increase their value and profit share by making companies successful in value creation processes. The notion of Industry 4.0 can be considered as a collecting concept which includes actions such as eliminating errors due to human factor and optimizing the decision-making processes of artificial intelligence elements and evaluating the information obtained from different sources by using different methods.

One of the main objectives of Industry 4.0 is to use the robots that communicate with each other which can detect the environment with sensors and realize the needs and promoted by data analysis providing more quality, cheaper, faster and less waste in production processes. Structures equipped with such technological concepts are called smart factories. The comprehensive goal of the Industry 4.0 concept is to make all phases of the supply chain more efficient, effective, innovative, and quickly adapt to customer needs and demands through the use of technological elements.

Today, new production processes and business methods emerge thanks to digital technologies. The technologies emerging with Industry 4.0 are seen as parts of an important strategic step to ensure both product quality and process efficiency. Except these, as many different views and insights regarding the integration of Industry 4.0 technologies into existing production methods and processes are put forward, skeptical approaches to integration are highly debated.

According to Strandhagen (2017), in the implemeting process of Industry 4.0 into organizations, in order to ensure superintendence, planning and material - information flow at the basis of production logistics processes, the “production environment” of the organization should be determined. Here, the term “production environment” means the particularizations of the organizational structure, together with the market and structure, production processes and product range addressed by the organization. In order to enable the carrying out of the implementation process in a smooth, efficient and effective manner, the notion of the “production environment” should be considered, as

well as the applications to be used in implementation and the effect of the “production environment” on these integration processes. In the implementation process, determination of the basic requirements and production environment is possible through on - premise visits, workshops and surveys. With such projects, the applicability of Industry 4.0 technologies to the processes can be determined and necessary actions can be taken.

According to Unnikrishnan (2017), organizations that want to implement the concept of Industry 4.0 to their own processes should apply the implementation activities carried out by other organizations, such as trial and error, rather than theoretical studies. It is also possible to implement the change and transformation activities performed by different organizations as a benchmark. Although the author states that there is no definitive methodology for implementing Industry 4.0, a four-stage action plan should be applied in the implementation process. These steps are to analyze the implementation processes based on the preparations and observations in the first stage, in the second stage integration of the software and applications related to the Industry 4.0 concept into the processes through vertical integration methods, in the third step increasing the coordination between all shareholders, stakeholders and suppliers through horizontal integration methods and in the last step connecting the facilities and processes to each other through digital technologies and to ensure continuous improvements.

According to Pessl (2017), a 6-stage implementation plan can be used to integrate the Industry 4.0 concept into business processes in companies. This 6-stage development and implementation plan should be implemented in the procurement, manufacturing, logistics, sales-marketing and human resources departments of organizations. Before the implementation of the Industry 4.0 concept to different departments, the current status of each department and the objectives for the short and long term Industry 4.0 should be determined in the 6 - stage plan. In this way, the general conditions, requirements and shortcomings of the organizations for the Industry 4.0 concept can be determined. According to the author, with the help of maturity models and procedure models, implementation of the Industry 4.0 concept can be achieved. Because of the maturity models, an action plan can be drawn up based on the needs and shortcomings to be determined according to the data to be obtained as well as the current status and

positions of the units to be implemented. The procedure models allow the tasks to be carried out in the implementation of the Industry 4.0 concept to be subdivided and performed by different units. Namely, the implementation activity to be applied to a part of the organizational structure is separated into smaller tasks, in other words, being carried out by individualizing. In addition, the human resources department should organize training seminars to ensure the integration between employees and Industry 4.0 processes and take actions to improve employee skills. 6 - step implementation plan covers below actions :

i. Creating an Industry 4.0 awareness within the organizational structure
ii. Adjusting the current state, capabilities and needs of the organizational structure
iii. Providing communication between the units of organizational structure based on information sharing
iv. Getting a fix on the level of the organization's maturity
v. Determining harmony between actions to be taken and organization
vi. Identifying integration projects and funds to be allocated for these projects

According to Telukdarie (2018), Industry 4.0 activities to be performed in multinational companies require the effective and efficient execution of processes for Information Technology Management for obtaining instant data. In order to increase efficiency and effectiveness in the management of these processes, organizations can take actions on applications such as Enterprise Resource Planning (ERP), Financial Modeling, Supply Chain Optimization by creating a common platform both among themselves and within themselves.

According to Ibarra (2017), implementation of Industry 4.0 into business processes can be performed in three different ways. These methods are called a service - oriented approach, a network - oriented approach and a user - driven approach. A service - oriented approach is based on the fact that the increase in the value of the product in the organizational sense is possible through the services provided with the product. In this context, suppliers, customers, shareholders, stakeholders and senior management should be involved in an environment and processes in which the continuous flow of

information and instant information tools are effectively used. A network - oriented approach, with horizontal and vertical integration methods and interoperability operations to assist these integration techniques, aims to strengthen the value chain and competitive structures of organizations. A user - driven approach is based on making production lines and customer information focused on customer requests as effective and powerful as possible. The only method to reveal the services and products that are designed as user - oriented is to get the customer feedback on time and to evaluate correctly. In addition, collecting data and information related to the user contributes to increasing the brand quality and brand devotion as well as increasing the quality of sales and services.

With the implementation of the concepts such as IoT, ERP, and Information and Communication Technologies to organizational processes, the productivity of the employees has increased and the predictions about the business processes have also improved (Saraee et al., 2016). With the increasing the ability of workers to digital concepts, the solutions to business problems increased in alternatives. In the implementation of the elements of the Industry 4.0 concept, the priority should be given not only to the technological components but also to the activities such as training, seminars, meetings and brainstorming to improve the skills of the employees. By establishing cooperation between organizations or within the organizational structure, both horizontal and vertical integration and implementation of different business models can be made possible.

The effectiveness of organizations in supply chain processes and their efficiency are related to Industry 4.0 technologies that will be implemented correctly (Thoben et al., 2016). In addition, effective and efficient use of new technologies provides a new solution and enforcement mechanism for business problems and business models. Thanks to the use of cyber - physical systems (CPS) and IoT in logistics operations and assembly lines and in the supply chain processes, providing the instant information flow by expanding the information network and finding solutions to problems that occur momentarily provide organizations with agility and innovative approaches. In addition, the providing of a standard infrastructure, management of complex systems, data security, continuous training and improvement activities are necessary for

implementation of cyber physical logistics systems and data networks for continuous information flow. In the processes related to the supply chain, the creation of reference models, the introduction of concepts for artificial intelligence and virtual plant installation, and the establishment of mechanisms and applications that will ensure the continuous control of interdisciplinary business processes are important in order to ensure continuity and development. In supply chain networks where information flow is provided continuously, customer petitions and expectations are ascertained correctly and services are provided accordingly.

For the implementation of Industry 4.0, organizations should consider the process of imagining processes, evaluation of internal and external factors, and preparation for the transformation phase (Erol et al., 2016). Describing and imagining processes requires senior management, shareholders, stakeholders, and ultimately customers to come together and meet at a common denominator. Moreover, not only the organizational structure but also the ideas coming from the academic community and experts should be reached during the transformation of processes. In this way, issues such as the difficulties that the organizational structure will experience during the transformation process and the suitability of the business models to the transformation process can be addressed. In addition, long-term and short-term goals and investment plans of organizations can be identified with such studies. As a result of the exchange of ideas by coming together, the vision of Industry 4.0 to be implemented to the organization can be turned into a more specific operational plan. The channels in which realization of the implementation methods to be with terms are called “roadmapping”. Roadmapping encompasses product range, market status, processes from production to market, and value chain structure. Besides, the information obtained through roadmapping provides an insight into the technological infrastructure for supply chain processes and which technologies of the Industry 4.0 concept will be used in these processes. Finally, studies on how to build implementation projects and how to base the projects should be carried out taking into account risk factors and resource utilization.

Successful implementation of the Industry 4.0 concept depends on the horizontal and vertical integration of the elements of information technology that organizations use in areas such as production, planning and logistics. Thus, an information flow mechanism

is provided between all internal and external elements of the organization. When implementing Industry 4.0, two important factors should be taken into consideration, first of all, resource and process management, and the use of all elements in the highest efficiency. In addition to the implementation of Industry 4.0, it is also important to determine a vision of the organizational structure and to test and evaluate business models in the implementation and integration processes of new business models. Providing such developments is possible with an IT system with high data storage and evaluation capacity.

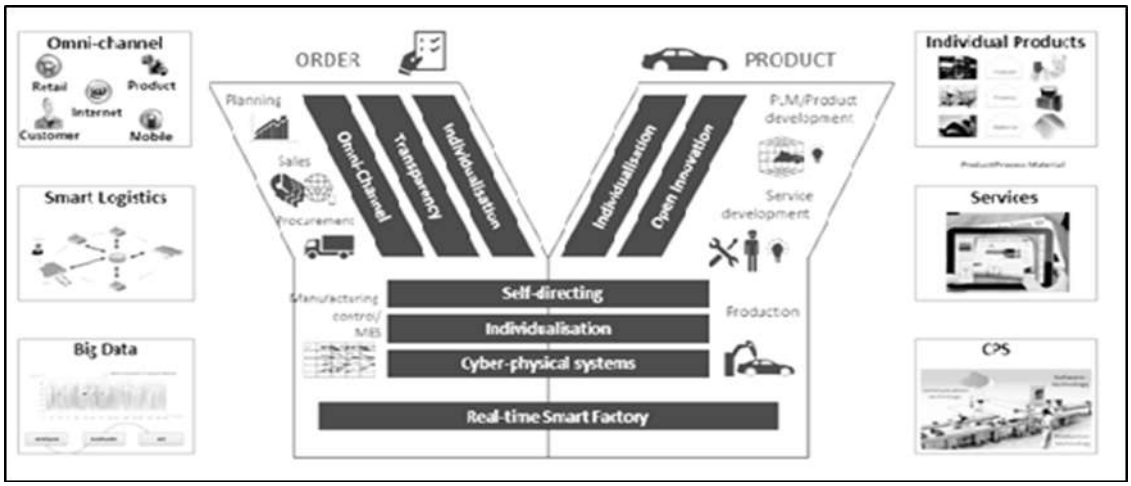
A three-step implementation of the Industry 4.0 implementation plan is based on activities that need to be carried out in strategic, tactical and operational terms (Merz 2015). The activities to be carried out in the strategic step can be grouped under two different headings. These are the five different components of the Industry 4.0 concept in the first step and the competitor, clients, company (3C) factors in the second step. Due to the competitive markets where organizations are involved, efforts to promote innovation, research and development and sustainability enable competitive advantage. Apart from these, it is beneficial to understand the relations of organizations with their customers, regarding to how the service, product, price and quality are evaluated by the customer. In the light of data and information obtained on customer and competition issues, organizations can carry out innovation and development activities related to the service and product they provide in order to ensure customer satisfaction. The activities to be carried out in tactical sense include Industry 4.0 technologies to be implemented in the processes of organizations. Operational activities include the implementation project, development and improvement of the processes, establishment of the IT infrastructure, determination of organizational tasks in the new structure and determination of the management team.

Reference architecture concept was conducted to successfully implement Industry 4.0 concepts in organizations and to carry out processes (Mueller et al., 2017). Implementation of Industry 4.0 concepts based on architecture covers some successive activities. These activities are planning, practising, controlling and taking action. During the planning phase, a supposal for the implementation process is established. Practising phase starts with implementation based on experiences and scientific approaches.

During the control phase, the accuracy and efficiency of the processes performed and the consequences obtained are evaluated. At the stage of taking action, studies are carried out to ensure continuous improvement and developments after the evaluation of the results obtained. There are some processes that organizations need to configure before the execution of Reference model. These include the analysis of the current situation of the organization, the evaluation of the components of the value chain, the vision and purpose of the processes performed in terms of the efficiency of the operational processes, the increase of the efficiency of the communication channels within and outside the organization, the inclusion of all components of the organizational structure in the processes.

A different perspective on the implementation of Industry 4.0 was introduced by Scheer (2017). According to Scheer (2017), the elements in the schematic representation of the Y - model show the basis of the technological infrastructure, which triggers the implementation of the Industry 4.0 and shows the areas to be worked on. On the basis of Y - model implementation, the focus is on smart factory concept, product development and supply chain - logistics processes.

Figure 2.1 : Y – model implementation



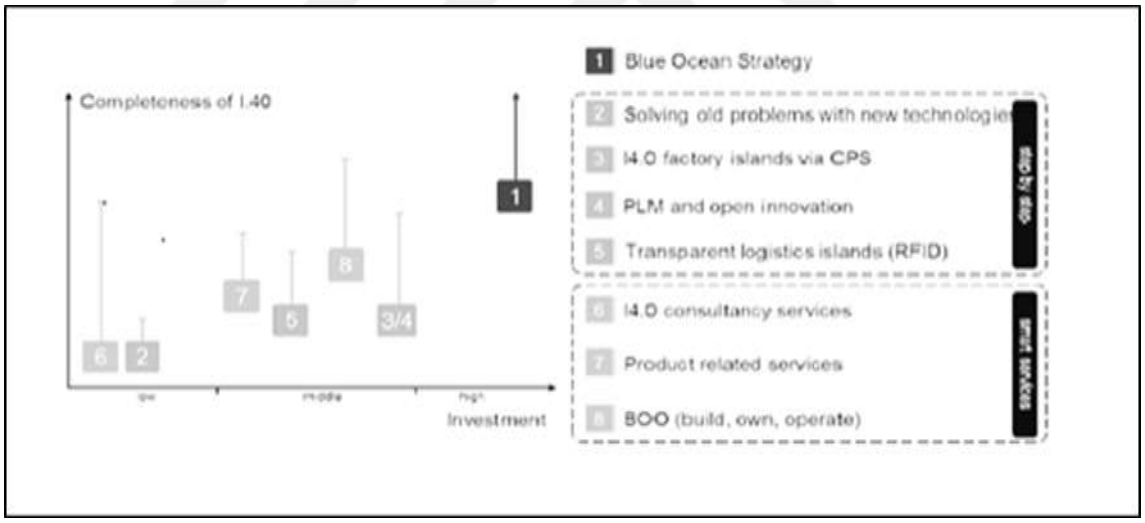
Source : Scheer, 2017

The concepts on the left side of the Y - shaped structure represent the business processes and the right-hand side represents the concepts needed for the products that are planned to be produced in accordance with the Industry 4.0 concept. CPS, sensor

technology, big data and radio frequency identification (RFID) concepts are considered as the main components of intelligent factory structure. In relation to the products to be produced on the basis of Industry 4.0, following the product - life cycle and planning the work to be carried out after product - service is one of the main components of the Y - model. In the diagram above, the X - axis shows areas that need to be embarked in nominal, medium and high levels depending on complexity and effort. The Y-axis shows the extent to which the activities carried out based on strategic structuring and decisions are performed and the success rate.

One of the important parts of the implementation methodology put forward by Scheer is the Blue Ocean Strategy. According to this strategy, a service or product that does not exist in the current market should be presented to the customer in an integrated manner with Industry 4.0.

Figure 2.2 : Implementation steps



Source : Scheer, 2017

Implementation of the Blue Ocean Strategy requires the use of high-level Industry 4.0 technologies and high-level investments. In addition, there is an approach called “step by step” in the second part of the implementation plan presented by Scheer. According to the step by step approach, it is aimed to solve the problems of the organizations before the implementation by the effective use of the Industry 4.0 technologies. In “factory islands” approach, the main purpose is to continuously control and optimize the

supply chain and logistics processes with the help of RFID, sensor technology and big data. The “PLM (Product life - cycle management) and open innovation” approach aims to manage the product life cycle by means of big data and data analysis methods and to work on product development. Thus, flexibility and new business models can be developed in production and product development stages.

In order to implement the Industry 4.0 concept in organizational processes, and in particular in the supply chain - production processes, the organization must have a certain level of maturity (Crnjac et al., 2017). The level of maturity is measured by criteria such as the technological infrastructure, the knowledge and quality of the personnel about the technological concepts, and the status of the joint working infrastructure between the different units of the organization. Since accurate making of organizational decisions depends on accurate evaluation of the data and information obtained, it should be ensured that information and data are obtained and evaluated correctly. According to Crnjac and other authors, the implementation phase is divided into three parts: preparation, adequate maturity and operational activity, and these three parts should be structured in a way that is based on the human factor, technical organizational structure and managerial factors. In addition, shareholders, stakeholders, customers, operational teams and senior management should actively take part in the process of structuring Industry 4.0 technologies. Thanks to the information to be obtained through concepts such as CPS, sensor technology, the information exchange environment of the organizational structure with internal and external elements becomes strong.

Connectivity and integration factors are the basis for intelligent manufacturing mechanisms to be created through Industry 4.0 (Samaranayake et al., 2017). In addition to process optimization by integrating resource planning and production-management software into the production phase, using exponential technologies such as big data, sensor technology, simulation, artificial intelligence is an important factor in increasing efficiency and effectiveness. Especially with the help of big data technologies that support CPS and sensor technologies in supply chain stages, horizontal and vertical integration is one of the basic building blocks of implementation. Such Industry 4.0

technologies will trigger improvement of processes, providing increased flexibility and efficiency.

The four basic concepts of Industry 4.0 are CPS, IoT, Internet of Services (IoS) and smart factory (Hermann et al.,2015). CPS are considered as a means of integrating reckoning and substantially executed business processes. The use of RFID technology as an extension of CPS in production processes enables both stock optimization in storage and order management to be done correctly. The IoT, one-to-one addressing technique, sensors, actuators, and mobile technology elements used for different purposes, enable interaction, communication and process optimization in supply chain processes. The IoS concept endows with products and service providers to deliver their services through internet and internet technologies. The elements necessary for the establishment of the IoS mechanism are the presence of participants such as shareholders, stakeholders, suppliers and service buyers, business models and business processes (Buxmann et al., 2009). With the IoS applications, it becomes possible to implement new methods by changing the production methods used by organizations and thus to strengthen the value chain. The smart factory concept is becoming a more and more powerful concept with the emerging Industry 4.0 technologies. The intelligent factory concept that enables communication and interaction between smart machines and people thanks to the different technologies it provides, enables the performance of tasks by evaluating the information coming from virtual and real structures. The Internet of the Things, the IoS, CPS and intelligent factory concepts, which form the basis of the Industry 4.0 structure, allow six different components to be considered in the implementation of it. These six components can be defined by sorting as follows :

i. *Interoperability* : In an environment where Industry 4.0 technologies are implemented, interoperability which enables data exchange between systems, devices and all other components and evaluating the data and performing the production and supply chain tasks, acts as a result of the interaction of IoT and CPS.

ii. *Virtualization* : Virtualization enables all processes through CPS and sensor technology to be monitored and simulated before execution, as well as the

virtual design of actual physical elements and the detection of possible deficiencies or errors.

iii. *Decentralization* : The shortening in the product - life cycle means that customers' requisitions and expectations are constantly changed and renewed. Change of requisition and expectations makes it hard to manage production systems and their decision-making mechanisms from monopoly. In the Industry 4.0 concept, the notion of decentralization can be considered as the interface that conveys the necessary steps based on the changing demands and requests to the machines in the production area with the use of big data elements besides RFID and sensor technology (Schlick et at., 2014).

iv. *Real – Time Capability* : Real-time data or information is a concept that is obtained and analyzed in accordance with the business processes and provides action on issues such as taking precautionary work in production processes and taking early action against possible problems. In addition, as a result of the evaluation of current data and information, project models, new business processes and models are also formed.

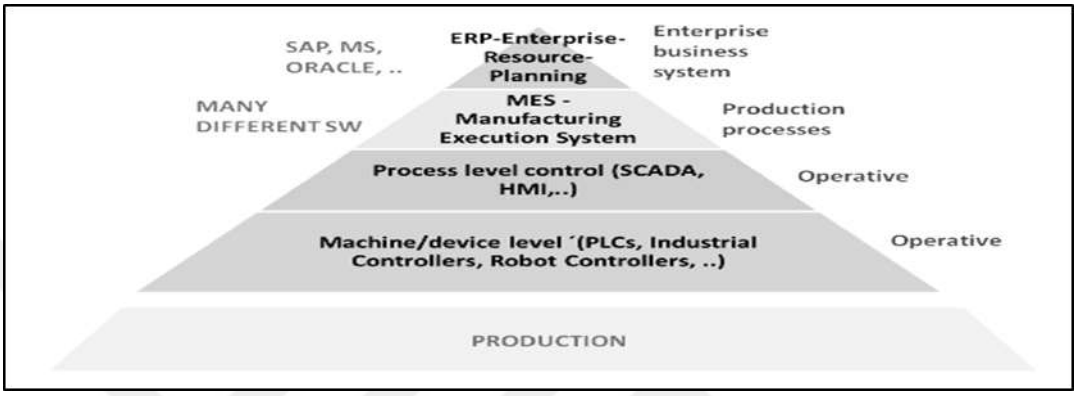
v. *Service – Orientation* : Service - Orientation, a multi-service structure, enables communication between platforms with different service concepts, enabling organizational activities to be performed.

vi. *Modularity* : Production systems need to be flexible to meet changing needs and demands at the right time and in the right way. The aim of a production system integrated with Industry 4.0 concept and technologies is to respond to changing requests and demands in the fastest way by evaluating the information gathered by technologies based on sensors and CPS.

In production-based organizations, the starting point for operations related to digitalization of processes is the production site and systems (Rojko 2017). With the modernization of the production site and production systems and the integration of the adjustable systems into the production processes, it is possible to take action and production on the basis of customer requests and demands.

Nowadays, the machines used in the production systems perform only the tasks related to the production of certain types of products in a certain quantity and to carry out the necessary steps. Although the machines used by some production systems are programmable, they do not provide litheness in production capacity.

