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Ticaret Anonim Şirketi Örneği

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The Impact of Industry 4.0 Applications on Production Processes: The Case
of Bosch Industry and Trade Corporation

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Öz

Henüz çok yeni bir kavram olmasına rağmen Endüstri 4.0 uygulamaları giderek yaygınlaşmakta ve özellikle üretim süreçlerinde etkilerini göstermeye başlamaktadır. Bu çalışmada Endüstri 4.0 uygulamalarının Bosch Şirketi'nin üretim süreçlerine etkileri derinlemesine mülakat yöntemiyle incelenmiştir. Bu firma Endüstri 4.0 Devrimi'ni uygulayan öncü firmalardan biridir. Endüstri 4.0 uygulamalarının iş geliştirme, verimliliğin artırılması, kaynak kullanımının optimum seviyede tutulmasını, süreç akışlarının hızlandırılması, maliyetlerin düşürülmesi konularında olumlu yönde etkileri olduğu belirlenmiştir. Tedarik zinciri yönetiminde kullanılan yazılımlar sayesinde Endüstri 4.0 uygulamalarından önceki dönemlere göre hata maliyetinin düştüğü, insan faktöründen kaynaklanan hatalarda azalma olduğu ve elektronik süreçlerin duraksamadan ilerlemesinden dolayı zaman tasarrufu elde edildiği tespit edilmiştir. Tedarik zinciri yönetiminde kullanılan uçtan uca yazılım ve donanım destekleri sayesinde tedarik ve sipariş teslim sürelerinin düştüğü saptanmıştır.

Anahtar Kelimeler: Endüstri 4.0, Üretim Süreçleri, Üretim Yönetimi, Tedarik Zinciri Yönetimi, Toplam Kalite Yönetimi

The Impact of Industry 4.0 Applications on Production Processes: The Case of Bosch Industry and Trade Corporation*

Abstract

Although it is a very new concept, Industry 4.0 applications are becoming more widespread and especially in production processes. In this study, the effects of Industry 4.0 applications on the production processes of Bosch Company were investigated in depth. It is one of the pioneers in implementing the Industry 4.0 Revolution. It has been determined that Industry 4.0 applications have positive effects on business development, increasing productivity, keeping resource usage at optimum level, accelerating process flows and reducing costs. Thanks to the software used in supply chain management, it was found that the cost of errors decreased, errors decreased due to the human factor and time savings were achieved due to the progression of electronic processes without hesitation. Thanks to the end-to-end software and hardware support used in supply chain management, it has been found that supply and order lead times are reduced.

Keywords: Industry 4.0, Production Processes, Production Management, Supply Chain Management, Total Quality Management

1. Industrial Revolutions and Industry 4.0

There have been many developments in the field of industry throughout history. The start of industrialization coincided with the mid-1700s. Starting from this date and passing through various stages industrialization has turned into Industry 4.0 today.

The first productive revolution took place in the field of agriculture. The first social radical change has been experienced with the commencement of agricultural production of societies that have moved

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from nomadic life to settled life. The first industrial revolution after this transformation was the First Industrial Revolution, which was called the Steam Age between 1750-1890. The reason why this period is called the steam age is that James Watt's invented steam engine gives a new direction to production. In this period, wide-scale developments were experienced in the weaving industry and metallurgy, and with the increase in steel production, the shipping and railways industries took their place among the developing sectors (Bulut and Akçacı, 2017: 52).

The industrial revolution first appeared in England and then spread to Europe. In this process, Europe provided cheap raw materials from Africa and Asia and used these raw materials in production. Telegraph, telephone and railways facilitated the establishment of large factories and businesses. The establishment of large factories made it compulsory to examine the management of these factories and to investigate efficient working methods. Taylor introduced the principles of scientific management during this period (Dilek, 2007: 206).

At the beginning of the 20th century there was a need for renewal in the industrial area. The increase in the importance of fossil fuels, the improvement of transportation areas, the great innovations in communication and the use of electricity have given a new impetus to the industry. Although it varies according to many sources, the generally accepted date range for the Second Industrial Revolution is between 1870-1914. Together with the effects of the First Industrial Revolution, the building blocks of the transition period to the Second Industrial Revolution are facilitation of easier access to distant markets and easier delivery of desired products with the effect of developing railways. Together with all these developments, the changes in the energy resources used and developing technologies constitute the foundations of the second industrial revolution (Pamuk and Soysal, 2018: 42).