Figure 2.3 : Automation pyramid in modern productions systems

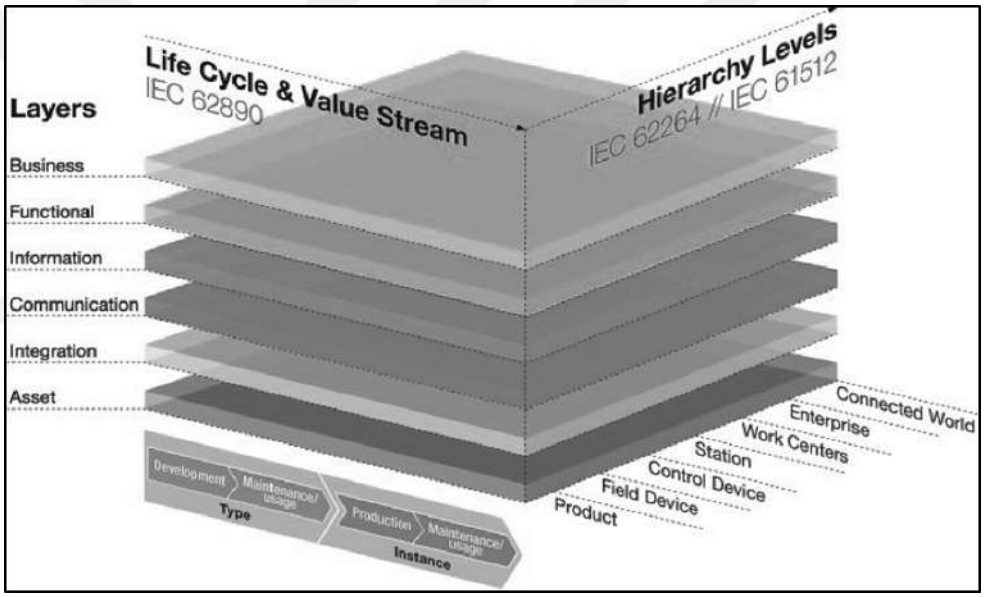


Source : Rojko, 2017

One of the most important elements of a production system in which industrial activities are implemented is the IT infrastructure. The automation processes that can operate with IT support are associated with ERP software and enable the decision mechanism to work as a non-centralized structure. Automation processes are described in a structure called automation pyramid. At the top of this structure there are software like ERP, System Analysis and Program Development (SAP), Oracle. The second one is the Manufacturing Execution System (MES) concepts. MES plays an active role in reporting on production processes, interpreting reports, planning, monitoring the product-life cycle, conducting efficiency and effectiveness analysis. In the third and fourth order, there are concepts including operational level, process level control and machine - tool selection and management activities. Process level control (PLC) processes in the third part are controlled by the structure called Supervisory control and data acquisition (SCADA), and the most important components of SCADA system are sensor and robot technology elements. The last part of the machine - tool management has an autonomous management mechanism, unlike the other parts of the pyramid.

The Reference Architecture Model for the Industry 4.0 (RAMI 4.0) system, created by the Industrial Internet Consortium for structuring a standard method for implementing Industry 4.0, is structured to allow planning and execution of production processes under Industry 4.0. The RAMI0.4 model was introduced with the addition of two additional layers to the Smart Grid model adopted by international platforms to make the implementation of the Industry 4.0 concept systematic. The RAMI4.0 concept, which is designed in three dimensions, is designed to describe the current situation and conditions of the organization, but this should be done in such a way as to determine the deficiencies of the conditions and the points to be improved.

Figure 2.4 : Reference architecture model for Industry 4.0



Source : Industrial Internet Consortium, 2015

The three dimensional RAMI4.0 concept consists of six different layers. The first ply, assets, executes the tasks related to the management and development of robot, sensor and other different CPS elements. Integration, which is the second layer of the three dimensional structure, fulfills the stages and tasks related to the provision of information which can be digitally manipulated and interpreted to the assets components. The task of the third grade, known as communication, is to carry out processes related to the use of monotype data and fixed rules in communication channels. The information slab allows the management of processes for the conversion

of information from sensor, robot, RFID and CPS elements into necessary data. The functional layer carries out and controls the steps for the identification, determination and control of the processes performed in other layers. The last layer, “business”, conducts tasks related to the inspection and implementation of different business models, as well as the supervision of business processes on different layers.

2.3 BUSINESS MODELS AND INDUSTRY 4.0

The increasing globalization and consequently the constant change and renewal of customer demands have led to changes in the managerial strategies of most international and production-oriented companies. While the actions taken by the companies to adapt to the current economic market and competitive environment conditions have changed their strategies, the concept of Industry 4.0 has become one of the main agenda topics of the companies.

One of the basic methods that companies choose to adapt to changing business conditions is the diversification (Song et al., 2014). There may be different reasons why companies choose the concept of diversification as a business model. For instance, the fact that the areas where companies operate are different from the market or market where the company wants to enter or they are located in different geographies or locations can be listed as only a few of these reasons (Ganzarain et al., 2016). The concept of diversification is based on the principle that an existing company provides services in a different sector other than the sector it serves. The correct implementation of this concept is based on establishing the correct communication and correlation between the value chains of different sectors in different markets. Factors such as technological advances, destruction of natural (permanent) resources and inability to protect existing energy resources cause non-egalitarian problems. In order to overcome such major problems, agile and sustainability based approaches should be implemented in both value chains and decision-making mechanisms of companies that have a managerial structure based on the concept of diversification.

The correct implementation of approaches based on sustainability is possible by the exchange of information and synchronization between the physical and virtual concepts that organizations have in the right way on the entire value chain (Walters et al., 2007).

Industry 4.0 promotes the use of different technological elements and applications in order to implement continuity in production platforms, but also encourages actions for the conservation of natural resources and energy resources (Kagermann 2015).

The most important technologies affecting the business models of production-based organizations with the introduction of the Industry 4.0 concept into the business world are the internet based elements such as cloud computing, IoT, IoS. Such internet-based technological concepts enable the realization of the concepts of flexibility and personalized service - product especially on the production sites. By implementing the Industry 4.0 concept to the production site, estimating production demands and providing flexibility in production processes, responding to customer demands and requests correctly, can be achieved with minimum expenditure and least negative impact on the sphere.

The concept of Industry 4.0 modifies the processes carried out in the production lines and the product - service understanding of the organizations by means of connectivity and non - centralized approaches resulting from internet - based technologies. The communication network established by means of connectivity and non-centralized approaches between the production components ensures that production processes are 30% faster and 25% more efficient and effective (Ganzarain et al., 2016).

Today, many organizations are unable to analyze current market conditions, economic imbalance and instability in cases where they are weak enough to use big data and analysis methods and to analyze new markets they want to serve. Because of the existing problems in the implementation of Industry 4.0 technologies, most organizations tend to perform implementation and integration methods into a collaborative strategy. Most companies that are focused on production aim to create diversification infrastructure that they want to create with the help of Industry 4.0 activities through a monolith approach within the framework of partnership with different companies.

Implementation of Industry 4.0 technologies to organizations leads to a change in the factors that constitute the value chain of an organization. In production-oriented firms, the studies to develop value chains are carried out in a way specific to some steps rather

than being holistic (Remane et al., 2017). Particularly, more innovative studies have been created for the business models with the inclusion of customers and consumers in product design and development processes. This type of customer and consumer-oriented work ensures open business models in production processes. Thus, the value chains of the organizations are shaped by user-specific and specially designed products and services instead of being shaped by collective - serial and uniform works.

Nowadays, innovative works for business processes are not only built on an increasingly complex ground, but also in a structure based on multiple relations, which is constantly updated. Innovative approaches built on the Industry 4.0 concept are based on internet and network technologies and play an important role in ensuring the integration between the customer, the end-user or the consumer and business processes. Innovative approaches based on innovative and technological elements of this kind, encourages the study of relations between different disciplines and research and development.

The main problem in open innovation processes is the protection of intellectual property rights. Most organizations are distant from an innovative approach of this type, as the wide open exploitation of intellectual property rights in open innovation processes harms patent rights in organizations' open innovation processes. Implementing business processes that are carried out in a purely traceable manner and with the components of the CPS concept, together with Industry 4.0, enables a sustainable service concept on the customer side. The basic action to be taken to create a basic business model is to reduce the business plan and model into different pieces and reduce them to individual structures. A business model structured in this way can be re-adapted in a simple and complex fashion (Zott et al., 2011).

Most companies in the digital era are trying to incorporate different business models into their own process and business operations by adapting them to the benchmark logic. Implementations involving such transfer logic or transformational applications do not provide the desired results. The reason for this is that the business models contain concepts that are different from the customer, value-added elements, value chain and profit mechanism. Business models are shaped according to the culture of an organization, value judgment and perceptions and employees. Disruptive technologies

can be thought of as a challenging factor for most organizations in implementing new business models.

Many companies serving in industrial areas have improved their communication with both their suppliers and clients through innovative and progressive work for their business models. Most of the reshaped ways of doing business with innovative business models provide important contributions and added value in the developed country's economy (Sanchez et al. 2010). A business model can be considered as a set of approaches to create and deliver the highest value to the customer or to the end user as well as to produce the highest revenue with the lowest cost. The activities of using and evaluating the resources of an organization, carrying out innovative approaches and fulfilling such actions in the most profitable manner are dependent on the strategic concepts contained in the business models.

Most companies serving in the manufacturing industry have created many new business models that are patentable through innovative approaches based on science, marketing these models and approaches to organizations in different sectors. There are some problems related to the creation or renewal of business models due to the continuous improvement and updating of the technological developments. But in contrast, the development and widespread use of design and simulation techniques and technologies has led to a significant increase in research and development activities.

Information technologies are not only directly effective in the process of renewal and development of business models, but are also effective in establishing and strengthening the relationship between customer and organization. The inclusion of technological concepts in organizational processes is not only seen as an important factor in gaining competitive advantage, but also strengthens the company strategy. The main purpose of implementing a business model is to improve the processes within the organization and to provide the highest value to the customer. The business model chosen by the organization in order to provide the highest value must be in harmony with the organization's IT processes as well as reflecting the organizational strategy, vision and mission.

Implementation of emerging business models with emerging technological concepts can be seen as a problematic process. In order to overcome this problematic process, seminars, short meetings and applications can be provided to employees on technology and technology based business models. In addition, firms can implement the methods used by organizations that implement new business models by using different technological concepts and implement them to their own processes by techniques such as benchmarking.

Implementing the Industry 4.0 concept to organizational processes makes the relationship between the organization and the internal and external components of the organization permanent. Business models, based on the ability to analyze information from different sources, enable the processes carried out in different ways and more effectively. Besides, the active cooperation of business models and information technologies ensures that processes are reorganized in an effective, creative and solution-oriented manner.

Business processes integrated in compliance with organizational objectives, products and services resulting from IT infrastructure and business models enable analysis of success in processes based on user experience. Because of the disappearing geographic boundaries via globalization, cooperation between organizations located in different locations has become possible. Efficient and effective execution of this innovative business-making approach arising from globalization is directly proportional to the harmony between the IT infrastructure and the business models used. The strategy and tactical understanding of the organization, in line with IT infrastructure and technological concepts, enable processes to be taken efficiently and effectively, as well as to take action quickly in response to market and customer side changes.

Many multinational companies form roadmaps with long-term and short-term goals for Industry 4.0. The technological concept and research and development activities of the organizations together with the implementation of Industry 4.0 should include some focal points in the long and short haul over the course of the design and development stages. Generally, studies involving long and short-term plans cover concepts such as digitalization in the process based on the usage of technologic platforms, simulation applications and 3D modeling. The use of such applications allows changes in

optimization methods, research-development, waste management by comparing performance observed with digital elements and performance observed in real terms.

The business models implemented by organizations have to take care of the interests of stakeholders, shareholders and customers, and their business models should be designed in such a way as to provide value in areas such as production, engineering - research and development, management of power, logistics and supply chain processes. The business models should schematize the organization and all other components of the organization in a common structure. Manufacturing, distribution and other high-level services should be unified under a common roof based on optimized business processes. While developing business models, the following elements should be taken into account in addition to numerical - mathematical methods.

i. *Pertinence :* Renewable and changing business processes and business models in conjunction with Industry 4.0 must comply with standards and legal reglements. The relations between the companies, the workers and the supplier should be examined in detail in the production based firms where the Industry 4.0 concept will be applied. For example, based on the relationship between the company and the worker, the implementation of Industry 4.0 should be based on the employment of qualified workers by providing the necessary training and adjustment processes, not the withdrawal and dismissal of the worker's muscle strength from the production.

ii. *Risk Management Plan* : Risk management processes, together with the implementation of Industry 4.0, are still more complex and difficult to perform as the number of components involved in the value chain increases. It is necessary to carry out activities to identify and eliminate all factors that may pose a risk to the organizational structure.

iii. *Supervision Mechanism* : It is necessary to implement the concepts necessary to monitor and improve the processes in terms of the components of the organization such as suppliers, customers, stakeholders and shareholders. Thus, the performance of all components of the value chain can be measured.

iv. *Change and Process Management* : Technologies that are evident with the Industry 4.0 concept accelerate the change in process and business models within the organizational structure. The occurrence of such process changes depends on the project and action to be managed in multiple ways.

Maturity models are created to control and measure development in business models and business processes implemented by organizations. These models have recently been used to test effectiveness and efficiency of new concepts emerging with Industry 4.0. Structures for categorizing and evaluating business models can be achieved with the help of a model based on management and decision-making processes. The efficiency and effectiveness of the maturity models created by organizations depend on the correct configuration of information management and information technologies.

Business models emerging with the implementation of the Industry 4.0 concept are distinctive from the business models that emerged and used in previous periods. This is because the implementation of new technologies requires serious investment and training activities, and the concepts managed through digital structures cannot be fully understood.

The customer-organization relationship that is going to be developed through the developments in IT management is one of the most important factors in shaping business models and business processes. The development of customer relations is possible through the use of IT concepts and the application of customer relationship concepts, collecting information and data about the customer and evaluating these data. Business models based on such real information enable both the cost of the service provided by the organization to be optimized and delivered more appropriately to the customer's intended use. Price optimization, which is one of the most important optimization areas for organizations, also provides a competitive charge and value based advantage.

Customer-oriented business models are like a structure that is connected to each other from the foundation to the last step, such as the rings of a chain. These types of business models are built to meet customer needs and where they cannot be addressed correctly.

In customer-oriented approaches, running solution-based processes requires three different actions. These actions are listed as follows :

i. *Investigating* : It is a process based on determining the customer's life and needs by using big data and other information gathering methods.

ii. *Disputation* : It is the process that is carried out based on some negotiation and dialogue methods with customers.

iii. *Fathoming Out* : It is a process based on the prerequisites of bringing together the ones obtained from the interview, dialogue, big data analysis and other information gathering methods.

After these three actions, a process starts to develop considerations in order to find keys to current problems and problems. The ideas and methods developed for the solution are evaluated on the basis of both the expediences of the organization and the interests of the customers. Here, the main aim is to take actions by determining the value to be gained to the customer and the factors that constitute this value. Necessary actions and determining the factors that provide value to the customer may benefit from revising, re-evaluating and improving the business models to be created, but sometimes causing the business model to be completely demolished and rebuilt.

Factors such as Industry 4.0 concepts, improvements in software and coding theory, big data analysis, have brought a different perspective to the change and transformation movement business models and business processes. Big data analysis as well as the ability to edit in the software - coding theory allow for faster and more accurate response to customer needs and requests. Technologies such as artificial intelligence, simulation, and cloud computing enable business models and business processes to be tested more quickly and with less cost, as well as increasing efficiency and productivity.

3. MAIN TECHNOLOGIES OF INDUSTRY 4.0

Industry 4.0 technologies have the power to change the processes and structure of an organization. The technological concepts that emerge with Industry 4.0 play an active role for organizations to achieve outstanding success in Six Sigma, Lean and Agile applications. Considering the Industry 4.0 concept and the technologies it contains, there are many concepts related to each other. In addition to providing the production of speed, flexibility and personalized products and services in the production thanks to the technologies included in the Industry 4.0 concept, Industry 4.0 is also effective in shaping the automation and optimization technologies and the formation of new business processes according to the needs.

Industry 4.0 refers to a whole new set of processes for real-time data, such as augmented reality, simulation, machine learning. In some cases, these processes are added in different tecnologies, such as IoT, sensor technology, and the common purpose of these technologies is to ensure that companies working in the supply chain oriented perform more effective and efficient operations within interconnected structures. Furthermore, the presence of IoT and sensor technology enables advanced monitoring - control and analysis. In this way, a mechanism works based on analysis, reasoning and communication between the processes carried out at the production site and the employees involved in these processes.

The technological components that develop with the Industry 4.0 concept require a serious investment. However, the return on investment is strengthening the structure and performance of the processes and thus protects the organization from serious losses. For example, research on predictive maintenance activities in conjunction with Industry 4.0 indicates a 30% reduction in costs and a 70% reduction in machinery - outfit failures (Sullivan et al., 2010).

Briefly, the technologies included in the Industry 4.0 concept enable organizations to increase their yieldance, effectiveness and agility, while strengthening the value chain and enabling innovative solutions, reducing organizational costs and maximizing profits and benefits.

3.1 BIG DATA AND ANALYTICS

Almost 3.5 billion people use internet and internet technologies as the world population approaches 8 billion. Every object connected to the internet continuously generates data. Autonomous cars or vehicles are capable of generating high gigabyte-sized data in just one second (Cheruvu, 2016). The use of such a wide range of data enables an automobile manufacturer to generate revenue and also to strengthen the value chain. The biggest challenge in the large data concept is not the accumulation of ever-growing data, but rather the conversion of complex data obtained into available information for better deciding mechanism.

Today, due to the rapid speed of globalization and communication technologies, increasing competitive market conditions encourage organizations to evaluate the data they obtain in real time and accurately. The widespread use of the Industry 4.0 concept among organizations has necessitated the implementation of big data applications (Gokalp et al., 2016). Implementation of such applications and software, especially to production processes, converts machines that perform simplex and only certain processes into self-learning units and autonomously actionable units in the light of the information obtained .

The variety of information sources causes the obtained information to be in different formats. The transfer of data sources into a multiple structure and the diversity in the resources have led to the complexity of the data structure. Obtained data can be dealt with in two different categories as structured and unstructured. This requires IT processes to be equipped with actions to process the data in the fastest and most accurate way. Such actions can facilitate the acquisition and evaluation of data as well as ensuring that the data sources are correctly coordinated and organized.

The Big Data concept does not only contain problems related to the excess of data or information. Apart from such problems, there are many problems related to data transmission speed, data security and storage. Big Data cannot be evaluated and stored in traditional ways that are available today. This means that issues such as the assessment and protection of the Big Data are transformed into increasingly globalized

problems in connection with the world. Data backup software is not preferred because of some security vulnerabilities.

Structured data is more suitable for processing, evaluation and storage. The structured data is easily stored in a database and has a standard structure according to the intended use. This kind of data includes concepts that have fixed use, showing sales figures of an organization, stock level of a warehouse or account numbers opened in a bank. The structured data has the advantage of being stored, evaluated, and modified for its intended use.

Non-structural data is usually the fastest developing data type that results from human activities such as video surveillance, listening to music (Mishra et al., 2016). According to statistics, approximately 80% of the data obtained by the organizations are non-structural data (Ise, 2016). The most intense effort is being made to measure and evaluate non-structural data. In addition, non-structural data cannot be assessed in a certain way by modeling because of its complex nature (Sivarajah et al., 2016).

Big data evaluation criteria should be appropriate to the structure of an organization. Until very recently, information gathered by organizations had a standard structure. But now the information is constantly updated and obtained from different sources. Thus, it is structurally dispersed and difficult to process and evaluate. With the help of Big Data, companies that want to shape organizational management decisions, especially employ data scientists and process development experts (Davenport et al., 2012). In recent years, many organizations have turned to processes related to the processing of real-time data, rather than storing data, in order to improve customer relationships and offer new services. Such activities enable the processes to be optimized and continuously improved.

Although there are many technologies that are associated with Big Data, there is no single criterion that is used for analysis and measures precisely the efficiency and accuracy of big data (Demchenko et al., 2013). Big Data transforms into a meaningful structure with the combination of four different components. These components are below :

i. *Volume* : This is the main component of Big Data, can be considered as a concept that requires the development of traditional data processing methods and the existence of systems and methods equipped with high technology (Alshboul et al., 2015). High volume data sets limits on traditional methods of evaluation, processing and storage. In other words, the storage and processing of very large amounts of data by conventional methods is very time consuming and costly. Data growth in the Industry 4.0 is predominantly at an exponential rate, primarily through the IoT and sensor technology. The methods used in storage and evaluation of Big Data generally operate based on relationships between databases that have correlations and similarities. In addition, the systems used for the processing and storage of Big Data are high in terms of both speed and flexibility and provide a wide range of storage space to the user.

ii. *Velocity* : This component can be thought of as the speed with which the data is generated, stored, analyzed and used in processes. The speed generated during the storage, transfer and processing of the data requires the data to be processed in real time and at a specific time interval (Pouchard, 2016). Nowadays, the volume of data is rapidly increasing with the help of sensors, measuring devices and similar technologies that collect data at every field. It is not the production of the data in a very large size but the processing of such a large data and the shortening of the decision making process are of greater importance. With the help of data processed in a fast way, companies can respond quickly to customer requests, can actively participate in product development and marketing processes and understand the needs of the market.

iii. *Variety* : In the era of Big Data, organizations get very different information from many different sources. The use, transfer and storage of data from different sources and available in different formats is probably the most problematic aspect of the Big Data concepts (Kaisler et al., 2013). The big data concept contains not only structured data but also unstructured data. The complexity and diversity in the structure of the data is related to its acquisition from different sources. The data obtained from different sources is complex and heterogeneous.

This complexity requires that the methods used in the storage, transfer and evaluation stages are up-to-date (Al Salim et al., 2017).

iv. *Value* : Obtaining value from Big Data depends on the accuracy and actuality of the methods used. Big Data can be used in many ways to improve processes and decisions made in business processes. The business world recognizes the value of big data and tries different applications to make this value available in all organizational processes (Watson, 2014). Many organizations today are doing big data analysis in a less costly way, and they can also make historical data inquiries. In this respect, they also form the basis for decisions to be made in future periods (Zeng et al., 2017). Things such as sales targets, product development actions, customer relationships, and the like in the coming years are shaped by what is obtained from big data. The creation of value depends on the processing of the data obtained by the organizations with the right methods and at the right time .

Organizations aim to create a big data life cycle that is most appropriate for their organizational structures in order to benefit more efficiently from big data. Generally, the diagram of a big data life cycle that each organization creates is as follows :

i. Identifying problems with business and business processes

Understanding business processes and work structure is one of the most important steps of the project to be established. So, it is necessary to do a detailed study on what is missing and how to deal with the process before the project starts. Researches on which problems will be solved first are done at this stage. Similar problems in the past and their solution methods should be investigated and selected as optimal from the solution paths that fit the current problems (Wang et al., 2016).

ii. Collecting information from different sources

Once the problem is identified and the main causes are identified, the target is collecting information from different sources. Gathering information from as many different sources as possible will help to improve processes. Examples of these different sources are databases, peer-claims, customer relationship management (CRM) documents, sales

reports, test reports for some products, and so on. Also, taking some actions to prevent similar mistakes in the future by evaluating the process and business errors in the past is also an important component at this stage.

iii. Data Cleaning

The next most important step is to separate this data from unnecessary things. If this is not done, the data at hand will lead to many false results and incorrectly set up the strategy to be created. Also, since the uncleaned data cluster means more time and cost, it will cause both financial loss and waste of time. Multiple filters can be used to get rid of this crowded structure (Wu et al., 2014). With the help of these filters, the remaining data allows analysis from many different directions. This means that different predictions and different results are obtained.

iv. Support The Results With Visual Elements

At this stage, it is necessary to visualize the results obtained by combining the data with statistics and graphics. Thus, the values created by the results obtained can be seen with the help of comparisons. Through these comparisons, the results can be reassessed and improvements can be made where necessary (Liu et al., 2013). In addition, with the help of the obtained results, actions to be invested can be taken in the fields of marketing and product development. Afterwards, modeling of the results to be achieved with the aid of assessment tools such as statistical survey, gallup poll, enquiry and so on can be done.

v. Forecasting for the future

In this part of the life cycle, predictions can be made about the future with the help of some algorithms and special software. Some important details that can not be seen with the help of statistics and graphics can come out thanks to these software and can make important changes in the course of the project. Future projects and product development studies can be done by making inferences about past trends and concepts thanks to software and algorithms (Hosni et al., 2017).

vi. Iterating and improving processes

The primary objective of a Big Data project is to continually improve the current situation and to conduct the organization with up-to-date inputs. Continuously growing

the dataset and getting results by getting different information from varied sources is essential for the success of Big Data projects (Wu et al., 2014). The likelihood of success of Big Data projects increases as the process of obtaining different results and predictions in different information lights from different sources is repeated.

Continuous repetition of these processes contributes both to the flow of information and to the continuity of the success of the project. Due to the different results that are continuously obtained, changes may ocur in the data enrichment, data clearing and modeling stages.

3.2 3-D Printers

Three dimensional (3D) printers serve as a kind of CNC machine in the Industry 4.0 concept. A product designed in a virtual structure can be produced in three dimensional form by means of these printers. The 3D printers enable the development of the production activities in the Industry 4.0 concept, but also allow for the production of the products in a unique way. Although 3D printers are based on hardware components, they require software components to meet and design changing needs.

3D printers are used in many sectors such as automotive, aviation, architecture, electronics and defense. The limited availability of methods and modeling in traditional production techniques increases the popularity of 3D printing and prototyping methods. Processes where 3D printing and prototyping methods are most used are addictive manufacturing processes. Additive manufacturing can be defined as the advanced and industrially functionalized state of the rapid prototyping phase with long-term three-dimensional printers (Dilberoglu et al., 2017). Since one of the main objectives in the production processes carried out with Industry 4.0 is to create personal products specific to the audience, old methods are removed from the application. Considering the effective contribution of 3D printers both in terms of speeding up production processes and designing and producing complex objects, it is thought that the production processes can be redesigned with an innovative approach.

The incorporation of technological concepts such as intelligent components, intelligent manufacturing processes and 3D printing into the additive manufacturing processes, and rearranging the product and shortening the lead times are both advantageous to the

production platform and to the customer. Products that are difficult to produce in terms of shape and which cannot be produced by conventional methods can be produced by additive manufacturing and 3D printer technology.

Additive manufacturing offers advantages to organizations and the environment with innovations such as providing trash optimization, designing personal products and reducing raw material use (Horst et al., 2018). The supply used, the work - force, equipment costs and power spent are the cost items of the additive manufacturing concept. In the additive manufacturing processes, the most cost is the raw material used. In addition, the workforce cost is 2 - 3% and the cost of power expenditure is less than 1% (Thomas et al., 2014).

The concept of additive manufacturing can change the production methods based on economic, geopolitical and ambient concepts (Campbell et al., 2011). The additive manufacturing method, which aims at maintaining production processes by taking a holistic approach, ensures that the supply chain and assembly stages are carried out with lean methods. Considering the presence of parts transported from different regions in the supply chain processes, the additive manufacturing method also reduces the logistics costs and the deadlines. Such innovative production models change the places of production centers that change as a result of globalization and enable international firms to build their production centers at specific locations.

In additive manufacturing processes, design and production plans can be formed on monoblock, thus reducing the number of parts to be used in mounting, shortening the overall production processes and minimizing the number of procedures to be performed. Today, constantly changing customer demands, increasing globalization, and so on, are causing difficulties in the industrial equipment design and production.

End users and customers want to access both personalized, innovative and top quality products at the cheapest prices. Due to its geometrical structure, objects which are difficult to produce by traditional methods can be produced by means of additive manufacturing. This offers flexibility in both design and planning stages. The design stages in the production processes are performed in a digital-based file in a virtual environment. In these processes carried out with the support of computer and software,

the human interference is minimal and the error caused by the human factor is reduced to a minimum level. Although the additive manufacturing approach provides significant gains in the design, planning and production processes, there are some disadvantages and shortcomings in some areas. Additive manufacturing processes have a more costly technological infrastructure than other traditional production processes and are more efficient in the production of industrial auxiliary parts and parts of certain dimensions.

The variety of materials used in layered production processes carried out through 3D printers is also limited. The most widely used materials and feed stocks in additive manufacturing processes are plastic based. Although the use of plastic-based materials reduces the amount of waste, particles inside and outside the machinery that are not considered as waste may cause environmental problems.

World - wide economic balances and plans start to change with the expansion of additive manufacturing processes. The positions of the importing and exporting countries vary with the facilities established through innovative and visionary approaches in their production forms. It can be seen as the beginning of a new industrial production process by addressing the users operating in different sectors by increasing the capacity and capabilities as a result of supporting the additive manufacturing elements with different technologies.

3.3 ARTIFICIAL INTELLIGENCE

Nowadays, during industrial production processes, information and data are produced in very large amounts and in very different formats. Such a variety of information enables the optimization and improvement of the processes of organizational components such as production, quality management, logistics management, sales and the like.

With the help of robot and automation processes supported by progress in areas such as mathematics, physics and software, the sustainability of improvements and in the production area and production processes are ensured. With the expansion of the Industry 4.0 concept, high technology elements such as artificial intelligence and machine learning provide new methods and theories in the processes of production and planning (Wuest et al., 2016).

Artificial intelligence can be thought of as a concept that aims to transform machines and robots into a being and learners by transferring human intelligence to machinery and automation tools. Similar to the concept of artificial intelligence, machine learning is developed on the basis of transferring some processes to machines and robots by means of various software and codes (Alpaydin 2010). The use of machine learning and artificial intelligence elements in planning, design and production processes and supporting with big data enables future predictions on different contexts. Machine learning and the use of artificial intelligence as a common application of the different sources of an organization to evaluate the data obtained provides useful information.

The realization, evaluation and implementation of real-time data at the product and service design stages enables the fastest response to changing conditions. One of the main objectives of using machine learning and artificial intelligence algorithms is to ensure continuous control and improvement of business processes. Machine learning and the use of artificial intelligence play an active role in performing the transactions related to the data that need to be processed in a multidimensional and instantaneous manner. Continuously developing machine learning and artificial intelligence applications with coding theory and softwares are changed according to different situations and processes and offer flexibility.

In spite of many advantages, machine learning and artificial intelligence practices may be insufficient to provide and interpret the information required in some supply chain processes. Machine learning and artificial intelligence act in a common manner, depending on the variables and algorithms inside the channel where information is available and evaluated.

The use of elements of artificial intelligence and machine learning concepts enables organizational and managerial decisions to be made independently of personal judgments. However, personal ideas and judgments of system users can enable manipulation of artificial intelligence elements to different purposes. This is open to abuse and may lead to misperceptions and operations. For example, in August 2017, more than 100 companies working on machine learning and artificial intelligence concepts issued a declaration to the United Nations on the dangers posed by weapons

equipped with intelligent technologies. Guns with such features are open to misguided purposes and can be used to infringe the law of war.

The elements of artificial intelligence and machine learning can provide customized solutions in the treatment of some diseases by developing specific treatment and diagnoses specific to the condition of the disease. For example, in the United States, some prototype studies are conducted within the context of aged care. Within the scope of these studies, the daily activities of the elderly are carried out with the help of robots and machines, chores, physical therapy and rehabilitation services are carried out.

Providing system security in areas where artificial intelligence and machine learning concepts are used can be seen as a problem. Ensuring system security is considered to be a challenging factor because of the large variety of both systemic attacks and expenditure. In terms of organizational processes, the integration of artificial intelligence and machine learning processes with human factors is another problematic issue. Such integration involves problems related to design and infrastructure rather than a technical challenge. It is not always possible to perform and manage the interactive processes perfectly in the areas where people's structures and robotic concepts are involved. The prevention of such situations is only possible with the structuring of task and work definitions and forms designed separately for robots and humans.

The unlimited development of intelligent machine and artificial intelligence concepts raises a concern such as technology addiction (Veruggio et al., 2008). This situation raises the danger that the work done or the processes carried out is transferred to the robots and the human skills decrease or become dull.

To make the human and intelligent machine interaction the most powerful and efficient, organizations must know how to structure their business processes. Concepts that are equipped with machine learning and artificial intelligence elements can play an active role in the ordinary activities carried out by organizations. But this situation can destroy the critical thinking ability of the organizational structure.

The fact that the elements developed with the concepts of artificial intelligence and machine learning do not have emotional quotient is another reason for the problems that

may arise in the processes carried out with the people. Lack of emotional intelligence can lead to decisions that may be severe by eliminating the humane and critical thinking factor that must be involved in organizational decision-making processes.

3.4 CLOUD COMPUTING

The cloud computing concept has some characteristics that will change the course of information technologies. The cloud computing concept is based on the principle of providing solutions or methods within the scope of information technology as a service rather than a product. It may be considered as a feature of the cloud computing system that a software or hardware component is leased for a period of time instead of being purchased in accordance with its intended use. The most important feature in the cloud computing concept is to use the software or hardware to be used in the fastest way in accordance with the purpose without having to install it from the beginning.

Changes in the process of providing products and services contribute to the efficiency and genericness of the organizations by decreasing the costs of informatics systems. Preventing loss of takings and clients as a result of the wrong methods and misuse of expensive resources is another important gain that can be achieved with the cloud computing concepts. When such possibilities are taken into consideration, it is seen that there is no need for training activities and infrastructure - superstructure costs after a new process implementation.

Many organizations use cloud computing elements that have been developed in a customer-oriented way to achieve competitive advantage. Cloud computing systems provide flexibility in organizational processes. For instance, providing the resources required for the execution of organizational processes on the necessary scale and syntonizing the capacity according to this scale is an element of flexibility. In addition, the cloud computing concept does not create a financial burden and security problem in the company's databases as it hosts all applications and resources on a virtual platform.

Since cloud computing applications are deposited on a virtual structures, they are self-managing and have the ability to carry out repairing processes on their own (Truong et al., 2010). Organizations can take advantage of cloud computing elements in different ways to take strategic decisions. Especially when the link between cost and strategic

management is considered, the scalability of resources so that they can be used in a necessary way, reduces the organizational cost (Smith 2009). Cloud computing provides new business models with innovative and different media initiatives. Organizations tend to use their resources in a flexible way both in terms of financial and infrastructure. This flexibility is made possible through cooperation processes with different organizations and foundations. Such activities are offered as added value to the customer by increasing the quality of products and services by the experiences of different organizations (Powell et al., 1997).

Innovative steps and approaches in services and products are important characteristics in the success of organizations. The redesign of the processes in an reformer and driving manner and the arrangement according to the needs are related to the use of the cloud computing concept. When organizations provide the necessary positions within their exigences and organize them in accordance with their intended use, they take an integrated action with their aims.

Although useful for organizations, the cloud computing concept also has some disadvantages. Since cloud computing systems are a concept in which a lot of processes and transactions are carried out on a virtual platform at the same time, it is thought that there may be serious security related problems. This raises a concern about the disclosure of confidential information that organizations have. The efficiency in the organizational processes carried out through the cloud computing concept is directly proportional to the openness to access without considering the security and time options.

The exchange of information between the cloud concepts and the provision of common operating processes is also critical to the efficiency of the system. Most organizations focus on the implementation of corporate governance programs such as ERP and SAP in order to ensure efficiency and standardization on the cloud system (Hoffman et al., 2010). When the activity based costing processes are taken into consideration, cloud computing implementation is performed considering the profitability of the investment. Therefore, implementation and change processes are carried out in some local processes. The change and implementation processes carried out with a holistic approach in the initial phase can be costly for organizations.

IT solutions and applications used in organizational processes also change depending on cloud computing concept. The change in IT practices encompasses the implementation of new abilities and applications or the basic structuring of processes. When the cloud computing concept and IT processes are integrated, it is likely that some problems related to privacy and infollution will arise. Situations that compromise system security may occur as a result of errors of system users or key users. The use of tools such as external memory, computers, and so on, where users store the processes of the organization, may cause this information to be acquired by third parties. The lack of information in the processes of using the system implemented by the organizations is also an important factor in revealing system problems. The problems associated with the deficiencies in the service of the cloud computing provider negatively affect the efficiency and measurement of system. The elimination of security gaps in cloud computing systems can be demolished through the use of appropriate surveillance methods and the implementation of contemporary security protocols.

3.5 INTERNET OF THINGS

The concept, known as the Internet of Things, is based on the communication of the elements within the Industry 4.0 technologies. This concept can be defined as the conveying of information and data from any object, device, smart reader, machine to other components by dint of a meshwork. The examination of the IoT concept in the context of Industry 4.0 is directly related to the integration of intelligent system components with different machines and devices, ensuring the transfer of information without the need for any external intervention.

The application of the IoT concept to the production processes leads to the transformation of the processes from the traditional form. This transformation is based on processes carried out with decentralized structures instead of centralized control methods, which aim at the elimination of communication problems and disruptions between different units involved in the production processes (Liao et al., 2017).

The inclusion of the IoT concept into the industrial production processes contributes to the emergence of different work descriptions and practices. Based on the information obtained in the instant and long term, the IoT concept is used to avert inventory losses

in the storage and stocking processes. In addition, the concept of IoT is effectively used in the stages of predictive maintenance, production - quality control in industrial processes. Business models in different and new perspectives used in production and assembly lines contribute to efficiency and savings based on the optimum transmission of information through processes structured with sensors and intelligent readers (Alexopoulos et al., 2016).

The IoT concept is often involved in the conduct of control, calculation and combination operations in a decentralized and heterogeneous chain of processes. The data obtained through the sensors and smart readers placed within the facility provide important information about the logistics activities within the plant, control of the conditions and optimization of the operational processes. The information obtained also ensures the transparency of the processes. Increasing the transparency of the processes leads to the objective evaluation and optimal modeling of the obtained data.

The accurate modeling and use of data from different components ensures that quality processes are improved and root causes are determined and costs are brought down. In the production processes where the IoT concept is actively used, it is necessary to take certain actions taking into account the risk factors such as confidentiality, loss of control, information and data security. Automatization, information gathering, relocation and artificial intelligence applications can also be used in the development of the IoT concept during the period of plant and process configuration.

IoT applications are used in many different areas such as health management, planet research, city management. System users and managers operating in different areas should design processes for monitoring and developing applications. The applications related to the IoT play an important role in the process of problem detection and resolution by acting on the basis of human intelligence, environmental conditions and collected data. The active use of the IoT applications in industrial production processes also contributes to the sustainability of developments in the processes.

The evaluation of the heterogeneous data collected by the IoT applications leads to an efficient and effective response to demand alterations in industrial processes. The applications of IoT have to provide important features such as security, flexibility and

traceability. The application and business models of the IoT vary depending on the area of use. The IoT concept has a hierarchical structure within itself. Sensors, monitoring and auditing systems, sepulchered and wearable technologies are the components of the hierarchical structure that are deployed in different locations of the facility. Each component included in the hierarchical structure has its own specific tasks. The development and optimization of the system becomes possible thanks to the advanced analytical evaluation methods used in the phase after the exchange of information between the components of the hierarchical structure and the storage of the information.

Individuity and correct positioning are important factors in order for objects to communicate with each other correctly and to function flawlessly. The elements of the hierarchical structure, which are not run in the correct locations, become problematic elements in the acquisition and transmission of knowledge. Systems that are capable of reason and reasoning play an effective role in increasing litheness, yieldance and authenticity in both processes and organizational structure. Improving and updating such factors, besides providing economic advantages, also makes actions on occupational safety effective.

The IoT concept contributes to the evaluating, hounding and improvement of the supply chain processes among organizations operating as partners in the scope of horizontal integration. In addition, significant contribution to the traceability process allows the disposal of situations that are neglected in the processes, based on security vulnerabilities. As a result of the development of sensors and big data technologies, predictive maintenance techniques help prevent the damages and losses that occur in the production site by preventing the failures that may occur in advance. In addition to the advantages it offers, the storage and evaluation of very large data is a disadvantage of the concept. There are some concerns as to what sanctions may be imposed on the exploitation of certain practices, as there is no internationally standardized structure for the applications of the IoT concepts.

Also, some or all of the components of the IoT concept, which provides support for organizational processes can be cyber-attacked causing temporary or permanent destruction of the system. The concept of the IoT is actively used to ensure traceability and process integrity among the organizations that are merged under the scope of

horizontal integration. However, there are congruence and connection problems between the applications used in cooperation processes between different organizations.

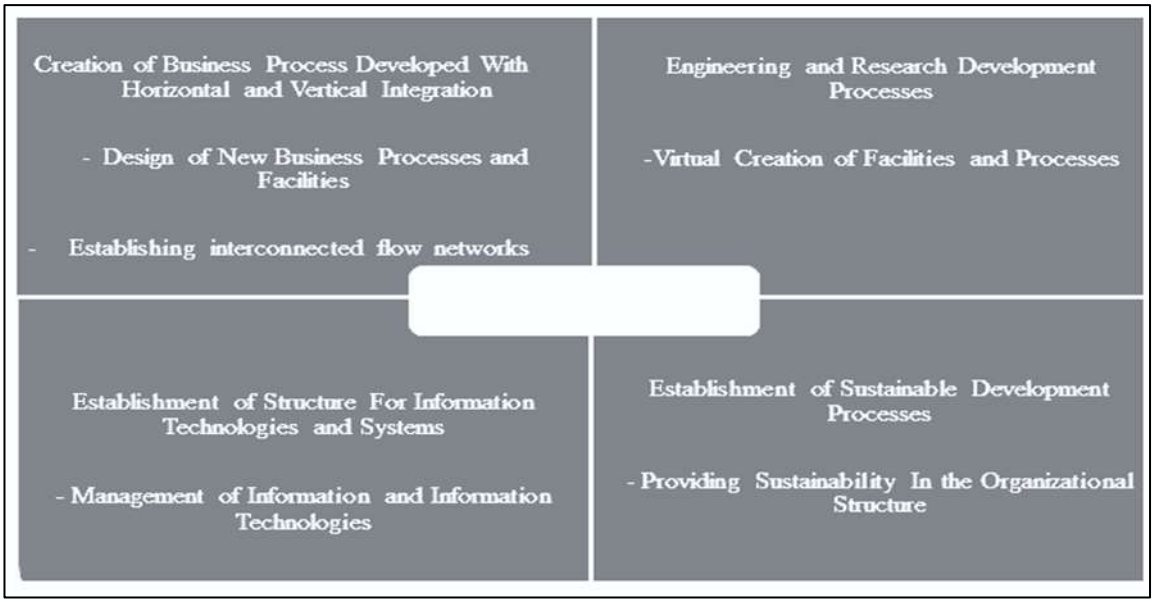
The IoT concept must operate in accordance with the organizational goals to create value and contribute to an organization and its components. The technical problems in the concept of IoT affect the efficiency of the concept negatively. When the risk factors that are likely to arise with the IoT concept are managed correctly, they contribute significantly to the organizational processes.

4. IMPLEMENTATION OF INDUSTRY 4.0

Organizations and companies have to implement Industry 4.0 to business processes and structures to meet the rivalry conditions of today. A detailed strategic roadmap and implementation process should be prepared in order for this kind of change - being a transformation that organizational structures will face for the first time. Nowadays, in order to implement these processes, contributions are made by combining studies of the academic world and ideas and works of business professionals acting close to realize technological development - progress, and process standardization projects. With Industry 4.0, organizations' value measures, value flows, information acquisition and evaluation processes will enter the digitalization era. The most important steps in the transition to Industry 4.0 are below.

i. Research – development and innovation.
ii. Reconstruction of the organization chart according to Industry 4.0 and setting of standard criterion.
iii. Providing continuous information flow and system security between interconnected systems.