While the effects of the First Industrial Revolution were observed in iron and steam engine technologies and in the textile sector, further developments were achieved in the steel, railways, petroleum, chemical and electrical framework with the Second Industrial Revolution. In addition, the use of energy resources, science and technical innovations

for the first time enabled the creation of high-energy societies producing mass production. The Second Industrial Revolution can also be defined as the birth of a new era of information with the spread of communication systems such as telegraph, telephone and radios (Schlötzer, 2015: 2).

Factors forming the basis of the Third Industrial Revolution began to emerge after World War II. Innovations have emerged in the realization of computers, nuclear activities, genetic science and similar subjects. Rapid developments in information technologies constituted the core of the Third Industrial Revolution. Developments in information technologies have increased along with the increase in the information sector and the spread of the internet, allowing for a cost reduction approach in product production. This period, which was later called the Digital Age, became a period in which certain sectors came to the forefront (Özsoylu, 2017: 43).

The Third Industrial Revolution has affected the development of communication with new information systems, and the effective use of these technology systems and developments in the industry, as well as the acceleration of transportation systems. On the other hand, with the rapidly growing technological and environmental impacts, competition in the world has gradually increased and this has enabled the start of the process of Industry 4.0 with the use of appropriate methodology, programming and information systems (Görçün, 2017: 138).

1.1 The Emergence of the Industrial 4.0 Revolution

At the beginning of the 2000s, high technological developments gained momentum and led to the shift of industrial power from west to east along with cheap production. Countries such as China and India, which can provide cheap labor and raw materials, have started to have a voice industrially. On the other hand, Germany organized Messe 2011 Fair, one of the largest industrial fairs in the world, in order to prevent future problems in the industrialization scene.

The concept of Industry 4.0, the New Industrial Revolution, first appeared at the Messe Technology Fair. Later in 2013, Germany prepared an action plan covering the adaptation process to the new industrial revolution on a government basis and announced to the

world. The aim of this fair is to introduce advanced or emerging industrial technologies to the participants. Although the new industrial revolution phenomenon first appeared qualitatively at this fair, the content of the fair is already composed of some Industry 4.0 concepts. Concepts such as Industrial Automation, Movement, Transmission and Automation, Mobile Technologies, Digital Factories, Micro-Nano Technologies are the main topics that constitute the content of Messe Fair (Mess Hannover Messe ", 2011).

In this fair, Industry 4.0 has found its place in industrial technologies and innovative approach and has made a great impact. Industry 4.0 was formed by a working group and presented to the German government authorities and officially accepted and became one of the official projects of the German State in the industry after its name was announced at this fair.

Thus, the new industrial revolution which encompasses the production of smart services and products, smart factories, the Internet of Things and many other innovations such as blending the information systems with the traditional production methods was put into practice (Aydın, 2018).

Klaus Schwab (2017: 11) stated that Industry 4.0 does not resemble the pioneering industrial revolutions of mankind in terms of its scale, scope and complexity, unlike the three previous major industrial revolutions. Schwab based this difference on three reasons.

Speed; He described this industrial revolution as a rapid development rather than a linear development compared to the first three revolutions, and stated that each innovation was supported by another innovation in a short time.

Width and Depth; It emphasizes that the fourth industrial revolution has risen on the digital world. It is the combination of a wide range of technologies in the fields of finance, business, society and individuals. System effect is the systematic transformation of these three factors among companies, sectors and societies.

Brynjolfsson and McAfee (2016: 12) called the Fourth Industrial Revolution, the Second Machine Age, referring to the innovations and

influences of the third industrial revolutions, and supported this definition with two main elements. The first is that computers will continue to evolve and bring out unmatched innovations that have never been discussed before. These innovations suggest that the machines will create new environments with all their power. The second element is that consumption and production will produce diversity and difference in a way that has not been discussed before. The volume and type of consumption can be increased in this period and thanks to new technologies, the economy and industry can reach a better position.

This new industrial revolution encompasses a new generation of flexible production, convertible factories, customer-centric solutions, optimized logistics networks, data usage and the use of renewable resources. Industry 4.0 Platform (Industry Industrie 4.0) has defined Industry 4.0 as intelligent machinery and processes for industry that are used with the support of information and communication technologies (“Platform Industrie t, ty.).

However, the Federal Government of Germany has defined Industry 4.0 as a structure supported by Cyber Physical Systems, which have high levels of automation enabling automatic exchange of information and the existing information and communication networks are used extensively (Vaidya et al., 2017: 234).

According to many scientists and businessmen, industrialization, which gained a new form, has started to be effective in every field of life just like other industrial revolutions. It constitutes an observable asset in commercial areas, economy and social life. From portable electronic platforms to mobile applications, from self-generating systems to intelligent machines that can operate without human impact, many innovations are emerging in Industry 4.0.

1.2 The Main Concepts of Industry 4.0

Following the developments such as the use of electricity, mechanization and computerization, with the development of the communication network that enables the interaction of physical objects called the Internet of Objects and Services with each other, today's industries have progressed towards a new industrial revolution. In this

industrial revolution, which is also called Industry 4.0, it is foreseen that companies can easily communicate with their machines, storage systems and resources. The machines that are called 'smart' are able to adjust themselves and switch on and off as needed. Smart factories, already in use, have brought a new approach to production together with smart machines. In this way, smart products are produced. These products are highly customizable, positioned under all circumstances and at any time, and are able to create new alternatives to meet needs (Papadopoulou, 2014: 10).

This industrial acceleration, which emerged with new needs, brought along new concepts and new inventions. These new production technologies aim to make faster decisions, keep production at appropriate values, and at the same time produce meaningful data that can be used in the future. These technologies, which are used in production, produce their own data and provide accurate data transfer to employees as well as managers and other devices.

In his book *The Fourth Industrial Revolution*, Klaus Schwab (2017: 23) described the basic concepts of Industry 4.0 as "Megatrends". The Megatrends concept represents the aforementioned complex and interactive advanced technologies. According to Schwab, megatrends are the driving forces of the new industrial revolution. Schwab divided these trends into three main categories: Physical, Digital and Biological. Physical trends are 3D printers, autonomous vehicles, advanced robotics and new materials. Physical megatrends are easily visible because they are tangible. Digital trends can be explained as the transfer of virtual environment to physical environment and physical environment to virtual environment through internet, sensors, receivers and actuators. Biological megatrends represent the use of industry's new inventions in biology studies. Studies, such as gene sequencing, gene activation and gene regulation, which were costly and long lasting in the past are reduced to less than a few minutes and a thousand dollars with the help of biological megatrends.

1.3 Advantages and Disadvantages of Industry 4.0

The Industry 4.0 revolution has brought along many positive and negative effects. Similar situations have taken place in every industrial revolution that has taken place. As a result of the change in the existing order, new concepts have an impact on all aspects of adaptation and innovation processes.

One of the most important advantages of Industry 4.0 is that it creates a large increase in efficiency and productivity by creating low costs. With the systems it has developed, it has minimized human intervention and created the concept of unmanned manufacturing by eliminating human-induced errors. With the system and manufacturing units on the production line, it saves time and creates energy efficiency. It makes all processes realized in enterprises simple and understandable and provides easy observation. With fast and high talent works, performance is increased in production and as a result, errors are minimized and customer satisfaction is also positively affected. With these positive effects of Industry 4.0, value creation processes become more efficient and productive. They lead to great opportunities all over the world.

Foreseeable threats and adverse situations for every new concept are also present in Industry 4.0. One of the major disadvantages of the Industry 4.0 concept is data security. The concept of security can pose great hazards and problems in the smallest exposed area. From a broad perspective, implementation may be difficult in small enterprises. Mechanization and unmanned production can create unemployment in jobs that require medium level skills. However, when we look at the adaptation process, it appears that it has created new business areas.

Another negative impact is the high need for higher knowledge and higher education as it is a high technological revolution. Within this framework, it is necessary to ensure that societies are more developed and knowledge-based. In this case, it will be possible for developed countries to adapt more easily to Industry 4.0 and to have an important role in the manufacturing sector, and in terms of industry, countries that have not yet completed their second or third industrial stages will be lagging behind.

2. Industry 4.0 Applications at Bosch

In this study, the effects of Industry 4.0 applications on the production processes of Bosch Company were examined with the interviews conducted. In-depth interviews were answered by a Production Engineer in charge of Industry 4.0, a Project Engineer, a Senior Production Engineer and a Production Engineer at Bosch Bursa Plant.