Figure 4.1 : Implementation steps



One of the most important issues in the process of applying the theme of Industry 4.0 to operations is the constitution of a scientific infrastructure. Innovation, research and development, process optimizations should be carried out both industrially and scientifically. The factors for accomplished enforcement of the process are

i. *Creation of business processes developed with horizontal and vertical integration* : One of the biggest drivers that have vital importance for growth of companies is integration. The integration of the companies is a very fast and effective method and it is more advantageous than the other factors. Vertical integration means that a single company or organization is strong in more than one process at a time in the production of a material. That is, at least one of the stages in the supply chain process is under the monopoly of an organization. In other words, the transactions carried out by the outsourcing in the supply chain are carried in and the outsourcing is terminated.

   It is envisaged that the added value and value chains should be strengthened and enhanced by the full integration of the production - manufacturing systems and the sales - marketing processes that are related to each other through the same system, which are related to one another through vertical integration. Thanks to vertical integration, companies strengthen their supply chains and eliminate their dependence on external suppliers. In addition to this, they expand sales and after-sales service networks to increase market and marketing power. Product prices, which are the main reason for today's competitive conditions, can also be reduced through vertical integration. In this case, the profitability rate of an organization also increases.

   One of the companies that performs vertical integration most successfully and implements its processes is Apple. Apple has begun to produce the A series of chips and sensors at its facilities for Ipad and Iphone. In addition, Apple also conducts research and development studies on LCD technology in Taiwan. Thanks to these efforts, Apple has created flexibility in its supply chain and ended outsourcing in the production phases.

Horizontal integration is the union of different companies with the same customer type. The primary objective of this merger is to enhance the market share of these companies that address the same customer type. Horizontal integration means providing uninterrupted flow between each step in the production and planning process, including raw materials, suppliers, producers, logistics, distributors, customers, recycling, as well as between the steps of production and planning processes of different enterprises. This integration covers everything from raw material procurement to design, production, marketing and referral. Horizontal integration between different businesses also allows for the coming to exist of new business models. One of the companies which has successfully carried out horizontal integration processes is Baskey Energy. This company has increased its market share by adding other companies which serve in the same sector with itself and prevented the division into the market.

ii. *Engineering and research – development processes* : The basic engineering and investment activities in this area are generally oriented towards technical subjects, such as designing, modeling, simulation, plant installation. The core aim of such activities is to continuously support the flow of value of the whole system together with the advancement of functions and services.

iii. *Establishment of an appropriate organizational structure and task distribution in developing technology* : The most important factor in the success of organizations is, of course, the presence of qualified people. Because of the qualified people as the human assets of organization, companies' processes are successful and contribute to the profitability of the organization. In addition, technology-focused trainings that are designed to ensure sustainability of gains play an active role in successful implementation of required changes in the business environment. Continuous information flow enables employees to be more productive. As the developing technology creates new business lines, it alters the form of business transactions and in this process, companies apply different methods to increase the motivation and productivity of the employees.

These are methods such as creating a more loose - jointed work environment with regards to time and comfort, including mobility and high technology concepts in business processes, and so on.

iv. *Providing sustainability of system and process as well as carrying out technological studies and projects between the different units* : The technological interaction and communication between the different units of the company structure should be provided in order to fully implement the Industry 4.0. Examples of these technologies are cloud system, data processing, cyber security, sensor technology.

During implementation of vertical and horizontal integration processes, feasibility studies are carried out for areas where companies have added value in order to ensure information and system security. In this way, vulnerabilities and actions to be taken are determined. Actions to be taken in subsequent periods are used to improve the system's configuration and standardization. Activities to implement Industry 4.0 should be performed in a more regular, planned, detailed and scientific way than in the past. The research and development activities in this section are based on the steps for implementing the technological elements and concepts.

The Industry 4.0 work to be done for the private sector must be supported by the government, the incentive elements must be created and the necessary infrastructure for academic and industrial cooperation should be established. An integration map that will only be created by the government will not fully reflect the Industry 4.0 and implementation process. For this reason, an implementation map with guaranteed sustainability should be established with the active participation of the industrial sector

4.1 CREATION OF BUSINESS PROCESS DEVELOPED WITH HORIZONTAL AND VERTICAL INTEGRATION

In the above section it is included definitions and examples of horizontal and vertical integration concepts. Briefly, horizontal and vertical integration gives added value to fields such as production, supply chain, marketing, research and development, after sales solutions and so on in organizations and companies.

Horizontal and vertical integrations are methods put into practice by organizations with the goal of minimizing risk factors.

4.1.1 Design of New Business Processes and Facilities

When creating a business process, it is necessary to take actions at the top level of the optimization. When the business processes that are created come together, a business model emerges that explains how an organization operates, adds value creation methods, and processes the quality management system. The concept of the Industry 4.0 will also have signicant influence on business models other than product, service and productive effects. This emerging structure enables the company to effectively carry out investment and action plans for the future as well as to explain the value criteria.

By using data for value chain through analytical methods, the industry identifies new styles of conducting business, enabling the discovery of new markets and the creation of new business models for these markets. Improved business models will become more efficient and easier due to increased connectivity and analytical capabilities (Koch et al., 2014). With the industry penetrating into the Industry 4.0 organization and the structure of the companies, business processes have changed. Some points expected to change with Industry 4.0 are below :

i. Marketing - after-sales service and solution
ii. Investment and product development methods for the future
iii. Identify and eliminate potential risk factors for organizational structure
iv. Modernization of distribution and supply chain phases

Besides increasing future profits, the main purpose of changing business processes and creating a business model is to strengthen the investment and research and development infrastructure in different fields for the future by making a profit to companies and organizations over the long run. At this point, it is supposed to the organization to increase its power in the market alongside its competitive advantage. Members of the organizations are not only forced to embrace new and rational daily tasks, but also to use hi – tech components which are the key parameters of their work (Grecky D et al. 2014).

By means of the increasing use of industrial internet, IoT and sensor technology, organizations will undergo a huge change in the stages of production and supply chain. With implementation of Industry 4.0 concept, most of working environment will get automatized with CPS and IoT with data is being processed online using cloud computing (Wang S et al. 2016). With the help of internet and sensor technology of objects, it will be possible to monitor the product life cycle in real time. The most important need in business processes and business models to implement is to provide a seamless technological infrastructure. With the creation of the technological infrastructure, two important technologies that will guide the future of the organization and the companies are intelligent machines and advanced analytics.

Care of digital infrastructure emanation, profitability of organizations can be increased by designing digitally ordering, personalized product development, linked planning and production processes. Companies implementing integrated planning systems can monitor changes in horizontal and vertical integration components, fluctuations in customer demand, stock levels, and so on, which require instantaneous information flow, through analysis of data acquired from varied sources. All these factors combined, the predictions gained about the customer will affect the marketing strategies of the companies. Integration with customers and other channels, as well as digital integration within the organizational structure, allows for better understanding and interpretation of customer requests.

As a result of digitization and data sharing between producers and customers, value - added transactions such as increasing value - added in business – to - business forms and creation of new value flow charts are realized. Increased interaction also affects platform - level business processes. In particular, companies that serve at the manufacturing and heavy industry level and in platform form need to be able to access the customer and the data belonging to the market they are in order to make improvements. As far as all of the processes mentioned above are concerned, “decision making” has an important influence on all of them. As in all other processes, the decision-making process passes through the computer-aided process planning (CAPP) stage at the operational level and in the planning criteria.

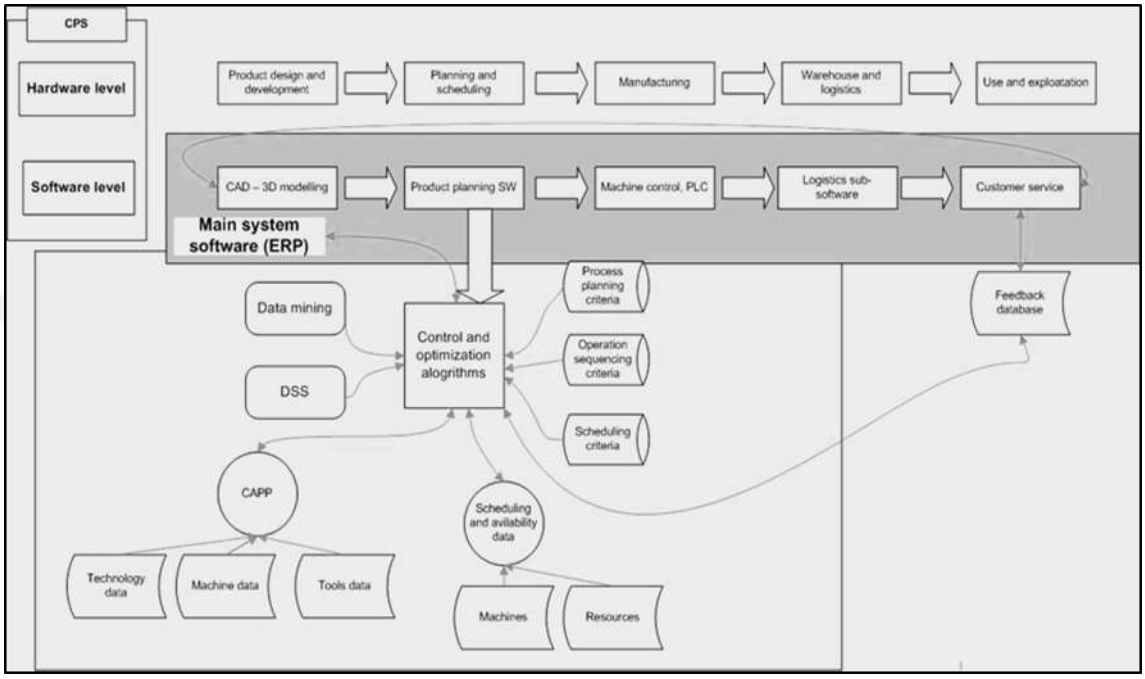
With the emerging new process design and design software and programs, methods used by process designers in the planning and operational units will change. This can be considered as a set of processes that start with CAPP and continue with the implementation of artificial intelligence elements into business processes. Many “smart concepts” that organizations want to implement are aiming to make processes fast and efficient. In addition, computer-aided design methods used in the product development phases are also available in the organizational structure as an extension of the advancing technology. After analyzing the data obtained from different sources, the arguments and parameters necessary for the revision of the processes and the implementation of the technology should be defined. The CAPP elements used to increase the number of special needs and to adapt the production band quickly to changing demands is the most important factor in adapting to changing needs and demands.

CAPP concepts are the most preferred elements that can respond to rapid change. The CAPP elements become active in the most appropriate manner for operation and planning by taking relevant factual data from a pool of data in order to comply with changing requirements and demands. CAPP software is now part of the production and order - demand planning phase. Especially, it is required to establish a inspection and regulation contraption in the production lines in order to detect errors, such as the detection of products which are in conflict with quality procedures, misplaced or wrongly packed, and so on.

Some software and mathematical modelling methods must also be implemented in this control and regulation mechanism in order to detect the shapes and surfaces of the materials in production lines such as industrial equipment, automobiles and the like, to arrange the order of the operations to be carried out or the tape order. “Planning - optimization and product development” software and algorithms, which are at the beginning of the production process to optimize product planning and production, are included in the CAPP processes to ensure that production planning is done in an orderly manner and optimizations are identified and improved where they are needed. In the diagram above, CAPP executes the processes of arranging and preparing the chart. In these steps, CAPP software and algorithms enable the design of processes by processing data from different sources.

The CAPP process operates under the control of product planning algorithms and software, and the production and product development processes are coordinated through information from the CAPP.

Figure 4.2 : Computer – aided process planning flow



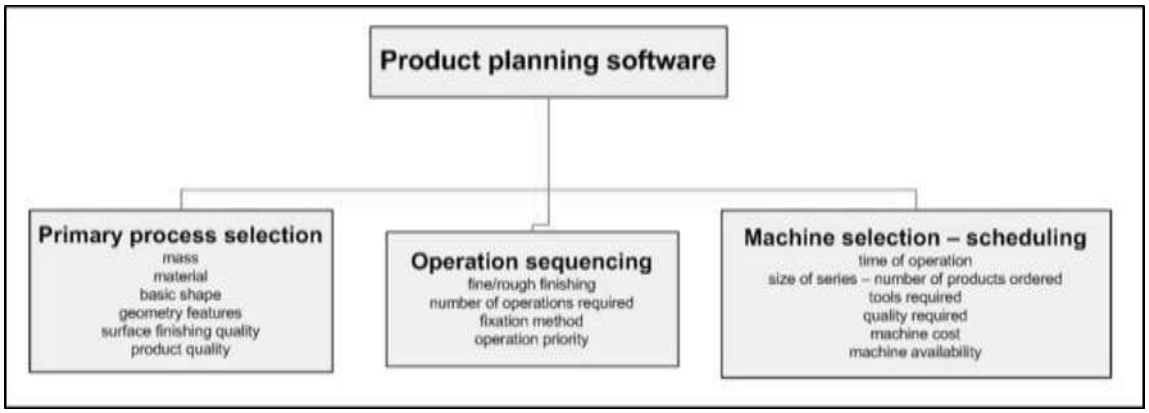
Source : Trstenjak and Cosic, 2017

The production planning and product development software are linked to the overall system. Accurate information from different sources is used in modeling and optimizing basic stages of product planning and research and development. The operations in the first part of the above table are essential for making necessary checks at the beginning of the production phase, preventing future problems and taking the deficient precautions on time. The amount of raw materials and required is not just the right amount of raw material to be obtained, but the amount that can be needed extra in the process at the right time, and the amount of waste to be determined. If the raw material to be used comes from different regions to the production point, formation of an appropriate logistics system and elimination of the risk factors that may occur on the way are also a part of this phase. In the following stages, the raw material with the right price should be supplied in order to make the pricing correctly. Since the raw material is one of the

most critical steps in the production phase, the presence and term of the product from different suppliers should be checked and supplied accordingly. Features such as shape, volume, weight and the like of the product can be continuously optimized compared to the production made in the past. In addition to this, the supply of equipment and machine groups suitable for changing the machine apparatus according to the geometrical structure of the product to be produced, the pre-determination of the machines or apparatus to be used and the changing shapes are included in this stage. The processes to be implemented in the first stage are generally used to calculate the cost - benefit ratio of the product and to evaluate the quality of the product group and, if necessary, to revise it.

The steps in the second group contain details on the ordering of operational transactions. Different external factors significantly influence the operational planning steps and methods. However, planning and product development software and big data analysis can safeguard the order or priority of the important steps. In the stages of research, development and product planning, technical limitations and possible problems that may occur during the production phase can be determined with the aid of simulation methods and necessary improvements and adjustments can be done. In addition, with the help of these types of simulation methods, the amount of waste generated during the production phase can be optimized and profitability can be ensured in the production and time savings can be achieved by eliminating unnecessary processes.

Figure 4.3 : Product planning steps with CAPP



Source : Trstenjak and Cosic, 2017

The last group covers the planning and programming processes. In this section, besides the concepts of time and optimization, it is aimed to use the correct machine and to use the system in the most effective and efficient way. Through the information flow in the system and software for process design, the selection of the appropriate machine and auxiliary equipment is ensured. The information shared between the optimization tools and the system components provides optimization of the time, money, and components required for the production line installation prior to the production process.

In addition, almost every company try to provide a process called “just in time” based on concepts such as the ordered product, the number of final products, the amount of waste, the total time spent, the number of vehicles and machines used. If there are different machines that perform the same function in the organization, the required product can be produced with the required raw material and the existing machines in certain amounts. In other words, with the correct fixations made during the planning process, time and production losses due to insufficient equipment and machinery are eliminated for the production phase. Also, with the algorithms and information flow processes used, the most optimal routes are selected to send the processed parts in the production plant to different units to be combined.

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Two different methods can be integrated into CAPP. The first of these is the predictive analysis, which is generated by big data analysis and data mining. Analyzes or forecasting studies for future situations can be carried out with the help of data sets and sample models obtained. Thus, work can be done in advance to detect the defects and

solve the problems. The second method is decision support system which is used to optimize deciding processes. In this method, big data analysis and data mining operations are performed in order to give the most optimal decision and predictions about current situations are obtained. CAPP software is used by most organizations to redesign and manage internal processes. The main purpose here is to prevent any intervention from outside manually. In particular, some conflicts between manually prepared processes, which are evident in production processes, necessitate the use of CAPP software.

In the manual planning processes, the quality and efficiency of established processes depends on the knowledge, ability and experimentation of the person designing the process. In addition, manual planning also worsens creativity due to the monotonous nature of the work as well as the loss of time and money. Integrating the software and the computerized support system into the processes ensures that the continuous and time-consuming steps are performed more quickly, as well as the sustainability of the optimization. Due to some complicated steps in the production planning process, it may not be immediately possible to create a CAPP concept at the beginning.

Organizational planning activities generally lead to time loss in the planning phase, which is the first stage. Once some problems are removed in the first step, then organizations take some actions for process adaptation and management. As integration of CAPP software into organizational processes necessitates the involvement of different branches of the organization, it can take time to check, monitor and perform the necessary corrections after the process implementation. Due to such problems, organizations' work on CAPP implementation does not immediately reach a good level. Due to such restrictions, production and planning activities are carried out with a narrower perspective. For example, in some CAPP applications, algorithms are created based only on the geometric properties of the parts to be produced. Although these limited methods are not a common method for each production, they appear as a road map at the production-planning stages (Xu et al., 2011).

Among the CAPP programs, there are softwares that have different features and that produce and plan with different techniques. Most of these programs try to optimize with big data analysis, data mining and mathematical modeling methods.

Process planning software and programs must host the following features to ensure optimization continuity.

i. Be productive
ii. Relied on technology and big data
iii. Compatible with all planning stages

Generally, computer aided process planning is performed in two different ways. These are called generative and variant approaches.

In these two approaches, it is aimed to create new process planning actions by implementing the similarity between stages and the relations to different production methods, taking into consideration the technical structure of production processes. In the variant approach method, an existing process plan is adapted to the phase to be used by making the necessary changes when a new process plan is made.

Considering the semblances between new and old parts, it is thought that new parts can be produced by almost the same methods. The variant approach method is similar to the manual process planning methods. Computer algorithms and planning using data mining make significant contribution to optimization in process planning stages through the code and software they contain. In the variant approach method, the information to be integrated into the system must be entered manually. Since the information to be integrated into the system is separate for each stage and can be used in different formats according to need, manual entry of information leads to both loss of time and possible mistake. In addition, the major disadvantage of the variant approach method is that the planning process is limited by the planner's personal skill, experience and foresight. For this reason, the production of a new and original piece is not feasible with the variant approach method.

The main aim of generative approach is to generate a new operations plan for a exclusive product based on data acquired from database (Architecture Technology Corpor: Computer Aided Process Planning (CAPP): 2nd Edition, Elevier 2016). The generative approach method is used to generate an unprecedented constituent using data from different channels. Data entry into these types of systems is done either with mathematical modeling or by coding based on the algorithms. With the generative

approach method, process planning begins with the control of the requirements for the production of the component and continues with the creation of optimized steps. In the process planning stages, the use of the necessary raw materials, machines and tools can be determined in the most optimally manner by means of automation and algorithms. The most important feature of the generative approach method is that each process is performed by automation. This allows the work to be carried out without changing the apparatus without interruption in the lines where too many pieces and various products are produced.

A common understanding by the whole organization of the implementation and change process ensures a sustainable growth by making the profitability of the organization permanent. In addition, quality management methods can be created with the help of projects and improvements made within the different units of the organization. Establishing new business models with Industry 4.0 applications and providing a new value stream will cause significant changes in organizations especially for sales and marketing methods. Accounting operations such as invoicing, cash delivering, and so on have become easier as accounting and information storing processes in finance departments have been performed through manual methods of integrating computer and cloud systems. In the supply chain processes, thanks to advanced production, planning and rotation techniques helped time and monetary costs to be drawn to the lowest level.

4.1.2 Establishing Interconnected Flow Networks

Organizations are aiming to gain competitive advantage by increasing their gains and strengthening their position through the instrumentality of changing business methods and emerging developmentes in technology. The challenge is that these “left – brained” systems only handle with the perceptible entries that fit neatly into spreadsheets and engineering diagrams (Allee 2009). Employees of the organization use abstract and concrete perceived values and concepts to fulfill the different functions of the organization. Interconnected flow networks aim to penetrate the overall value of the organization based on the production of personal value.

There is also a collaboration between the organizational structure components and the implementation of the different processes that the individuals in the organizational

structure revolve with their own experience, accumulation and personal skills. There is a direct and indirect link between the industrial producers and those serving in the industry sector. Most companies work in cooperation in activities such as production, planning, distribution and the like, and through this cooperation they aim to increase the quality of the products by reducing production and logistic costs and to make them available in the market (Johanson and Mattson 1991). In addition, thanks to the information sharing activities carried out through short and long-term partnerships, it is possible to create new outputs and services and the mutual development of the organizations and establishment of control mechanisms on each other are ensured.

In the structures that organizations come together, the methods and stages of value creation are performed in a complex discipline-based manner, different from the stages that an organization alone uses to do the same job (Hamel 2001, Allee 2000). Interest in risk factors, resource and information sharing, joint trainings and the like are of critical importance in close collaboration activities, both within the organizational structure and between different organizations. It is reasonable and logical for organizations to co-operate with different numbers of companies because their opportunities to create added value are limited and costly (Herrala M et al. 2011). The achievements gained through the co-operation of specialized organizations in different fields provide organizations with competitive advantage as well as the development of organizational competencies.

Creating value and achieving positive returns from the value created form the basis for operations for organizations that are united in both firm and co-operation contexts (Shafer et al. 2005). Firms are obliged to perform their basic processes in the most efficient and effective way to offer value to clients. The methods of value creation of most organizations are based on collaborative mechanisms with different organizations, rather than using and evaluating their own processes. Value creation and profit and benefit derived from the created value provide organizations with competitive advantage and enable the organization to develop its own capabilities and keep it out of competing companies. The added value created by the cooperation agreements made and the studies carried out together must be considered with a wider perspective due to the potential possibilities it contains.