Bosch Turkey is one of the leading companies in the industry 4.0. Industry 4.0 and related organizational activities that they started in 2014 continue today with international projects. For this purpose, necessary projects have been developed and implemented gradually. In the selection and implementation of these projects, compliance with the Digital Bosch Digital Transformation Strategy,, QCD (Quality - Cost - Delivery) and the target of being the leading technology company in the sector are prioritized. Cycle time tracking which enables early intervention in production lines, predictive "maintenance application with smart touch tablet support in maintenance area, use of robot in transportation area, RFID-Radio Frequency Identification in finance area, parts tracking of production machines in product line, smart sensor data collection is provided in all areas of the factory.

The interviewees stated that Bosch's production systems are called Bosch Production Systems (BPS). The production engineer, who was among the interviewees, stated that the production systems were designed in accordance with the principles of Lean Manufacturing Approach, that the same system was used in all Bosch plants and that all plants had the same standard. The project engineer stated that BPS is designed to provide the most accurate response to customer demands, that the production lines can be adjusted according to the differences in demands, and that the goods can be produced with different qualities on different bands. The Project Engineer stated that Bosch highly values Industrial 4.0 applications and that many new technologies are used in the development of production processes. These technologies include smart robots, Internet of Things, sensor systems, and Cloud

Computing. Senior Manufacturing Engineer stated that Industry 4.0 applications used in production have an important role in providing customer oriented service and production.

Industry 4.0 technologies are applied not only to the machines in production, but also to almost all departments in the factory. However, the projects directly increase productivity in manufacturing machine according to the Sustainability Report published by Bosch in Turkey is provided, and thus delivery units are also kept at the highest level ("Bosch", 2015). In addition, projects in maintenance areas aim to eliminate unexpected incidents and reduce certain maintenance costs.

In addition, according to the authorities interviewed, the robots used in some locations are delivered to the required place just in time. These smart robots, which are now widely used in production lines, are also planned to be used extensively as logistical support.

Within the scope of Industry 4.0 Projects, data collection is possible in many areas of the factory. For example; data collection sensors working within the scope of Cyber Physical Networks will collect and transmit data to the required unit such as determining the service life of worn parts, and great support will be provided for the supply or storage of the spare part. Furthermore, these Cyber Physical Systems used in the factory environment play an important role in detecting environmental conditions, preventing transport damage and intervening if there is a negative condition. In the near future the company will be able to collect data from very old machines that cannot adapt to Industry 4.0 applications by integrating these and similar Technologies.

Bosch uses SAP-based software called NIV Plus where internal communication is provided, Industry 4.0 applications can be informed of all data, previous production data is kept, analyzed, production records are recorded, inventory management is done and product input and outputs are kept. This software is used at Bursa plant of Bosch Diesel and Gasoline Systems' which is the subject of this research and provide access to and monitoring of production processes, stock information, material information in Bosch plants all over the world from a single point. On the other hand, these systems provide the opportunity to reach the right person, to reduce communication times,

to process the correct data and to intervene in the event of error, damage and deviation early without loss of information.

Big Data and data mining are also used in the factory as an important part of Industry 4.0 applications. These applications are used in performance and efficiency analysis in production, error cost issues.

2.1 Effects of Industry 4.0 Applications on Production Processes

During interviews at Bosch, the most important impacts of Industry 4.0 applications were on supply chain, production system, resource planning and inventory management, process management and total quality management. These effects will be explained deeply.

2.1.1 Effects of Industry 4.0 Applications on Supply Chain

The interviewed production engineer noted that the NIV Plus software, which was customized for Bosch by the SAP software company, was designed to supply raw materials from suppliers and stockpiles, and then forward them to production lines when they are due. This software was designed to help customers to keep stock occupancy rates at an optimum level by informing suppliers of reductions in real-time notifications. The Project Engineer in charge of Industry 4.0 said that the management process can be easily managed from a single point on a single device, as it enables the management processes of the software integrated into the supply chain to be fully monitored electronically. Compared to the previous working principles, the fact that these processes are carried out in electronic environments reduces the likelihood of causing an error in factors except the human factor. In addition, since the product information of the raw material, which needs to be supplied, has previously entered into the NIV Plus program, it is provided to the suppliers without requiring any process. It is also stated that due to the fact that the information about the raw material is used in the production of which product, for which customer it will be produced and which features it should have, exists on the system, the faulty and wrong order rate decreases to a great

extent. Common opinion of the interviewees is that the necessary product is provided without loss of time and this has positive effects on time saving and increased employee productivity.

2.1.2 Effects of Industry 4.0 Applications on Supply Chain

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2.1.3 Effects of Industry 4.0 Applications on the Production System

During the interview with the senior production engineer, it was learned that almost all of the machines used in production systems

were integrated into Industry 4.0. It is stated that human intervention is minimized in production lines equipped with Industry 4.0 technologies but still unmanned production is not performed. It was underlined that one hundred percent unmanned production has not yet become widespread in the world, and that it will take a long time. It is stated that after the integration of new technologies, human-based errors are reduced and the personnel who previously worked at the machine are assigned to other units which are not automated yet or not fully automated, and the loss that may occur in terms of human resources is eliminated. At this point, one of the most controversial issues of Industry 4.0, “fully mechanized workforce” is prevented from causing a loss of motivation among the personnel. Other discussions on the effects of Industry 4.0 applications used in production systems have addressed the exchange of data between robots and machines used in production lines. The technologies used in the production systems were recorded to allow the transfer of data between the two machines.

For example, it is decided to transfer the data under which conditions to the next station during the phase of the product coming from a station which is welding with high precision, to the next station and and to what extent the process should be performed. The Production Engineer stated that this process reduces the error cost due to not entering the data manually. In addition, the laser devices on the raw material that will be put into production are read by means of the imaging devices used during production and all stations in the band are ready to be prepared for the process. The interviewees stated that this process allows for fast and flexible movement capability in large batch production. In the event of an error in the production of the data received from the display devices enables faults or faulty products to respond quickly, flexibly to move easily. In addition, the intelligent robots used in the production identify the raw material flowing on the belt and direct it to the station where the necessary process will be performed. This ensures uninterrupted line flow.

2.1.4 Effects of Industry 4.0 Applications on Resource Planning and Inventory Management

The Production Engineer said that the idle time was eliminated due to resource planning and inventory management operations being managed in a closed loop, thus saving time and increasing efficiency. In addition, Industry 4.0 applications ensure that if a directed inventory for production drops to certain levels, it is supplied from suppliers through sensors and automation systems. In this regard, the Production Engineer in charge of Industry 4.0 stated that the purchase of the missing price was achieved without the need to prepare a new offer for the pre-determined standard price, since the decreasing quantity was easy to detect and the order to be given to the supplier was already known. The decrease in prices was also favorable due to the decrease in wholesale purchases. The project engineer stated that with the use of NIV Plus programme, resource planning can be done in real time with production, and which resources will be planned and how much stock will be used for production can be determined. All of these transactions are kept in large data pools and stock and resource plans can be made for the future. Many manual operations can be performed in a more controlled manner by eliminating errors and deficiencies thanks to these applications. These systems also provide support for production planning and provide reliable information for managers to make critical decisions.

2.1.5 Effects of Industry 4.0 Applications on Process Management

In the interviews, it was stated that the processes that were previously managed manually or with less technological support could be managed more effectively and efficiently after the transition to Industry 4.0 applications. The fact that processes can be carried out from a single point via cloud systems and automations without the need for extra operations has a positive effect on the cycle speed of the processes. In addition, many issues such as production data, error and fault information, parts information, production personnel information, inventory input-outputs, supply chain management, logistics management have become available to be managed from a single point by producing interactive and real-time data.

2.1.6 Effects of Industry 4.0 Applications on Total Quality Management

In the interview with the Production Engineer Responsible for Industry 4.0, he stated that in terms of Total Quality Management, Industry 4.0 applications provide higher quality production and services at lower cost than the old applications. In this regard, Senior Production Engineer stated that automation systems used in production processes are an important step in making the faulty production visible. In this way, faulty products are detected before they reach the customer. The point that interviewees frequently dwell on is; the fact that the Industry 4.0 applications allow continuous improvement ensures that the quality standards are always raised both in the pre-production processes and during the production processes and in the sales and after-sales phases of the product. Q-Team Error Reporting System, which is designed as Process Tracking Systems, supports the immediate intervention of the errors, and detects the faulty product by means of the applications tool and provides the necessary unit to be sorted out and to reproduce the missing goods due to the error. Thus, the number of faulty products reaching the customer is kept at minimum level and customer satisfaction is maintained at the highest level. In addition, this system allows to control all actions in production by storing them in data. In the controls, it is possible to determine which machine makes a mistake in which product and thus, necessary measures can be taken within the framework of quality controls.