Value creation activities can actually be thought of as activities designed to provide added value to the product and designed to meet customer expectations and demands from a product or service. Such activities are linked to each other and aim to increase organizational success and satisfaction. All activities performed in this sense are designed to be interdependent and affect the steps that follow them. During this interaction, factors such as information flow, raw material structure, resources and so on are shared, and each organization is working on its own areas of expertise in the value creation activities created between different organizations.

Activities involving the purpose of creating value have often been studied both by the private sector and by academic researchers. The information obtained theoretically is still transformed into practice, tested in organizational structures, and the results obtained are examined in a scientific perspective. Numerous theories and applications are being studied in order to overcome the shortcomings of companies in value creation. One such method is the "value-added partnership" method introduced by Johnston and Lawrence in 1991. In this method, a certain number of firms work closely to provide product and service flows and to improve the flow of products and functions. Examples of this type of partnership are production partnerships in the textile and automobile sectors. Textile and automotive sectors can be shown among the sectors that VAP partnerships give positive results. It is known, for example, that Toyota, Honda and the like, especially in the Far East, have been tasked with hundreds of very small companies to form the Keiretsu network, one of the key constituents in the supply chain of automotive manufacturers. Firms in the Keiretsu networks have a significant position in many areas such as finance, quality management, competition, innovation and so on (Miyastiha and Russell 1994).

Another method that organizations use to create value chains is value – constellation by Norman and Ramirez. In this method, elements that come together to form a product or service generate value components simultaneously, instead of performing value generation through sequential (Porter's Value System) operations. In this way, all participants concentrate on activities that can be done to improve the value chain. The main purpose is to achieve maximum efficiency from the system used. In addition, actions taken to ensure effectiveness and efficiency must be consistent with the

objectives of the client being serviced. The value constellation method aims at the creation of low cost high quality and service and the sharing and elimination of the risk elements that may arise (Herrala M et al. 2011). This method, introduced by Norman and Ramirez, revised Parolini in 1999 with a different perspective and named it as "value – net". In this way, Parolini sees organizations that come together to create value as components that meet and come together to create value instead of value-creating elements based on cost - saving. In this system redefined by Parolini, it is the focus of increasing the competition power of the system by creating long term cooperation which does not depend on the conditions.

In addition, this system encourages the common use of information, materials, money, and other resources in value creation, similar to systems previously defined. As with all value creation activities, in this method, the actions to be taken are to be considered from the client's vantage point and the optimization studies are carried out in necessary situations for the applications which are essential in the value creation stages. In general, value-creation methods and value-added networks enable companies to optimize their time and place by developing customer-oriented thinking activities. Such activities improve the mutual contentedness by progressing the perception of the customers about the service and product given to them. Value networks are built to meet customer needs and requirements, to accommodate dynamic and continuous improvement mechanisms, to use information flow and common resources. A value network can be defined as any purposeful group of people or organizations creating social and economic good through complex dynamic exchanges of tangible and intangible value (Allee 2009).

With the help of this definition, the "value network" concept is applied to both intra-organizational and non-organizational activities. Value creation activities related to the internal structure of the organization can be exemplified by the activities of the groups established for cooperation between different units. Activities outside the organization can be exemplified by the activities carried out with the organization and components such as suppliers - external sources, shareholders, business associates. Initial definitions on the value networks were generally made for supply chain and logistics management processes based on changes and variations in scorecards, benchmarks, and modeling

methods (Parolini, 1999; Bovet and Martha, 2000). Such definitions centering on supply chain and logistics management revised more broadly, including customers and strategic business partners (Normann and Ramirez, 1993; Christensen et al. 1995). The most important features of value creation networks can be listed as follows:

i. **Customer oriented**: The activities within the value creation network are designed according to customer requirements.
ii. **Partnership and system based**: Organizations serving in different fields provide the common source, money and information to create value.
iii. **Productivity, effectiveness and solution oriented**: It is a system that can adapt to changing conditions and provides continuous information flow and common resource usage.
iv. **Equipped with digital technologies:** In the supply chain process, all digital concepts and applications are used as a whole.

Digital solution methods, customer centricity, agility and so on, which are available in all value creation networks based on customer satisfaction are the most important factors in the success of value creating network. Most value creation networks owned by organizations seem to be complex structures with methods such as value sharing, common resource use, money and so on. Factors such as digital technology and business partnership enable the decision-making processes to be conducted in the most efficient manner by providing information to the stakeholders simultaneously and accurately from different sources in the decision-making stages.

In value creation networks, all the participants work for the creation of common value and aim at performing the activities that will add value to the output and service in the creation of the competition strategies (Peppard and Rylander 2006). All studies in value creation networks are aimed to be at a superior level of service to be revealed, and as a result they are seen as constructions of continuous information flow and communication. Companies that act as partners in the value creation process are not aiming to create value on their own but aim to build value by working collectively and to strengthen competition.

With the help of such collaborations, organizations contribute to the overall improvement by optimizing the processes they are implementing. Also, the most important factors driving organizations to collaborate are increasing customer demands, developing new technologies, competition and globalization (Weiner et al. 1997). Cooperating firms and organizations are obliged to perform their own tasks in the most efficient and effective manner in the processes carried out in cooperation and in this way all the companies involved in cooperation gain profits and benefits as well as providing maximum value to the customers (Starber, 1996).

Studies of value creation networks and process optimization have importance in determining the most significant drivers in developing products and services and in ensuring continuous improvement. Thanks to these activities, opportunities for new business associations can emerge with the use of new resources and information. Value production networks can change over time based on different causes. These include competition strategies of competing firms, product and product groups produced or developed by different firms, and changes in customer volume. The most important factor for jointly acting organizations is the method of obtaining information supported by the analysis. The right and necessary information is the most important factor for the safety of other resources that organizations commonly use.

The systems obtained by combining the different data acquisition and data analysis methods that organizations use in their own way enable the process of the business associations they have formed among themselves to be carried out more efficiently and effectively while the interaction with external suppliers and customers affects positively. For example, with the help of vehicle tracking applications developed by transport companies, customers have the opportunity to track where their orders are and when they will reach them. But this type of vehicle tracking systems can also turn into systems where it becomes impossible to get instant information if necessary updates are not made. In addition, high technology is also optimizing communication methods such as unnecessary and time-consuming mail and telephone traffic.

With the help of information technologies, it is possible to share real-time information between stakeholders, shareholders, suppliers and all other participants and to get the right actions on time. There are three important elements for organizations' value

networks. These include value for the customer, basic skills and capabilities, customer and organization communication (Möller et al. 2005). With their basic talents and capabilities, organizations can compete with products that can meet customer demands and provide customer satisfaction and gain competitive advantage.

As a result of the partnership or cooperation activities that they create among themselves, companies can share their experiences and competences mutually. The value that emerges with the development of the knowledge and skills of the companies with such methods is also satisfactory for the customer.

As a result of interactions and partnerships between different participants or components, value creation methods and value creation networks become strong structures with the help of information sharing, common material and resource use, financial partnerships and so on. The value perception that organizations define for their customers is variable but the most accurate definition that can remove these differences is that all the tangible and abstract components come together and at last can be thought of as a reflection of these combinations. That is, the value element is a complex structure formed by the combination of multiple components such as supplier, customer, society and so on. The generated value has a subjective structure because it can be shaped by the end user or consumer's perception. Therefore, customer or end user views are influential in determining the tasks that must be performed in the value creation process.

The core competencies are shown as one of the most fundamental elements of the value creation activities that companies carry out in both individual and collaborative processes. The capabilities and abilities of organizations need to address customer needs in a way that will provide customer satisfaction. Basic skills and capabilities elements are the factors that organizations use to organize the way they do business and the reaction they have to unexpected situations. These qualities are shaped based on the experience and knowledge of the organizations, but in general they affect most vital steps such as all organizational decisions, the organization's ability to develop strategies, and so on.

Factors affecting basic capabilities and skills can be thought of as organizational management strategy, customer satisfaction, making the strategies tangible, corporate investments in long and short spans and creating investment plans. Basic skills and competencies can be transferred to the end-user as value by developing common strategic activities, project and communication development activities within the organization.

In addition, all methods used at the point of value creation and transfer should be considered to be around the targets and it is a long-term benefit for organizations to design all value creation activities in a way that is flexible enough to accommodate changing customer demands and market conditions. Value creation activities and customer expectations must be consistent as the views of the customer or end user regarding the service provided are the most important factors determining value perception (Hamel and Prahalad 1994). All value creation activities are created by taking into consideration the organizational and competence factors that shape the direction of customer considerations and demands.

One of the goals of every organization that comes together to create value is to revise their internal processes and to increase their competence. The most common activities for value creation and individual competency enhancement are shown as joint ventures and franchises. These methods are effective methods in creating value and delivering value to the customer because they have elements such as organizational closeness, information and common resource use, and easy traceability. Partnerships established to create value are subject to periodic fluctuations due to eco - politics derangements (Selsky et al., 2005).

According to the form of partnership established, organizations are affected in different ways from changing conditions. Factors influencing organizations include shared material and information, common funds and resources used, legal obligations, strategic planning and operational control, and mutual trust and agreement between participants and stakeholders. Value creation stages and chains are those that can be analyzed to assess factors such as efficiency and effectiveness. In the analysis stage, answers for questions such as who the customer is and what factors the value factors have in terms of the customer, the demands of the customer, what tasks must be performed in order to

create value are searched. Before the analysis phase, it is necessary to make it possible to identify all value creation stages and process plans correctly. The answers and suggestions from the client's side are the most important factors in determining which activities are worth creating and what the value is.

In addition, factors such as the quality of the value offered, the price and the possibility of after-sales technical service are also important factors in the change of value perception. In value creation processes, waiting for all predictions and comments from customers can make organizations mislead. Therefore, market analysis and value chain analysis should not be unilateral. Analysis to test the value creation steps and methodology provide interpretations of the interactions of the activities from different perspectives. By bringing together the predictions and ideas that have been formed, future performance and planning can be measured, as well as the performance of all components involved in value creation processes.

The main purpose of the performance measurement and future planning processes is to determine the purpose of cooperation of companies operating in an organized manner and actually serving in different sectors and determining what criteria the firms use in resource utilization and information sharing. Companies working together in the context of co-operation projects with the aim of creating value can provide the creation and development of a value chain through their value elements to their suppliers in relation to their suppliers. Customers, who are the most important factor in the value of the services offered to create value, consider all fiscal components as well as all the activities in the value presentation as components of the value chain.

The value notion can be thought of as a set of actions to be taken to meet the contemplations and needs of the customers. Supply chain and logistics activities are important operational actions that contribute to value creation processes under changing customer expectations and economic conditions. The purpose of these processes is to transfer the value starting from to the customer in the last stage. In addition, supply chain and logistics processes are based on customer satisfaction, where processes are carried out to create value independently of each other (Walters D, 2009). Here, customer demands determines the actions that the supply chain will take, and the

actions taken in response to these requests shape events such as capacity planning, outsourcing and sustainability.

A supply chain strategy that is developed independently of customer requests and demands is not effective or efficient. A customer-focused supply chain strategy provides solutions to problems in the right time and place, as well as revenue for the company. An example of this type could be the supply chain structure that Dell has offered to its customers. Dell's supply chain is easily accessible by customer service and provides spare parts to customers at reasonable prices, which can be an alternative to unavailable parts (Harsono, 2014). This, on the part of the customer, is pleased to find solutions to the problems and is reflected in the financial unit of the company as revenue. Properly structured demand management planning ensures that the activities of production, marketing and distribution are done in the right way and also enables the development of fast solutions for the bottlenecks and restrictives that arise at different points.

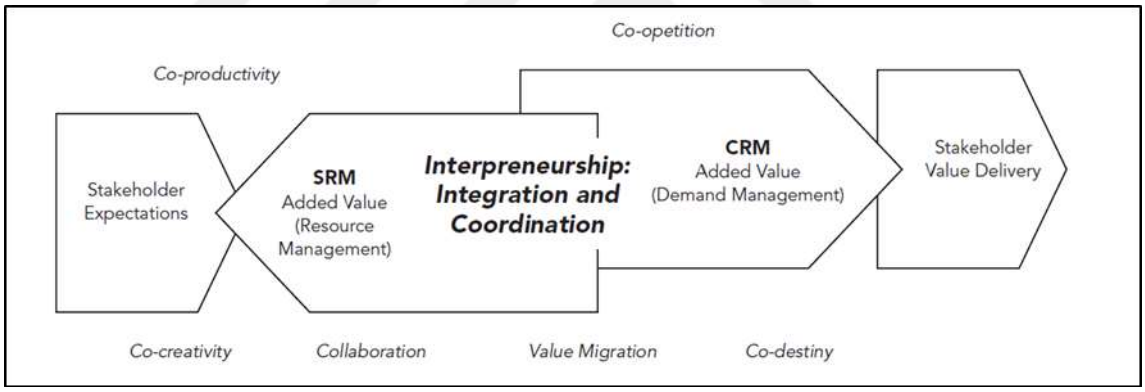
Organizations aim to contribute to the whole value chain by setting some criteria in order to carry out other value creation activities effectively and efficiently when they come together in order to share a common value. Organizations strive to create holistic value chains and to use notions such as information, resources, money in the partnerships they establish in the most efficient and effective way. Systems based on resource use and integrating concepts of automation, artificial intelligence and data analysis into their processes can perform activities to create value in the right time and place by making resource planning based on correct predictions. Value creation is possible not only by offering a new service or product but also by innovating an existing service or product, that is, by innovative approaches. Along with improving existing products and services, it is possible to meet customer needs and expectations in a cost effective manner. While these methods are generally preferred by technology companies, they provide value for customers by developing and integrating existing platforms and technologies instead of creating additional cost and designing product or service from scratch.

In value chains, expectations of all participants, such as stakeholders, shareholders, customers, end users, must be met. Meeting the expectations ensures continuity of achievement. This success and the continuity of success are possible through the

efficient use of resources by all stakeholders, shareholders and co-operatives and by optimizing their processes. In all of the value creation processes co-operated with the diagram above there are steps to manage the relationships between the participants and to determine the duties of each participant and work models to be implemented (Walters D 2009).

Collaborations aimed at ensuring that processes are coordinated among organizations and solving customer problems in the fastest and most effective manner enables new business models to emerge. The processes that are presented to accomplish this and to execute it in an efficient manner are; co - creativity, co - productivity, co - operation and co – destiny (Walters D 2009). The concept of co – creativity which is on the Figure 4.4, is a formation that considers the participation of customers and end users in planning and designing products and services.

Figure 4.4 : A value chain network based business model



Source : Walters, 2009

The concept of co - productivity envisages more participation in operations-based activities, such as suppliers and consumers in the value chain. Co - operation concept is that the competing firms in the sector act jointly to meet customer expectations and create value. Co - destiny is a concept that summarizes the degree to which the components in the organizational structure will perform which tasks. Complementors refers to new markets and different segmentations in existing markets. Complementors can discover new sales channels and customer potential through different approaches to existing markets.

Due to optimizations in the value chain creation process and new markets being explored, older business models are transformed into new models created to achieve higher performance and profit for the organization. Entrepreneurship is a concept that summarizes profitability by approaching an existing market with a different approach that envisages the management and operation of existing experiences in order to constitute a new business model.

Organizations should examine the consumer's consumption rates in order to gain competitive edge and to understand how much they benefit from the competitive advantage. Establishment of the consumption chain is possible through big data analysis and CRM with continuous information. The concept of consumption chain was first introduced by MacMillan and McGrath in 1997. The concept of consumption chain is an efficient and effective method of making strategic moves correctly in order to create a value chain. Customer-based business models and innovation processes have been evident in recent years. Given the general structure of the consumer chain concept, it seems to be a customer-focused structure.

When creating and optimizing the consumption chain, it is necessary to pay regard the mindfulness, existence of product - service, forms of payment, procurement procedures, warehousing, product configuration - after-sales services, subvention and processes of faulty product-service exchanges (MacMillan and McGrath 1997). The customer or end user considers all of these factors when buying a service or product. The concept known as added value is that the additional contribution and benefits through the service bought by the customer are obtained at the same level of service in a more cost-effective manner from the economical aspect.

The information and analysis obtained from the creation of consumption chains can form the basis for strategic decisions and actions to be taken during organizational management. For example, many online sales and shopping sites can gain profit and benefit by changing the product development, inventory planning and sales activities according to customer preferences by virtue of the information provided instantly through sales. In the value chain processes, organizations' goals are to change the traditionally functioning business models and mechanisms to create a structure equipped with innovative and modern methods and solutions. Revising processes and

actively integrating business processes and the value chain require executive approaches that are dependent on strategic decisions.

The administrative approaches that are carried out for this purpose consist of several different stages. At the first of these steps, the organizational structure, with the help of sales and marketing channel and the introduction of the product or service must effectively describe for the customer and make the customer feel the brand value. Sample cases and events should be explained where customer and brand are brought together in the case of the customer in order to strengthen the brand value and sense.

In order to increase productivity and brand value in the processes that operate in business to business activities, the advantages of the product and the brand should be mentioned. Second, marketing and sales activities must be organized to meet customer demand and needs. These activities should cover not only the sales and marketing phase, but also the post-marketing aspects. At the last stage, it is necessary to organize communication between the shareholders, stakeholders, external resources and similar elements that are part of the organization and the end users.

Organizations can successfully manage value chains if these three steps are effectively and efficiently performed. One of the most important point that organizations should not miss while trying to create a value chain is to take action to provide customer satisfaction in the long run. This can be achieved by producing a solution to the problems that the customer may encounter. Practising within the value chain requires special attention to marketing and sales activities. In this sense, direct involvement of the organizational structure with both the distributor and other customer groups and their relationship management plays an important role.

Logistics and financial activities are also factors that affect customer satisfaction. Through adapting the “Just in time” and “Vendor Managed Inventory” softwares, logistics and supply chain actions are taken correctly and responded to the high volume of products on the market as quickly as possible. Support and after-sales services and marketing activities are often more important than service or product punctual delivery. Such services also directly affect CRM and the processes that the client performs within itself. Logistics and supply chain processes involve not only the right time delivery of

products or services but also the right time to deliver information to the right places at the right time.

In addition, order forecasting, demand planning, optimization of delivery-term periods, and reverse logistics processes are the most recent phases of the supply chain process, which are performed by programs and software. The main purpose of performing such activities with the help of programs and software is to meet customer demands and needs in a timely manner, to increase the quality of service and to contribute to the organization by reducing costs.

Flexibility should be provided in order to provide effective responses to changing customer needs and demands, as well as being effective and productive in the activities of value creation. Innovation, effective resource utilization and the flow of information through software and programs are the main goals. In addition, customer-centered action in process planning ensures that both customer expectations and needs are met and that costs are reduced through the business unit.

4.2 ENGINEERING AND RESEARCH DEVELOPMENT PROCESSES

Organizations make very important investments in research, development and engineering every year. Through these investments, it is aimed to develop existing technologies and to produce new technologies. Among the main objectives of the investments made in such areas, it is possible to increase the profit share and gain competitive advantage in the market based on innovation. Innovation can be demonstrated as the basic element of engineering and research - development activities. By means of innovative methods, it is possible to renew an existing product, service or process as well as to reveal a new product. The primary aim of improvements with innovation is to ensure value to the organization and the customer.

4.2.1 Virtual Creation and Control of Facilities and Processes

In organizational structures, when multiple decision making processes and systematic analysis and change processes are simulated by traditional methods, generally desired results can not be achieved (Bal et al. 2009). Simulation processes in plant planning and installation stages provide the correct operation of knowledge flow and multiple

decision making mechanisms based on real-time situations. Such applications allow for the pre-calculation of the time lost when a product or a facility is constructed, and the time and money saved by eliminating errors that may occur during the construction phase (Colledani et al. 2013). Additively to the design and diagramming processes, simulation applications also provide a quick solution to possible problems that may arise during the production and supply chain phases. Through these solutions, factors such as system updates, maintenance and repair work, data analysis and so on can be achieved at the lowest.

Industry 4.0 processes, in essence, also provide interaction between the virtual and the real world. All factors involved in the formation of a facility or product also have a digital counterpart. In virtual applications, the real world is treated as a structure built on decision-making processes and issues to be intued. Simulation and planning models play an important role when real and virtual structures are integrated. Simulation and planning models enable the establishment of complex systems and the identification and resolution of potential problems.

Providing and managing virtual information flow, automatic modeling and designing processes, ensuring communication between system elements are the pivotal steps of virtual plant installation. The virtual plant installation processes are constantly evolving, thanks to the modeling, calculation, technology integration and standard metrics that have emerged with Industry 4.0 applications (Jain et al. 2015). Simulation applications introduced by different scientists have dealt with the plant setup processes in virtually different ways. One of these is PROSA architecture modelling (Bal et al. 2009). The PROSA architecture provides control of the production processes and allows the system user to freely use different elements. Depending on the user's requirements, certain components may be actively included in the control process while other components may be eliminated.

Apart from PROSA architecture, Quest simulation tool is another virtual design component (Barnes 1997). The Quest simulation tool allows virtual plant design in 2 and 3 dimensions. Quest is a component that provides cost-effective, solution to possible problems in the plant installation process and flexibility in the processes.

In two dimensional (2D) planning processes, the goal is to see the sketch of the plant to be installed. For example, in a warehouse planning process, the details of the shipment site can not be determined through a 2D planning method. Mathematical and geometric modeling plays an important role in three dimensional (3D) design processes. The main goal of the 3D design process is to design the plant that will be produced in the most accurate way without being laid. The warehouse design plan that adduced for 2D planning is designed in the most accurate way to calculate the efficiency and effectiveness of the warehouse elements such as shelf locations, addresses, walking and forklift routes and so on when considering the 3D planning. Quest software provides 2D planning and design transfer to 3D as well as two and three dimensional planning facilities.