2.2 Advantages and Disadvantages of Industry 4.0 Applications

In the interview, the Project Engineer stated that there are certain disadvantages as well as the advantages of switching to Industry 4.0 applications. The Project Engineer state that the advantages of Industry 4.0 applications are: New technologies applied in production processes are simplified the steps taken in line with the targets, prevent loss of time, decrease in error costs, increase in the product produced in unit time, faster and flexible interventions to errors, easy integration between the units in the workflow processes. Industry 4.0 applications have also some disadvantages. The investment costs are high due to the fact that Industry 4.0 is still very new. It is not easy to provide spare parts as high technological products are used. The number of technical

personnel is not adequate to fix technical errors. The opinions of the Production Engineer in charge of Industry 4.0 on this subject were mostly on human resources on technical issues. The interviewee stated that the resistance of the technological change experienced in the business processes by the personnel and the lack of the desired level of personnel training and training material in this regard are disadvantages of the Industry 4.0 applications. Senior Manufacturing Engineer stated that the most important advantage of Industry 4.0 is that data storage, reporting, communication, breakdown interventions and logistic support can be obtained without the need for manual inputs.

2.3 Contributions of Industry 4.0 Applications to the Solutions of the Company's Problems

Production Engineer stated that they can be informed about the processes that will be made and problems, losses, constraints or disruptions with the help of the Early Warning System yield points to be able to have information. The production engineer in charge of Industry 4.0 stated that thanks to the warnings received from the part replacement time in advance about the part replacement requirements of the robots used in the production, the production lines were informed without stopping, loss of time, production and money, and this application was done by stopping the bands during certain maintenance periods before. Senior Production Engineer stated that solutions are produced for negativities in the production areas and in the office environments caused by the human and environmental factors. These automation systems provide solutions both for facilitating the work and for standardizing the generated message, for example the person can select the information by means of the codes on the screens instead of typing them by hand. On the other hand, the Project Engineer stated that the robots, which provide logistic support used in some locations within the factory, provide solutions to reduce work accidents to a certain extent. In addition, these robots can provide a solution against these negativities by realizing the danger situations such as slippery floor and step that cannot be easily noticed by individuals in the factory environment.

2.4 Factors for Success of Industry 4.0 Applications

The Production Engineer Responsible for Industry 4.0 answered that there are two different requirements for what they need for company success in the integration, use and dissemination of Industry 4.0 applications. The first is preparation and infrastructure for both mental and personnel training, and the second is technical investment. The interviewee explained these requirements as follows; The first requirement is to convince staff that Industry 4.0 applications are not a threat, but an opportunity to facilitate their work in all areas and to simplify workload and mixed processes for both the company and the worker. The second requirement is to allocate more capital and accelerate the integration processes, to invest more in infrastructure and to establish support units with technical competence. The views of the Manufacturing Engineer on the same issue have been to optimize some of the procedures that go through the managers' wet signature approvals to electronic environments using more information technology. The Senior Manufacturing Engineer stated that Industry 4.0 integrations should be performed faster, using less simple software, and systems that allow automated data analysis. This will shorten the reporting periods and ensure the reliability of the reports. On the other hand, the Project Engineer stated that Re Quick Reaction Modules should be used in order to solve the problems in the processes as soon as possible.

2.5 Future of Industry 4.0 Applications

The interviewees stated that Industry 4.0 applications have affected every process that has been experienced in the factory so far, and that these effects have positive effects in line with company targets and strategies. The Project Engineer stated that in the future, the factories will be integrated with each other at a rate of one hundred percent through the Internet of Things. Bosch plans to make all of its systems and processes compatible with Industry 4.0 in 2019-2020. the company officials stated that in the future the data update and verification times

will be reduced to a much shorter period In this way, and they will reach higher efficiency and quality ratios.