The factory design is similar to a product development process when the overall structure is considered. Organizations are working on factory design with the aim of finding new redresses to production processes, enhancing quality criteria, achieving just in time criteria, reducing goods delivery times and decreasing costs. The problems of organizing and building a plant are the dependency between plant planning, process planning and product - service development phases. The solution of these problems requires a large number of different processes. Production facilities vary depending on such criteria as product, process, infrastructure, and so on. Production facilities should have the flexibility to respond to changing market conditions and customer demands at the right time and in the right way.

Compliance with changing conditions and continuity of adaptation are among the most important tasks for organizations. The most important way to adapt to change is to provide flexibility. The degree of flexibility is directly proportional to the flexibility of production processes and the changing market conditions. Virtually designed installations ensure that the flexibility is provided, as well as the geometric and mathematical modeling of the actual facilities to be revealed. In addition, virtual design and planning work enable any improvement and development to be performed at different times. In this context, features such as cost effectiveness, flexibility, reliability, and solution focus can be acquired (Pedrazzoli et al. 2007).

Data analytics is one of the most important factors that enables us to take action against the alterations that occur in the market conditions and to understand the customer demands and exigencies in the most accurate way (Dean 2013). Through the use of manufacturing data analytics methods, an integrated form of data analytics applications into production processes, performance enhancement at the production stage can be achieved through sampling, modeling and simulation. The data and information necessary for the execution of such processes can be obtained by means of advanced technology elements such as sensors, machine language, intelligent readers, RFID technologies, barcode and so on.

The vast majority of manufacturing companies can not effectively use the information they have acquired (Hazen et al. 2014). While modeling and simulation techniques are frequently used by manufacturing companies and successful results are being achieved, data analytics methods have not yet become widespread. Different technologies must be integrated to process optimization and processes of the virtual plant installation and the production and design process.

In this way, it is possible to execute processes efficiently and effectively, as well as to respond quickly to sudden changes and to quickly resolve unforeseen problems (Tolio, 2013). A virtual facility is a structure that is as flexible as possible, sharing information and communication among all its components (Dumitraceh, 2013). Manufacturers of industrial equipment, lacking flexibility and having difficulty responding quickly to changes, must be technologically at the top to meet their production needs and make design - planning processes efficient.

A virtually structured facility performs analysis of its own business processes through continuous information and data analysis and flow. The “complexity” considered as a problem brought about by the ability to be virtualized has led to the necessity for digital tools and methods to be easily learned and manageable. The fact that the technological concepts, which are the main components of the processes that are managed in a virtual way, fed by continuous information flow through a single platform makes the cooperation between the components stronger. This jointly structured platform has the ability to analyze information on all processes, such as production, product development, resource use and the like, in the most up-to-date and optimized manner.

A facility and processes that are governed in this way eliminate the need for investments to improve decision-making processes. Shaping production and planning processes as well as in modeling and simulation techniques used in virtual plant applications have influenced the emergence of the concept of “intelligent production”. Intelligent production and intelligent factory concepts, while being effective in ensuring that organizations have a competitive advantage, also enable most organizations to approach specific situations and problems scientifically thanks to its applications, softwares and new research fields.

Given the scientific studies and the processes that firms have implemented within their organizations, it is understood that the organizational sense of success depends on product development, process design and improvement, strategic decision-making and implementation, in a stable and accurate manner. In order to achieve this, the concept of “co - evolution” philosophy must be implemented in the whole of the processes that will exist within the facility from the construction of a smart plant (Tolio 2013).

The philosophy of “co - evolution” enables organizations that serve in all branches of the industry, especially industrial spare parts manufacturers, to effectively learn and manage the processes outside of production and production with accurate information - based methods. Firms have solutions for different action plans that they have developed regarding product design and development, marketing - sales, and engineering - based problems following sales. But these different methods and approaches need to be used in an interactive manner on a common platform to give the best results. In other words, the process from plant construction to product design is addressed in a holistic approach.

Companies implementing the Co - evolution philosophy, while not being adversely affected by changing market conditions and customer demands, can overcome change processes by providing profitability and maximum benefit. Through the virtual plant design, software implemented in plant processes ensures continuous improvement of key factors such as supply chain processes, system installation, predictive maintenance processes, product and production planning, quality control mechanism development. ERP, SAP, Oracle like software products are the elements that contribute to the design of all other processes, starting with virtual facility planning.

It is one of the most important functions of such software to obtain the information and data that are necessary for the design of process design and operational level, which are heterogeneous from different sources, to be made usable by processing. The most optimistic way of doing this is to maximize the harmony between real-time processes and virtually executed processes. This means that costs other than investment and operational costs, such as maintenance, repair, adaptation and the like, will be minimized.

It is known that organizations and the academic community use many different methods of information and data management and modeling. One of these methods is known as Exchange or Product Model Data (STEP) (ISO 10303 – 1 : 1994). The overall objective of STEP is to base the processes related to the use and modeling of data on a specific methodology. STEP obtains for modeling using the product life cycle.

Today, data on activities such as an intelligent facility, a product development or planning are collected and stored in very different ways. Another data modeling method emerging as the result of the development of STEP is STEP – NC (ISO 14649 – 1 : 2002). STEP - NC is generally structured on the execution of supply chain processes. Process Specification Language (PSL), a software similar to STEP and STEP - NC, aims to make the most rapid and accurate information sharing process between supply chain processes such as production planning, listing, process optimization and logistics process control. These are tools and software that are need to be integrated into one process in a digital factory for uninterrupted processing on a common platform, which executes transfer, analysis, exchange and storage processes. Such software and tools should be open to interventions for integration and improvement in a flexible manner.

The most basic requirement for the digital factory concept is that it has a data modeling and sharing system that can provide continuous processing. The use of technologies based on Graphical User Interface (GUI) methods is common in digital factory and plant construction. GUI-based technologies enable communication and necessary actions through visually symbolized concepts with tools and other elements that play a role in the execution of the processes. GUI technologies are programmes that are easy to learn and do not require learning any programming or software language. In addition,

GUI software makes real-time returns to instant operations. For example, you can see that a file has been opened by clicking on any icon on the home screen.

Processes for establishing and managing an intelligent plant are generally designed and managed based on the centralization of the production mechanism. Decisions on the installation and management of such facilities are processes that operate in the long run and are burdened financially on organizational resources. There are different criteria for performance measurement and evaluation of facilities that function in this way.

Examples of benchmarks used for performance measurement and evaluation are factors such as annual or monthly production, product quality, reduction in costs, and so on. In addition, resource utilization, decrease in working time - drop in work and decrease in waste rates can also be used as performance measurement - evaluation criteria. Under normal circumstances, the installation of a standard factory site plant can be done in different ways depending on such factors as planning, process design, and so on.

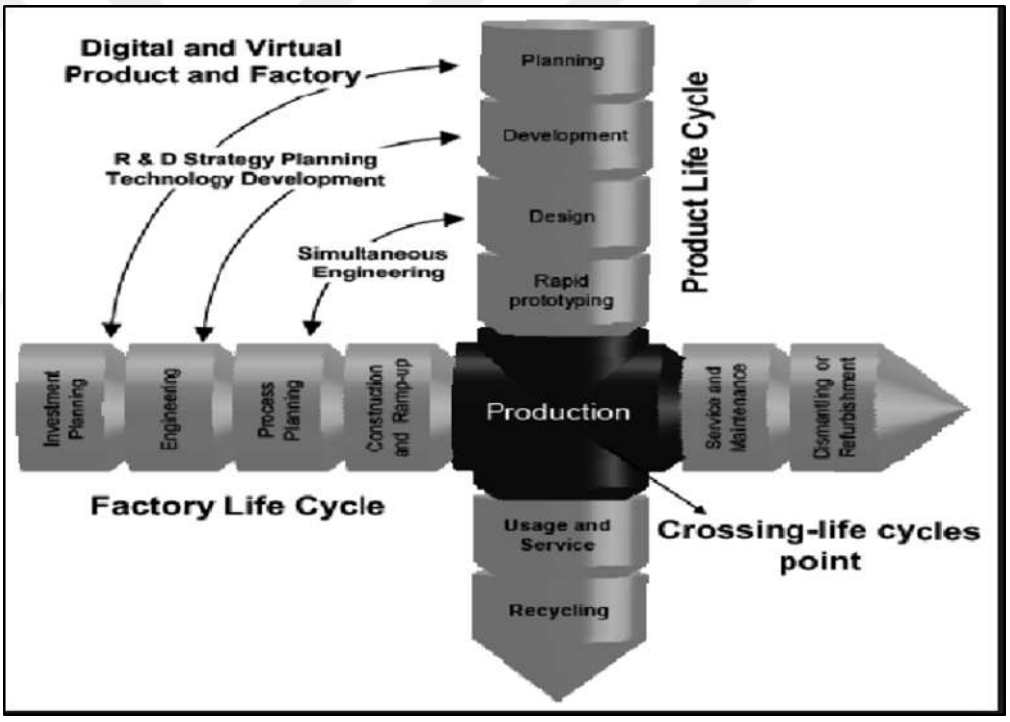
In addition, in the case of factors such as stakeholders, shareholders and the like who participate directly or indirectly in the process, their existence necessitated the departure from traditional models in factory or plant establishment. Each plant has its own unique characteristics. These characteristics can vary in many different ways from such as manufactured products, processes used, factory layout etc (Azevedo et al. 2010). The most important factors for the organizations that form the dynamics of production and sales to meet the customer demands, which must comply with the competitive conditions, is to manage the harmonization process in the most correct way.

A factory that must adapt to changing demands and seasons must be flexible, open to change, measurable and knowledge-centric in its processes. In the first stage, the factors that spring to mind when setting up the factory are process design and research and development activities. According to Mital et al. (2008), the product life-cycle is the time period between the time of product design (concept, plan, design, idea, notion, or thought) and when its production is no longer profitable. The product life - cycle concept can also be adapted to a factory setup and process design phases in general terms. The product life - cycle philosophy makes it possible to achieve the concept of

sustainability when it is actively involved in the process of factory installation and process design by adapting to the organizational structure.

The detection and adaptation of phases parallel to each other between product life - cycle and factory life - cycle is done by simultaneous engineering methods. Simultaneous engineering methods allow processes to be transposed to processes similar to each other, based on the adaptation of similarities between two different life cycles. By virtue of the philosophies created by these similarities, organizations can quickly catch up with the changes that take place in the marketplace (Westkamper, 2006).

Figure 4.5 : Factory vs product life - cycle



Source : Azevedo, 2010

The concept of the virtual factory must be integrated in a factory structure that exists in real life both in the simulation phase and in real time. The execution of this activity plays an important role in ensuring the realization and improvement of the real plant, as well as in providing quick solutions to the problems that may arise. One of the important consequences of the adaptation of the product life - cycle concept to the factory life - cycle structure is the strong structuring of the concept of predictive

maintenance in factories or production facilities. The virtual factory concept provides access to the elements that make up the factory to handle a set of information to illustrate the general situation of the plant and to examine the state of this fact.

There are some approaches to the continuous development of virtual factory and plant activities. These can be listed as follows:

i. Having performance measurements and indicators that are constantly updated, covering the entire factory concept and having fit dynamics
ii. Establishment of well-equipped and trained teams to provide predictive maintenance and other human factor-requiring activities
iii. Create elements to support decision-making with up-to-date information and information sharing network
iv. Establishment of scenario-based methods for cause-effect and evaluation

The existence of a virtual plant that can be tailored to holistic, changing needs and suitable for performance measurement allows the correct execution of ongoing production stages in a plant. In this way, product quality, stock quantities, waste rates, financial obligations and activities, efficiency and effectiveness of processes are positively affected. Moreover, with the increase of the production speed, it becomes possible to drive the product to the market in a timely and correct amount (Azevedo et al. 2010). Considering that a plant is a product, the adaptation of the product - life cycle stages to the plant provides a standard methodology reduction of the factory setup. A system uses data obtained from different sources in different formats.

Organizations execute information - data management processes successfully when they perform tasks such as process - facility planning, and perform activities such as acquiring, editing, and sharing data and data among system components. In addition to enhancing the effectiveness and efficiency of processes, the development of such quality measures, optimizing resource utilization and creating innovative business methods can be achieved. The efficiency of virtual plant installation and other decision-making processes beyond process design is also possible by analyzing the acquired knowledge and values. In this way, it is ensured that the decision-making mechanism performs its processes effectively and efficiently.

By virtue of concepts such as knowledge-based decision making, effective problem solving techniques, quality measures, flexibility and the like, which are obtained when the simulated process and plant design are transformed into reality, the actions to meet the changes in both market conditions and demand can be taken in a timely and accurate manner. The Virtual Factory Framework (VFF), which is part of the European Commission Seventh Framework Programme (FP7). The main purpose of this project is to save cost and time by increasing the European power of production with the help of optimization of factories and processes and strengthening activities such as management, evaluation and so on. ((FP7-NMP-2008-3.4-1, 228595), 2009).

To this end, VFF aims to establish the infrastructure needed for complex processes and structuring activities that exist within a virtual factory installation. This requires the capability to simulate dynamic complex behaviour over the entire life cycle of the factory, which in itself is considered as a complex and long – living product (Pedrazzoli et al. 2007). The VFF concept, which will be one of the most important elements of the near future, is formed by different stages of installation. The VFF concept is fully integrated and equipped with simulation applications and is a concept that provides support in the process of strategic decision making, process design and planning. The main objective of the VFF project is to establish collaborative structures and units for tasks performed within the plant and to ensure that resources, information, and so on are used for optimization purposes, especially during the production phase. The VFF model begins with the creation of a reference model for plant and factory designing.

The VFF model includes project management phases and virtually interconnected concepts, providing the use of the data source required for process design. In addition, transposing a product of the product life - cycle concept available for a product is also done through the reference model. In the second step, “VF manager” plays a concept role. The “VF manager” concept is available to manage all the elements involved in production, information sources, interconnected components with the human factor. At this point, the task of “VF manager” is to provide data security and data transfer between factory components (Pedrazzoli et al. 2007).

The development and optimization of mutually independent functional units is important for the existence of the VFF concept. The functional units play a role in

providing the necessary tools and other services for process and facility design, optimization, redesign and assesstment, as well as taking action to deliver value to the customer. Due to the presence of functional units, it is possible to carry out tasks such as cost reduction carried out within the framework of cooperation, performing research and development activities, factories and plant planning which are managed through instant information - based processes.

The final step is to create a pool of information from which the necessary information can be stored and analyzed. As a result of analyzing the obtained instant information, the processes to be carried out in a factory and the operations for the creation and execution of strategies for activities to be carried out at the production stage are determined. In addition, this information is carried out in arrangements for production planning and capacity utilization according to future changes in customer demand and needs.

When these four elements come together, the concept of virtual plant and factory becomes a real structure. The processes of the virtual factory concept should be structured in parallel with the actual factory - plant concept. In this way, real-time process optimization can be realized besides saving time and cost efficiency. First, the goal should be to create an environment in which mechanical - mechatronics engineering and software engineering activities for plant - process design can be performed.

To provide these features, the concept of using information technology is essential. The goal in the long run is to ensure that the supply chain processes are profitable, cost – effective and two - sided. This is possible only if the virtual world and the real world are interconnected by mixed methods from different disciplines.

4.3 ESTABLISHMENT OF STRUCTURE FOR INFORMATION TECHNOLOGIES AND SYSTEMS

Actions for the management of Information Technologies are taken on the basis of the necessity of meeting the needs of the organizations and achieving their priorities and objectives. In the process of taking these actions, organizations work on concepts such as software and hardware technologies, sensor technologies, data security and

evaluation. The main objective in IT management is to provide added value to organizational processes through technological concepts. Information Management Systems provide support for the important units of organization such as accounting, finance, human resources and supply chain processes. In other words, it is the main task of information technology systems to ensure that the technological concepts and organizational strategy and business models are fully harmonized. Technological concepts take on a binding role among these elements, as the value creation and value-added activities in an organizational sense are based on the aggregation and development of all elements within and outside the organization.

4.3.1 Management of Information and Information Technologies

The business models of organizations are changing due to reasons such as globalization, competition, cheap labor force and so on. IT management has many influences from the business processes, from inside and outside the organization.

Information Technology (IT) management is a concept that incorporates all the "information technology methods" that organizations use in their operations to meet their needs and priorities and perform their processes (Nowduri, 2011). The basis of IT management is to prioritize the activities that will enhance and improve the links between organizational processes. Through the integrated modules, the executed processes contribute to the continuous improvement of the service or developed products provided with the benefit of the organization in the stages of testing and decision making.

In addition to these activities, it is also a duty of the IT management to provide continuous feedback for the purpose of the development of facilities or factories and to contribute to the development of engineering studies. Organizations exist through processes that are executed by some concepts that are governed by one another. IT ensures that important tasks such as information generation, storage, organizing and processing, communicating between components, and performing essential and priority activities are carried out through the relationship between human and information systems. Through the information obtained by means of IT, it provides information necessary for tracking and controlling business processes and forecasts for the future, as

well as providing information in real-time, contributing to organizations' decision making and management methods.

IT provides operational tactical sense to organizations in the short run, while allowing the entire organization to move around a plan in a strategic sense (Furduescu, 2017). IT is a discipline that relate to each other through information exchange between independent concepts to achieve an organizational objective. IT is responsible for providing information and data to all the components of the organization so that the organizational structure can reach strategic decisions and objectives. The IT should be user friendly, able to present the necessary information in the most in-depth detail, make predictions in the most accurate way, and be able to shape the usage characteristics in the way the user desires. IT is used in different processes within the organization. Examples of these are the following functions;

i. Assessing the current situation and make accurate forecasts for the future (It analyzes the information from different sources and compares it with the situation in the past and the current situation).
ii. Processing and analyzing the information and data obtained (Creating links between algorithms, innovative ways, alternatives, processes and applications in the deciding process by analyzing and controlling the data and information obtained).
iii. Detecting system malfunction or system attacks (Identifying mistakes by providing control of elements in the system).

Knowledge represents, in an organizational sense, a much more complex and difficult notion than the conceivable concept used in everyday life (Adekeye, 1997). Every existing community maintains its assets through information. The management of information and knowledge is an important concept for effective management of organizational management and for prioritization (Karim, 2011). So, information and especially “up-to-date information” is one of the most critical concepts for all organizations. Information must be managed in the right way so that organizations can save its assets in every sense.

Given the processes involved in the acquisition, existence and governance of information, it is clear that it plays a unifying role for organizations. The functioning of organizational processes is often possible with the cooperation of more than one unit and requires information sharing. The information symbolizes the analyzed data in general (Kumar, 2006). Put it differently, information is a filtered concept that results from the analysis of business data (such as sales figures, number of shipments performed, product prices and so on). Regardless of the nature of the activities carried out in organizational structures, the only common goal is to obtain to-day information. With the management and evaluation of the updated information and data obtained, the organizations are encouraged to develop new products and services as well as to give an idea for the introduction of different markets and new investments to be made.

The accuracy of managerial decision – making depends directly on the quality of available information (Ustudy.in 2010). Namely, the quality of the information obtained and the correct management of this information make organizations' decision-making mechanisms work in the right way. The following factors play an important role in the correct adoption and implementation of decisions regarding organizational activities (Adekeye, 1997);

i. Assessment of the management team's business processes and the information they have obtained at the right time and in the right place about the doings.
ii. Ability of the responsible units of the organization to provide constant access to information resources.
iii. Evaluate the general situation of the organization with specific periods and identify possible problematic elements.

Processes involving the acquisition, evaluation and management of information have an important role in the development of effective and efficient management understanding, as well as the interaction of computers, software and human figures. In order for the organizational activities to be carried out effectively and efficiently, it is compulsory for the organizational units concerned with the access to information and the management of information to make arrangements for the identification, creation and use of information resources.

Information acquisition and management systems help to provide communication between parts of the organization as well as support decision-making processes. In organizational structures, planning, research and development and decision making processes are the primary mechanisms, and the way these processes are performed affects each unit of the organization in different ways. Information management involves the process of creating, acquiring, presenting and informing an organization with the accurate methods in the right place at the right time.

Given the innovations in information technology, artificial intelligence applications, sensor technology, and methods of analyzing information, most of the organizations integrate information technologies elements into problem-solving methods. Concepts of information systems can be reviewed in four different sections;

i. Management Information Systems (MIS)
ii. Transaction Processing Systems (TPS)
iii. Decision Support Systems (DSS)
iv. Expert Systems and Neural Networks

MIS does not have an accepted universal definition. MIS is popularly known as information system, information and decision system, computer based information system. The concept of MIS has more than one definition. The definition of MIS is, in its simplest form, “a system that collects and filters raw data from within and outside the organization, and then presents them to the managers after making them into meaningful information” (Al Mamary et al., 2014). The MIS does the job of providing communication between the components of the organization, as well as converting the raw data into information.

MIS have importance for the most important processes for organizational structures, such as planning, supervising, acting against inappreciable situations, triggering and managing change. The efficiency and effectiveness of processes and activities for information and information management are measured by the efficiency and effectiveness of the results obtained using information obtained and information management methods. The importance given to processes such as decision-making, strategic planning, and the like varies depending on the forms of management.

Processes for planning include when and how to take action. As a result of the planning activities, the acquired items also determine the policies that the organization will follow for quite a while.

To ensure efficiency and effectiveness in organizational planning and decision-making processes, MIS applications must be tailored to organizational needs and hierarchical structure. When integrating MIS into organizational processes, criteria such as decisions to be taken, how these decisions are taken, the relationships of decision makers with the organization, the position of the organization in the market and so on must be taken into consideration (Adekeye, 1997). Consequentially, organizations' desire to acquire data and information in order to strengthen their positions, there has been a significant increase in MIS techniques and MIS software.

Accordingly, different methods and applications are being tested in the management of data and information. In administrative processes, organizations need up-to-date information about the general situation. By the help of instant and up-to-date information and prompt actions and decisions taken by management staff, stakeholders, and shareholders on the execution of organizational activities and processes. Thus, they aim to both contribute to productivity and remove ambiguities.

Companies and firms follow up important issues such as their financial processes, employee performance and so on, thanks to the current reports they obtain. In this way, process improvements can be made where necessary. In addition, activities such as promotion, marketing and product-service development can be efficiently managed through the right method of managing the feedbacks received from the customer's side. The fundamental factor of organizational success is the efficient use of organizational resources.

The optimization provided for resource utilization ensures that progress and improvements are made in a well - timed manner. MIS applications and software can be changed according to usage requirements and provide data and information about activities to be performed temporarily (Nowduri, 2011). The ability to make changes to the software and applications can save a vast quantity of time and money with respect to organizational processes and activities, while increasing the organization's focus and

skill in problem solving. Some MIS applications can warrant more than one users to access the same system, database, or content at the same time. This action, which is performed by more than one user, can determine the degree of correctness of the information content and allow to do the necessary modifications (Jahangir, 2005).

Transaction Processing Systems (TPS) is a concept that covers the operational processes associated with the acquisition, storage and organization of information related to organizational structure and business. Performance measurement, trustability and consistency of information are the most important features of this concept. Transaction includes all the concepts that make it organizational and affect the way doing business. Examples of transaction concept include system order creation, product billing and similar.

TPS systems are often considered to be the same as Batch Processing. The reason for this is that more than one task is performed simultaneously in both concepts. There are two main differences between these two concepts. For TPS, the presence or intervention of a user is required while for Batch Processing operations a user's intervention is not required. TPS provides four different tasks for organizations. These can be listed as follows :

i. Storing data
ii. Regulation of data
iii. Determining and correcting missing parts of data
iv. Processing of data

The steps for the operation of TPS are as follows;

i. The relevant data is loaded by a user into the TPS application
ii. The uploaded data is processed in the relevant parts of the TPS application
iii. After the processing of the data, the TPS application stores the acquired file in the database

In TPS applications, the processing of the data is provided in two different processes :

i. Online Processing: Online Processing is based on the processing of the data concurrently with the processing. In addition, as a result of any manual changes

to the data structure, the system automatically detects this change and updates it automatically. Online Processing has a structure that separates the process to be done from the different phases and integrates these phases into different processes. As Online Processing is based on concurrency, it gives organizations an advantage in reporting and getting instant information. In addition, with this method, past transactions can also be viewed with backtracking queries. For instance, an inquiry screen can be created to review the shipping and order status for a specific date range, so that both the past order and shipment status can be examined, and drafting can be done to create a future order and shipment schedule. With the growth of organizations, increasing competition, changing customer expectations, online processing tools have gained great importance.

ii. Batch Processing: Batch Processing is based on the grouping of data and information obtained as a result of the execution of organizational activities and the use of them for organizational purposes by processing at specific intervals. Batch Processing does not require the system to remain on continuously. Even if the system is turned off, the Batch Processing elements are still able to continue running. This method is usually used when the concept of time is not important. Batch Processing applications include billing transactions made by credit card companies to their customers. Instead of getting a separate invoice for every spending the user makes, they receive a bulk invoice for each weekly period.

Almost all business processes involve a wide range of transactions, and to conclude of these transactions services and products are exchanged for money. These processes are short and can be executed continuously, ensuring that possible delays in business processes are eliminated. Organizations take care to ensure that the processes involved in the management of business and the transactions to be carried out are compatible. This type of transactions should be effective in performing important activities such as being open to authorized users only, being able to back up quickly by noticing system faults, being in constant contact with the database, and so on. Transaction processing phases can operate differently than other IT processes. Also, on platforms where too many users can access, data and transaction security are the most important criteria to

be met. There are some factors that affect the Transaction Processing stages. These can be listed as follows;

i. By developing new products or services, increasing the customer base and attracting customers.
ii. Adapt to increasing competition and create new business partnerships.
iii. Increase profitability by reducing costs.

In the world, the increasing demand for globalization is changing customer demands, and in many other sectors, especially in sectors such as health, travel, game rules have begun to change. Many basic needs require easy access over the Internet, driving competition and increasing power of organizational transaction processing.

Organizations that provide this kind of requirements, while achieving customer loyalty and succeeding in acquiring new customers, also provide high profits to investors, stakeholders and shareholders. Having a competitive advantage has always been a priority for organizations. However, the increase in globalization has also increased the competition among organizations, as well as IT and Transaction Processing activities. Organizations are simplifying their IT management and Transaction Processing activities to save time and cost in order to ensure success. In addition, improvements in IT management and Transaction Processing facilitate organizations' instant access to information, resulting in effectiveness and efficiency in decision-making. Through this platform, organizations can successfully anticipate potential risks, and successfully manage key processes such as doing business, managing future investments, and so on.

The main goal in risk management processes is to eliminate the possible risk elements with the help of obtaining quality and accurate information and managing the processes according to this information. Besides, organizations are using appropriate IT management and Transaction Processing methods to manage risk and adapt to changing processes.

IT management is also effective in reducing costs in the context of organizational processes, as well as eliminating risk factors and providing flexibility in business processes. Systems used by organizations can reduce costs for both process and process performance through the following methods;

i. Transaction-intensive tasks to be shared across different platforms
ii. Simplify integration processes with IT management interventions and spread tasks across multiple platforms
iii. Mobile solution and application development - execution of improvement processes
iv. Creation of customer-service oriented IT and process management mechanism
v. Business analysis and use of the cloud system

Customer - service oriented and knowledge management oriented IT management processes are the cornerstones of organizational and customer relationship management, especially in the problem solving processes. The element that creates value here is IT management, which provides the fastest way to find solutions to customer problems.

In recent years, the widespread use of mobile and portable technology concepts has provided great opportunities for solutions and information access to business problems. Through mobile devices and mobile technology elements, many operations are performed in daily life. For example, with the extensive usage of mobile devices and the development of mobile banking, it has become possible for users to make banking transactions via mobile devices. Organizations that integrated systems that allow multiple tasks to be performed into processes, IT management, and improvements in Transaction Processing management provide both a competitive advantage and a more effective position to solve problems.

The emerging new technologies have shown the most significant impact on IT management and Transaction Processing processes as well as organizational management patterns, business models and structures. Work on programming with the increase of mobile technologies gives significant results and accordingly the success of organizations in the value creation process is increasing.

Developments in programming, IT management and Transaction Processing areas strategically contribute to the organization's decision-making processes as well as to the following factors;

i. Use of different sources for data acquisition.
ii. An IT structure and Transaction Processing systems that have the necessary hardware to acquire and process data will not only be effective in achieving organizational success, but will also enable the acquisition and processing of unstructured data, a major challenge for organizations.
iii. Ensure the optimization of IT and Transaction Processing systems and establish the flexibility of processes on this side.

Factors such as change in customer expectations and requests, diversity and the like, also lead to changes in IT management and Transaction Processing methods. For example, cloud computing based data acquisition and processing methods provide a significant contribution to achieving organizational goals and delivering products and services to a customer or end user. The widespread use of mobile technologies has led to the change of business models and organizational structures, and it has led to the establishment of organizations operating on commercial platforms, especially on mobile platforms.

Mobile applications and platforms are also an important influence on the emerging markets. The increase in the relations of these markets with technology and the use of technological concepts in the processes being carried out makes it possible to develop both market and integration between new business models and business processes. It is obvious that the increase in the integration of mobile technologies will be effective in the formation of cooperation and new business models between organizations in the coming years.

Along with of mobile platforms and applications, mobile-based business models are emerging and the integration of business collaboration processes between organizations is made possible through operational activities and other services carried out over mobile networks and platforms. For instance, in the insurance sector, the integration of insurance accounts in different insurance companies into a single platform via mobile platforms and the execution of transactions in a single platform contribute to reducing the transaction processing costs while ensuring that companies are economized. The use of mobile platforms and cutting-edge Transaction Processing methods in business processes helps to deliver value added services to customers by adding flexibility and

dynamism to process designs. Business processes with flexibility in the structure are effective in reducing the operational costs, as well as enabling competitive advantage in many industries such as supply chain, banking, insurance and so on. Therefore, effective IT and Transaction Processing management, the design of the processes that accommodate the elements of flexibility, has a strategic significance for organizations.

In the Transaction Processing stages, the baseline reduction of the transition stages between design and modeling methods and processes based on the service and product to be provided ensures that business models and processes are executed more efficiently and effectively. Integrating business processes together and supporting these integration processes with the help of IT management and Transaction Processing processes are effective in ensuring customer satisfaction and in executing the processes in the value chain effectively and efficiently. For instance, in the transportation processes, which are one of the most important phases of logistics and supply chain management, the availability of vehicle tracking systems ensures both the transport of the transported vehicle in time and saving the material sense by creating the optimum route. This contributes to both customer satisfaction and organizational costs.

Integrating business processes and resources on a mobile platform requires the presence of predictive maintenance elements. The predictive maintenance elements have the ability to eliminate possible error elements that may occur in the system using information exchange and Transaction Processing methods. Integration of transactions requires not only the integration of multiple transactions but also the integration of processes. In the integration of processes and transactions, the integration of both information and information sources as well as elements such as people, machines and the like in the system takes an active role.

The integration of information and information resources contributes to the provision of reliable, complete information at the right time and in the right place. The integration of the right information and the current sources of information ensures that new business models formed as a result of horizontal and vertical integration can quickly acquire information in different formats, evaluate and eventually take the right actions. Decision-making processes can be thought of as having more than one choice, and as a general definition of situations where appropriate alternatives are chosen. This

definition, when considered with different perspectives, is to consider alternate situations, and to restructure them when necessary to make them ready to take action to achieve organizational goals. Scientific approaches in decision-making processes support the assessment of both the variable states and the consequences of the mappings between different combinations of these variable states (Druzdel and Flynn, 2002).

The most important factor in terms of efficiency and effectiveness of decision-making processes is the selected criterions that evaluations and different approaches are based on. In the identification of such distinguishing features, computer and software assisted systems that interact with each other provide users with the most appropriate choices. These systems are called Decision Support Systems (DSS) and are used in many areas from business management to military. DSS provide access to sources of information in order to ensure the correctness of the decision to be made, as well as optimization by making decision models on decision mechanisms.

DSS is a concept that usually saves both time and money in making decisions that have tactical and strategy remediation and that will affect organizations in the long term. Vital concepts for DSS are information management systems (IMS), modeling and simulation systems (MSS).

i. Information Management Systems : IMS is the concept that supplies, stores and processes information that is essential for DSS. In addition, it is the task of this concept to determine the faulty parts of the obtained data and repair this data with error correction codes, thus saving both time and money.

ii. Modeling and Simulation Systems : The MSS helps to achieve and optimize different results and options by evaluating the results of modeling and simulation tools. In addition, the data obtained before modeling and simulation processes are transformed into information and it is possible to interfere with elements such as interfaces and the like in the direction of the users' wishes.

In organizational decision making processes, concepts about mathematical modeling, analysis and probability theory are used effectively. Decision-making processes are built up on a stronger basis with mathematical modeling and probability theory, with gradual processes based on some axioms. Some of the variable states and concepts in

the models involved in organizational decision making processes can be transferred to mathematical equations and the effects of the decision to be made can be observed. In addition to performing tasks such as modeling, analyzing, etc., DSS also has an important position with the interface structures that users provide to users. Interface applications, which are one of the basic concepts of DSS, provide users with access to information and evaluation, as well as the ability to develop thinking and reasoning skills. User interface applications also play an active role in mathematical modeling, problem assessment, optimization of steps for problem solving processes, and selection of appropriate variables. If a system has a correct logic diagram in theory, it will be accurate to the modeling to be done and the results to be achieved. In addition, the correct understanding of the results is directly related to the fact that the applications of the user interface have a strong and accurate mechanism of reasoning and guidance. Results that can not be correctly interpreted can be ignored by the user. This may lead to a misjudgment and an organizational failure.

The theorizing and modeling processes of the decision making process are formed in multiple steps, and the operational processes in these steps must be organized in a way that will raise the user's skills and reasoning ability. User interface applications can identify the most important processes performed at decision-making stages, through modeling, evaluation concepts they have in their organizations. In problem solving and decision making processes, evaluation, method determination and problem solving logic are as important as calculations made with the existence of variable elements.

Concepts such as logic, methodology, variables and the like in problem solving and decision making play an effective role in providing innovative solution choices to problem solving and decision making processes. Mathematical equation and 2D and 3D graphics are effective in structuring problem and solution. Most DSS applications have an inelastic framework when it is desired to build problems and solution methods on a flexible modeling system. DSS concepts have a function as a bridge between the development of globalization and networking technologies and the decision-making mechanisms of different organizations, rather than within the limits of organizational structure.

Also, the structure of the decisions taken is not a single organization, but rather a multi-organization structure. The pioneers of this transformation are some technological concepts that enable cooperation and joint action. The concepts created for the decisions made by more than one organization will provide the communication between the organizations and the teams and the establishment of the technology-assisted mechanisms. Especially the existence of technology - assisted mechanisms is important in terms of communication between organizational teams, information sharing and other activities taking place efficiently and effectively. Such technologies prevent problems such as loss of time, money loss, job loss by providing support to teams and organizations, in where person interviews and meetings are difficult, simultaneous information sharing and follow - up are essential.

As the structure of the decisions made changes, decisions made with the participation of more than one individual in the individuality, organizational structures and decision making bodies are forced to form different groups. These groups work in different locations within the organizational structure and work together on information and different topics, for the benefit of the organization. These kind of groups communicate via virtual applications from different locations, not the face to face. Unlike face-to-face communication, the impact of such communications is minimal. In this type of communication between the groups possible elements of the sharing of tasks are available and the other type of information is the minimum level of sharing.

The concepts belonging to information and information technologies provide important contributions to the success of the business association processes established between organizations. Most of the technologies used in the performance of organizational processes are preferred both on the basis of diversity and the advantages that it provides to user. The usability and applicability of information-based systems is generally measured by the effectiveness and efficiency of their interface applications. Activities for the integration of systems generally involve the integration of database and information-based systems. Neural and Expert systems offer different methods for the processes of acquiring, evaluating and using information.

Expert systems are part of information-assisted systems and enable the execution of the information process. These systems fulfill their analytical actions for acquired

knowledge through of symbolic logic concepts. Expert systems are divided into 2 different groups according to the methods performed in the course of using the information. These are the first generation expert systems and the second generation expert systems. First generation expert systems are used to carry out activities related to the processing and evaluation of information, which is generally based on intuition. Methods based on intuition and experience are used in large scale in these systems. The information obtained based on intuition and experience plays an active role in determining the relationship between related processes and taking necessary actions. Today, through the various methods that come with the development of information and information technologies, studies are being constantly developed to embody knowledge based on intuition.

The second generation expert systems are effective in reasoning, processing, and establishing logical connections to information and data in a unstructured and complex situation. The expert systems are often used where information processing and reasoning is problematic. The process of information processing and reasoning in expert systems can be managed by the combination of different forms of information processing and reasoning mechanisms. Expert systems usually have a parallel and successive mechanism.

As the database to be worked on grows, efficiency and effectiveness problems can come to exist when information is processed and judged. Neural networks and systems have a processing and reasoning structure based essentially on the way the human brain works. The main purpose of neural networks is to ensure that the disintegration of information and the relationship between these parts are precisely identified. The different elements that make up the mechanism of information processing and reasoning in neural systems are defined by the tasks they perform. Elements involved in the process of information processing and reasoning can store the information in a long or short period of time. Neural systems also have the ability to learn from their own experience, that is, they can develop their skills such as problem solving, reasoning and the like based on past experiences. Neural network technologies have advantages such as self-learning, error correction, concurrent processing and so on, although there are many problems in the process of obtaining, processing, displaying, judging (Mijwel 2018).

IT management processes are an area where continuity is essential and interdisciplinary work is possible and it is necessary to assess all the factors for the continuous development of technical systems. The integration of processes and the development of each other should be ensured and the whole system should be continuously developed. The testing and verification mechanisms in the decision-making process must be continuously updated and communicated with the information sources.

4.4 ESTABLISHMENT OF SUSTAINABLE DEVELOPMENT PROCESS

When organizations implement the concept of sustainability in their processes, they are based on economic, social and cultural factors. With the studies to be carried out in the right and long term about these factors and with the approaches that will contribute in different dimensions, it is ensured to obtain success in achieving organizational targets and preventing the excessive use of natural resources and tangible assets.

4.4.1 Providing Sustainability in the Organizational Structure

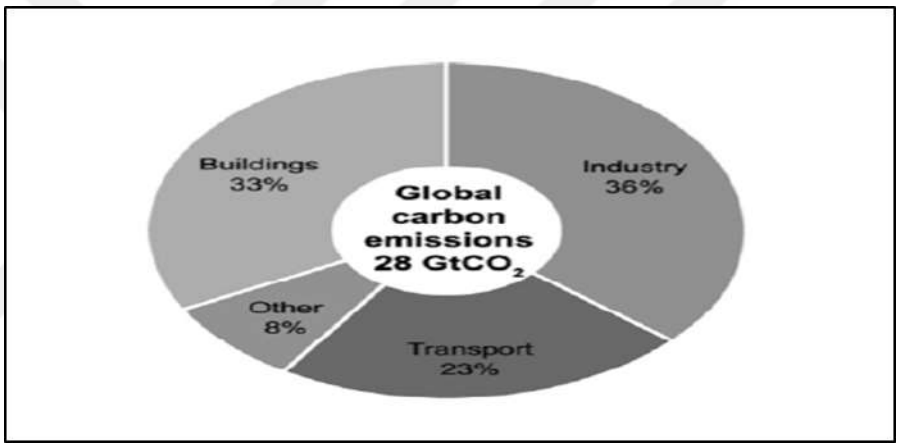
The fact that some of the factors involved in the production process have negative effects on nature and environment, are triggering concerns and views on the revision of these processes. From 1900s onwards, the use of fossil fuels and resources has increased nearly 60 times in the world today. Such examples clearly demonstrate the harm that industrial production processes have on the environment, and clearly determine consumption quantities. By 2050, production quantities in the world are projected to double increasing resource use by 50% and increasing CO2 use by 20% (Tonelli F. Et al.2013). In this sense, the areas in which industrial establishments need to work are listed as follows:

i. Reduction of carbon dioxide gas emission
ii. Energy - efficient processes in construction and production sector
iii. Reuse of industrial wastes

The resulting CO2 emissions from industrial production correspond to 36% of the world's total CO2 emissions. Regulations and sanctions applied to prevent CO2 emissions will affect sectors such as industrial production, transportation, construction and so on. More than 90% of today's industrial system products are delivered with an

efficiency and productivity loss of 10% - 15% due to the problems experienced in reaching the end user or customer (Tonelli F. Et al.2013). The famous retail chain Wal - Mart recently have launched an action to build stores under the name "environmental store" in locations such as Kansas, Lawrence. It is aimed at achieving an energy efficient position through the use of wood and concrete materials with 33% less energy than steel, and a roof and window system supported by holographic films to take advantage of the solar energy more extensively. The long-term actions of industries such as transportation, logistics and construction can provide energy use, CO2 emissions and long-term sustainability in the world.

Figure 4.6 : Breakdown of global CO2 emissions



Source : Tonelli, 2013

These actions can be listed as follows:

i. Limit and optimize the use of unnecessary energy, resources and raw materials during the production phase
ii. Reorganize forms of doing business in areas such as supply chain - logistics, construction - architecture, industrial production and so on

Taking such actions will lead to the following consequences:

i. Sustainability in an organizational sense with an energy saving of up to 25% - 30% during business processes as well as savings from materials and energy used in business processes and increase in added value offered to customers
ii. Establishing a reuse cycle by revising scrap - waste management processes

Business models include process and business changes as well as methods of value creation and value transfer to organizations (Hummel et al. 2010). Today, many businesses still consider sustainability to be only green. For this reason, before discussing why sustainability is necessary, the concept needs to be defined correctly.

Sustainability can be thought of as a social point of view that requires that every source in the world be consumed with care and with consideration for future generations. The concept of sustainability is a very dynamic concept. What's more, maintaining the continuation of something is not a spontaneous phenomenon, it depends on the multiple elements and the effort that the side has come together to spend on continuity. From this point of view, many researchers have defined sustainability as a whole of environmental, social and economic elements. It is even emphasized that sustainability in the supply chain is only possible if the intersection of these three elements is concerned. Sustainability is made up of three interconnected elements: environmental, socio-cultural and economic. These elements are the staples that will lead to some changes in the future, are unpredictable, constantly evolving and related to each other. Sustainability is a dynamic process, not the ultimate solution to a problem.

Industry 4.0 and sustainability concepts play an important role in taking strategic decisions in the logistics and supply chain processes, shaping economic activities, shaping innovation processes, shaping financial and accounting operations, and delivering end-user-customer value. Concepts such as optimization in industrial activities, redesigning processes and the like are necessary for the provision and development of the concept of “industrial sustainability” (IS). IS contributes to the world environmentally, socially and economically, based on improvements in industrial processes, optimization methods and ongoing development.

One of the basic concepts for the provision of IS is eco – efficiency. Eco - efficiency aims to optimize the resource utilization and the harm caused to the environment by changing the business processes and business models through the use of technological elements. As Eco - efficiency concept has some effects in organizational, financial and environmental sense, it provides a focus on business logic and its impact on environment when integrated into business processes and business models. In business models where Eco - efficiency methods are used, profitability and competitive

advantage are higher because less resources are used and more power and impetus as well as less profusion and contamination are generated. The concept of Eco - efficiency can be considered as a counterpart to the concept of “cleaner - efficient production and a stronger ecological balance”.

A clean environment, fewer resources and raw material use, more efficient and effective production processes, are the foundations of the IS concept. Companies seeking to contribute both organizationally as well as socially, economically and environmentally are trying to integrate the concept of sustainability into their processes. Risk factors that arise during the integration processes are eliminated in a way that is appropriate to corporate risk management. In this context, one of the substantial components in the organizational decision making process is sustainability.

Industry 4.0 provides a dynamic structure of business processes by ensuring that concepts such as interconnected processes in production, self-regulating and managing supply chain processes and the like are integrated into the organizational structure through sustainability (Prause G, 2015). Organizations wishing to implement IS should first give up their use of the environment for economic interests and integrate them into their technological development processes. In industrial production processes, the selection and processing of raw materials, processes and methods used to produce new products play a critical role in determining the amount of pollution to occur, how the pollutants are to be disposed of and how to handle them.

In order to ensure both environmental and economic sustainability in the supply chain and logistics processes where industrial production is available, information exchange between units such as sales, marketing, customer service, purchasing should be provided along with business and operation models (Skjott-Larsen and Schary, 2007). Concepts and methods such as recycling and waste utilization, regeneration, re-use must be included in the supply chain processes in order to provide and support the IS in an economic and environmentally sense. In this way, optimization in waste management, effective and efficient use of raw materials and resources, increase in recycling rates, less environmental pollution can be achieved.

Along with the effect of the concept of sustainability on the organizational processes, services and products that have emerged, some important issues have also been formed in the field of marketing. Factors contributing to marketing and valuing marketing activities are events such as increasing the life span of the products, identifying end-of-life products, destroying the environment harmlessly, subjecting it to the recycling process, and so on (Tonelli F. Et al.2013). Furthermore, the inclusion of the concept of sustainability in the organizational sense of research and development leads to proactive development on many units such as sales and marketing, customer relations, after-sales services and solutions.

The recycling methods used to ensure environmental sustainability and the cost incurred in the methods performed to ensure product reuse are also important to ensure economic sustainability. The conditions for achieving environmental and economic sustainability together are below :

i. The wider use of design products that can be transformed into different formats according to the need
ii. Perpetual optimization of recycling, remanufacturing and repairing methods
iii. Performing logistics processes in recycling, re-use, reproduction and repair operations with “green logistics” methods
iv. Using 5S (Sort, Straighten, Shine, Standardize, Sustain) techniques and managing EHS (Environment, Health, Safety)

The concept of supply chain management has become a sustainable process, with the incorporation of sustainability into organizational strategies, and the properly management of the time from when the raw materials enter the factory to when they are produced and distributed to consumers. Sustainability and supply chain is an integrated phenomenon that must be carried out in an operationally collaborative manner.

It is known that logistic costs are undeniable and even preventable in product cost. According to the IMF, logistic and transportation costs account for about 12% of world gross domestic product every year (Ballou, 2004). It is also known that about 75% of a company's carbon footprint is due to logistics and supply chain operations, pursuant to the Council of Supply Chain Management Professionals (The Council of Supply Chain

Management Professionals, 2008). Looking at both financial and environmental aspects, logistics operations need to be improved and made more effective. In a survey of CEOs of major third party logistics (3PL) companies in 2008, the five most important reasons for the creation of sustainability programs for identified companies were identified:

i. Desire to do the right thing
ii. Pressure from customers
iii. Desire to improve the company image
iv. Desire to link green customers to the company
v. Competitive pressures

In this context, implementations of supply chain and logistics management should be carried out carefully. While many businesses believe that providing sustainability is a cost-enhancing factor, it is known that the definition of sustainability actually addresses economic problems in particular. It has been observed that while environmental sustainability is being achieved in logistics operations, the performance of the environmental performance increases economically.

From transportation and logistics activities, it is known that one of the biggest causes of air pollution in the world is carbon dioxide emission, which is mostly caused by fossil fuel consumption. Carbon dioxide emissions are due to industrial processes - supply chain activities at 13%, and 87% of fossil fuel consumption takes place in transportation mostly (Le Quéré, C. et al, 2013). In 2016, the European Commission prepared an action plan in order to reduce the emissions of harmful gases by 2030 in areas where the European Union did not take actions to prevent the increase of emissions. Within the context of this action plan, the CO2 emission, which is required to reduce by 30% in 2030, is expected to be reduced by 20% below the CO2 emissions in 2005, thanks to CO2-optimized vehicles (European Commission, 2016). In the same way, eco-driving trainings are being held on the agenda, in which drivers who have come to the forefront in recent times can make both environmental and economic contributions.

In terms of warehouse and inventory management activities, it is known that logistics managers have developed better demand forecasting techniques to keep inventory down, reduced supply times, focused on freight consol- idation and tried to establish

more reliable ordering systems. The biggest reason for this is to reduce costs in order to be able to withstand the increased competition. At the same time, however, all these techniques, that is, less stock keeping operations lead to smaller storage, while less energy is consumed - cooling - heating - lighting - resulting in lower operating costs.

Green packaging is also one of the main issues in warehousing activities. Especially in the case of consumer products, the green packaging approach to be adopted jointly by suppliers, producers and distributors in the supply chain can provide significant environmental and economic contributions. Furthermore, the use of information technology in logistics management leads to the execution of all operations with fewer errors and less waste. The infrastructure is a good information technology and improves productivity both in stock management and in shipments. This increases profitability and results in an increase in customer satisfaction.

All of these underline the economic element of sustainability and indirectly contribute to environmental and social sustainability. For example, P & G, which has been listed on the world's “100 Most Sustainable 100 Global Companies” list for the past nine years in the Dow Jones Sustainability Index, publishes the biennial Sustainable Development Report on sustainability activities. According to the report, all P & G manufacturing facilities between 2007 – 2009 saved 11 percent energy, while providing 13 percent water savings and reducing waste as 30 percent (P&G Sustainability Overwiev, 2009). In addition, P & G makes operational improvements in all production stages, auxiliary plant operations and final product shipments, starting with raw material deliveries. As an different example, UPS announced that it aimed to reduce their carbon footprint by 20% by 2020 by increasing their use of alternative energy sources, according to UPS's 2013 sustainability report (UPS Corporate Sustainability Report, 2013). UPS also purchased another logistics company in North America to develop its logistics network and take advantage of its resources, thereby reducing costs and improving carbon emissions by reducing the number of full-blown trailers.

Apart from these, while contributing to the planting and growing of 15 million trees between the years 2015-2020, as another corporate social responsibility activity, UPS have given themselves the task of providing all kinds of natural philanthropy. Abuse of resources can create problems in the supply chain processes of firms with production

focus in the near future. These problems can be the increase in raw material prices, the lack of sources and the like (Preston and Herron 2016).

Organizations have recently done a lot of research on performance measurement and management. Normally, the concepts of performance measurement and management are effective in making evaluations about these issues in the performance of strategic - managerial and operational activities. Sustainability activities and actions taken by organizations are closely related to the changes taking place in social, environmental, economic and technological fields, together with the analysis and evaluation of data in these areas.

The concept of sustainability goes from the basic dynamics of the organization to the methods used such as production methods, product recycling, customer relations. Processes related to economic, social and environmental actions, which are the three pillars of sustainability, should be shared and included at all levels both within the organization and between the organizations.

The Circular Economy (CE) model that emerged in recent years appears to be a solution to the uncontrollable usage of resources and consumption madness (Blunck et al. 2017). CE is a concept that has many different approaches and these approaches differ according to their use. CE is seen as a harmonized approach in order to ensure sustainability in economic and environmental terms. It is clear that the linear economy model, which is composed of the traditional production-use stages currently in use, is not sustainable (Frosch et al. 1989).

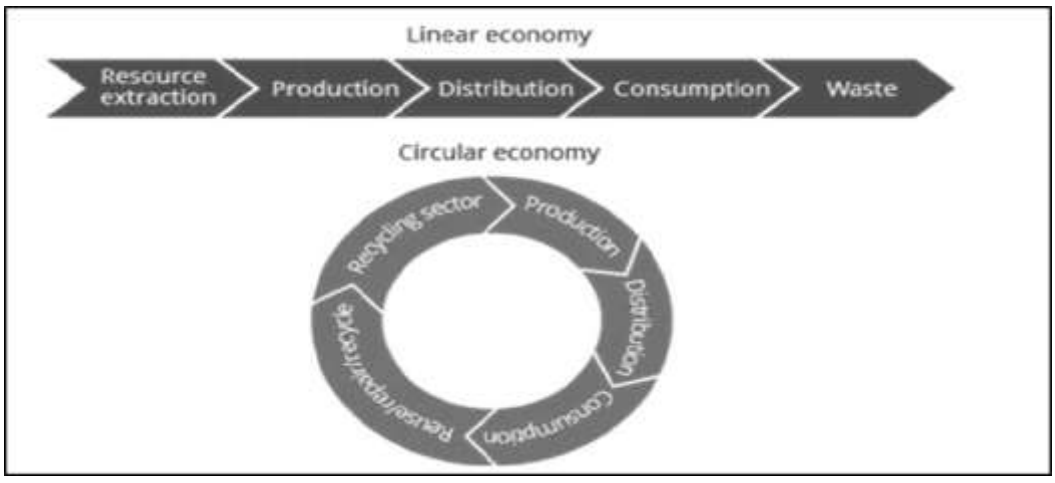
Based on CE, it includes reclamation, restoration, recycling, eco-design and low consumption. Relied on customer demands and requests, organizations can take actions to change their consumption ration with the services and products produced in accordance with the CE mentality. Value and contribution creation, as well as continuous improvement of processes, optimization of supply chain phases with the help of local production, and technology-based customized services and products, will encourage cooperation of organizations in the producer role.

It is envisaged that the CE model will contribute to reducing the urban and industrial waste rates as well as increasing the efficiency of resource utilization. When the product is manufactured by being designed so as not to cause any harm to the environment, that is, in a way that is not biologically harmful to the environment, it is one of the important purposes of the CE concept that the product does not occur after the product has reached the end of its useful life (Esposito et al. 2018). The use of diverse and varied methods in CE implementation plays an important role in ensuring the flexibility required in industrial sense and the durability required in process variations. It is not correct to say that the CE concept plays a role only in ensuring efficiency and effectiveness in the environmental sense.

Providing an environmental contribution is one of the important features of the CE, but in the general sense, maximizing the efficiency and effectiveness of an element that is in use is a fundamental goal. The CE model plays a balancing role in the performance of social, economic and environmental activities, the most important components of the concept of sustainability (Ghisellini et al. 2016).

With the quality of the material used, the innovative activities in the production system and the implementation of efficiency-effectiveness-based business models, CE can provide optimization in waste generation by encouraging the use and protection of renewable energy sources.

Figure 4.7 : Linear economy vs circular economy



Source : AkzoNobel, 2015

Establishment of facilities and production stages based on CE and sustainability ensures efficient use of energy, raw material and waste management. The concept of CE and sustainability as a holistic approach to key elements such as resources, raw materials, materials, and the like, positively impacts both cost and sustainability in terms of both cost and sustainability for organizations when considered together with Industry 4.0. The simultaneous use of CE and information technologies with the concept of sustainability provides flexibility in the production phase with less resource consumption.

With the help of IoT, sensor technology and other technologies an added value is being developed in the supply chain processes (Blunck et al. 2017). Accurate assessment of the concept of "big data" generated by CPS, sensor technology, IoT, interdependent robots contributes to the participation of CE in organizational processes, enabling organizations to increase efficiency and effectiveness rates of their supply chain processes.

With the IoT and CPS elements, instant information flow and real-time tracking of processes are possible, so that instantaneous evaluation of the multidimensional information obtained as a result of the interactions of the machines with each other and people enables fast, efficient, effective and automation-based action. Today, unlike production and business models used by organizations, circular economy has an innovative structure and aims to use natural capital with efficiency and effectiveness and to produce value throughout the life cycle of products. The following issues provide a general template for the purposes of the circular economy concept.

i. To protect and develop the flow of capital and natural building by ensuring that renewable energy sources are kept with the sources of consumable energy and raw materials
ii. Optimization at the highest level of use of basic concepts such as product, raw material, material and so on
iii. Increasing the effectiveness and efficiency of the system by eliminating all elements that have a negative effect on the system

With the use of Industry 4.0 concepts in the supply chain and organizational decision making processes, a function that meets the standards of the CE concept in general can be achieved. At this point, it is possible to meet the economic, social and environmental sustainability requirements (Stock et al. 2016). One of the important roles of the concept of sustainability in addition to economic, social and economic contribution is the effect of handing down a livable world to posterity. Organizationally, the implementation of sustainability involves a holistic approach, so the decisions to be made must take into account the whole organization.

Sustainability implementation includes many elements such as production - consumption, recycling - reuse, sales - marketing - customer service, after sales support, based on the basic dynamics of the organization. The CE model should incorporate the concept of renewable energy into this process as it is based on the principle of filling the gap between production and consumption by means of reuse, repair, recycling, and so on. The marketing, transmission and evaluation of flexible structures, which are reinforced by the enhancement of energy systems and which provide more energy flow, by the industrial herrasectors is an important activity that will contribute to the CE concept. CE is also effective in reducing global resource use, dependence and resource efficiency, as well as ensuring employment and economic growth. However, transition to CE appears to be costly for organizations. These costs stem from investments in research and development, asset investments, and the provision of digital infrastructures. For instance, the British Government states that the cost of a recycling facility to be built in accordance with CE is around 14 billion Euros. In addition, feed producers using renewable sources in Germany have had a cost of about 125 billion Euros between 2000 and 2013 (Ellen Macarthur Foundation, 2015).

Some big breaks may exist for economic growth and industrial productivity issues for organizations that are able to carry out this type of costly steps correctly. Through the transition to the CE concept, the duration of use, effectiveness and efficiency of the offered commercial services or assets can be optimized and the use of relevant resources can be optimized. Elements such as CPS, IoT, robotics and automation systems, big data analysis play an effective role in enhancing organizational performance and

deepening research and development studies, though they do not reduce costs in the process of CE implementation of organizations.

The main factors in organizations' sustainability implementations are the protection of employee rights, the provision of uninterrupted information flow among stakeholders, shareholders and employees, and the minimization of income inequality. Companies make a significant contribution to economic development and employment, balancing production and consumption, reducing the unfairness of income distribution, and so on. The implementation of the sustainability policy in companies requires a gradual set of processes. Every action that organizations and companies take to implement sustainability contributes to the long-term commitment to the realization of the main objective (Jaramillo et al. 2018).

Through negotiations and meetings between stakeholders, shareholders and top managers in the implementation stages of development and sustainability of companies, it becomes possible to implement and consolidate the decisions made during the implementation process. In addition, successful execution of the implementation process requires accurate identification of the company's value elements and vision (Bakkari et al. 2018). The implementation plan is a phenomenon that schemes companies' approach to the process and the methods they use, and it is possible to evaluate the achievement of the planned targets through regular reporting. Measures and initiatives mandated by sustainability, climate and natural resource conservation, and Industry 4.0 interlinking enable organizations to evolve supply chain structures into even wider networks, enabling the creation of digital structures for product and material procurement, enabling the monitoring of environmental impacts.

Companies must keep their goals up-to-date and retain additional options in order to achieve success and achieve sustainable environmental, economic and social success. By implementing the concept of sustainability in both organizational and social terms, it is aimed to protect the values of environmental, social and economic values and transfer them to next generations. In addition, organizations are encouraged to take action against social problems through strategically short and long term investments, training, research and development plans. With contributions from the studies on the implementation of sustainability, it is possible to save both the use of resources and the

technologies used, by making efforts to optimize the resource utilization of both organizations and societies.

5. DISCUSSION

Nowadays, the rapid growth of technological developments and the increase in globalization cause production-oriented organizations to face different problems. Factors such as minimizing length of term in production and delivery, increasing product diversity and high product class are just a few of the factors that necessitate change in the processes of organizations. Depending on the fluctuations in customer demands, changing production patterns, product variety, and the like change the characteristics of planning and operations based on estimates. Operations and planning processes that are not based on estimates and changed in terms of qualifications are usually included in the supply chain steps. The most rapid adaptation of supply chain processes and logistics operations and planning activities according to continuously changing conditions is possible with the flexibility provided by the technologies of the Industry 4.0 concept.

The Industry 4.0 concept provides flexibility with the technologies that allow real-time monitoring, control and information exchange contain within itself. With the flexibility provided, it is possible to adapt to competitive market conditions. Aiming to shape both business processes and business models with up-to-date knowledge and flexibility based on developing new technologies, the Industry 4.0 concept enables all organizational processes to be carried out from a decentralized structure, including supply chain processes, and enables personalized services to be provided.

In this study, some implications of the factors that constitute the concept of Industry 4.0 and their relevances with each other and with organizational structures and processes were obtained. In addition to the implementation of the Industry 4.0 concept for business processes and business models, examples of different areas where new technologies could be used were given.

First, the general characteristics and structure of the Industry 4.0 concept were mentioned. In addition to the organizational processes, an implementation plan has been created with the help of the method of comprehensive and methodological approach to be applied to the business models. The basic features of the implementation plan, which will increase the efficiency and effectiveness of the activities related to the design and

flow of value creation and the business processes, were identified and their main characteristics were handled with a scientific approach. In this way, a scientifically structured implementation plan concluded that the organizational structure and culture need to be changed on the basis of changing conditions as well as the need for continuous and up-to-date training on the concept of the different components of the organizational structure. Also, it is concluded that all processes regarding information and information systems management should be current and compatible with organizational activities.

Secondly, definitions of sustainability and circular economy models were included in the Industry 4.0 concept. In accordance with these definitions, the actions taken in order to improve organizational processes and to ensure the continuity of the developments were mentioned. It was concluded that the integration of the concept of sustainability into the organizational processes and business models will reach an advanced level by means of research and development activities starting with the social, cultural and economic investments of the organizations in the long and short term. In particular, it was observed that the actions taken in order to ensure sustainability in economic and social terms reduced costs and increased organizational profitability in all components of an organization.

In addition, considering the use of sensor technology and the use of cyber – physical systems, it was concluded that business processes and planning activities were both profitable and optimized. It is concluded that the approaches used in the management of the technologies of the Industry 4.0 concept cause changes in the management mechanisms and processes as well as the contribution to the organizational processes and business models.

Most organizations use horizontal and vertical integration methods to benefit from the advantages of the Industry 4.0 concept with less cost and higher profitability. Even though less cost and higher profitability lead organizations to move towards integration processes, sometimes horizontal and vertical integration activities can also harm organizations. In this context, it was deduced that horizontal integration activities can turn into a monopolistic understanding and cause unfair competition to turn into a legal problem for organizations.

Finally, the implementation of Industry 4.0 and the transformation movements of organizations in this context on their own process and business models will have significant and profitable results in the near future. It is essential that investments in information technologies take place on the basis of activities carried out for this purpose. Due to the right investments based on the management of information technologies, the sustainability of success in products and services as well as in customer-oriented activities will be ensured. Most of the organizations that adopt and implement the concept of Industry 4.0 today have a structure that correctly recognizes the technological developments in the past. In addition to carrying out new tasks related to change and transformation within the framework of the Industry 4.0 concept, these organizations also attach importance to studies for improving efficiency and effectiveness in business processes, especially in the production area.

6. FUTURE RESEARCH AND RESULTS

The main purpose of this thesis is to shed a light on the technologies, areas of application and implementation process of the Industry 4.0 concept. The implementation method which is the subject matter of the thesis, has been revealed based on a valid approach for all companies, not only for companies specialized in certain areas. Companies that want to cope with today's competitive market conditions and changing demands and want to maintain their strong presence in the market are striving to understand and implement the Industry 4.0 concept. Technological elements such as IoT and Big Data, which are part of the concept of Industry 4.0 and which have many commercial characteristics, contribute to all organizational components besides supply chain management.

By enabling the virtual design of the processes and facilities, it is foreseen that a structure that enables the realization of processes that can carry out autonomous processes by activating the instant information collection and evaluation mechanisms will decrease the cost and increase the profitability as well as increase the efficiency. Considering profitability, efficiency and productivity growth, the Industry 4.0 concept can be considered as a perfectly functioning modernized and integrated system.

For the factors such as profitability, efficiency and increase in productivity, the obscurity in the depreciation period of the system and the economic concerns cause the organizations to have some prejudices about Industry 4.0. In addition, organizations that want to implement the Industry 4.0 concept have an accumulation of lack of performance of interactive management methods, which is a different factor that complicates the process. The most effective elements that may hinder the implementation process can be considered as providing adequate staff in terms of management concerns, economic - financial problems and education. Such negative factors require a serious preparation process for most organizations in advance of the implementation process. Apart from the economic problems, the work processes and work areas equipped with the new technological infrastructure create trained and technical personnel with high technical skills.

Different implementation methods and approaches presented within the framework of Industry 4.0 also inspire different approaches and methods that can be developed in the process. In the installation of virtual facilities, the business processes and business models to be equipped with high-tech elements, to increase the efficiency of the value chain, this work can help managers about strategy and operational activities. It is doubtless that the correct predictions about the Industry 4.0 concept will contribute to the performance of the transition processes and change management processes with the least roughness.

The framework contained in this study may be a starting point for future research. Along with the different processes that can be added to the implementation method, the sustainability and circular economy models, which are seen as new concepts today, can be combined with Industry 4.0 to reveal new approaches that can be used by organizations to increase productivity. In addition, mathematical modeling and performance measurements to be performed before and after the implementation period can be used as an indicator of the success and efficiency of the organization. At the same time, improvements to the Industry 4.0 model implemented on the basis of constraints and activities to increase sustainability can be a focus for future work.

As regards the orientation and training of employees who will implement the processes for the Industry 4.0 concept, studies based on concept and human resources activities may be a research and development topic in the future. In addition, the studies which will minimize the environmental damage of the supply chain processes of the production-oriented organizations are among the future research activities within the Industry 4.0 concept. In general, business processes, business models and qualifications of employees will undergo a radical change in the near future due to the impact of the Industry 4.0 concept. Hence, both academicians and business executives need to examine the interactive relationships of topics such as sustainability, human resources management, supply chain management and so on with new technologies and concepts in order to bring forth new research topics and manage the change and transformation management processes in organizational structures in the future.

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