Conclusion

The structure, prevalence and frequency of use of the technology, which was previously only directed by human beings, has changed completely today. This change has made technology a part of the daily life of individuals, has become the unchangeable assistant of the workplace and even has the ability to do business without human intervention. High technology, which was previously only available to entrepreneurs with certain budgets, has reached a point where all enterprises can reach with the steps taken since 2000s and the infrastructure developed. However, the continuous change and advancement of technology has created necessities such as sustainability, more prudent use of resources, lowering costs in many sectors and even for the governments and has brought the concept of competition to a different dimension.

In order to meet all these requirements, Industry 4.0 was introduced in Germany as a new roadmap in 2011. The fact that Industry 4.0 is called as the 4th Industrial Revolution by various circles causes this concept to become a concept frequently used by sectors and academic circles in recent years. Based on the elements contained in Industry 4.0, it is seen that it is very different from the previous industrial revolutions. Industry 4.0 applications include software that improves human-machine compatibility, Internet of Things that enables machine-machine communication, intelligent robots that perform fully autonomous operations, Cyber Physical Systems that can obtain media data, 3D printers, Cloud Computing which enables data storage, processing, analysis and Big Data.

These concepts take their place in industrial activities first with a slow and then rapid expansion since the day they emerged. "Production Processes, which are one of the main elements of enterprises, has been the area where the first effects and results of the revolution were obtained on an industrial basis like other industrial revolutions.

German originated Bosch company in which the study was carried out is a pioneer in the world in the fields of technology and production. The company is also in a position to lead other businesses in Industry 4.0

applications. In all of its factories around the world, Industry 4.0 has been implemented as a company policy and strategy.

In this study, the effects of Industry 4.0 applications on production processes are examined in depth. It has been determined that Industry 4.0 applications have positive effects on business development, increasing productivity, keeping resource usage at an optimum level, accelerating process flows and reducing costs.

Thanks to the software used in supply chain management, it was found that the cost of errors decreased, errors decreased due to the human factor and time savings were achieved due to the progression of electronic processes. Thanks to the end-to-end software and hardware support used in supply chain management, it was found that supply and order lead times were reduced.

It has been found that Industry 4.0 applications used in production systems are not completely unmanned and therefore human factor is not reduced to zero. However, robots and high-tech production lines have minimized human intervention. In this way, it is avoided that the employee conducts erroneous transactions caused by human behavior (thoughtfulness, carelessness, ignorance, fatigue). This reduces the likelihood of staff making mistakes. It has been determined that the autonomous devices used in production have been adjusted once and there is a decrease in wasted time in production and production figures per unit time have increased.

The data obtained from inventory management indicate that stock levels can be kept at optimum level with the use of Industry 4.0 applications. There is no more need for new order proposals with the ease of defining stock shortages. This allows for the advantage of wholesale order discounts by allowing purchase at the predetermined price instead of receiving individual prices for the missing goods. This advantage allows a positive reduction in the cost of raw materials. In addition, the reports, data and analyzes provided by the data collection tools used in stock management, supply chain and resource planning have had a positive effect on managers making more reliable decisions in critical decision stages such as production planning.

In all production processes, the ability to intervene from a single point through cloud systems and automations has a positive impact on the flow rate of the processes. However, although the electronic environment has a positive effect on the flow of hierarchical approval and signature procedures encountered in the processes compared to the past, these procedures still take some time.

In Total Quality Management, the faulty product data obtained through the Q-Team program and the robots integrated into this program help to intervene in the faulty product during production. This resulted in a positive decrease in the number of faulty products to the customer. Customer satisfaction increased inversely with incorrect order deliveries.

Industry 4.0 applications used outside the production processes, have positive effects on the standardization of the way people work, the reduction of complex methods used in the business, the elimination of the lack of communication, the flexibility of team planning, the reduction of office expense costs, making reliable referrals, fast and easy data from a single point the decision making and the appropriateness of the decision.

In this research, it has been found that Industry 4.0 applications have some disadvantages for the company. These disadvantages are the high cost of spare parts and maintenance and repair of high-tech manufacturing products, supply chain, stock management, resource planning systems, robots and precision imaging devices due to the fact that applications are not widespread all over the world, high initial investment cost, high level of personnel resistance of the newly introduced devices, machines and automation systems.

Industry 4.0, which is based on providing technological solutions to the needs of industries, is becoming increasingly widespread today and demonstrating sensible effects. Looking at the historical effects of industrial revolutions, it is clear that Industry 4.0 will be one of the cornerstones of this issue in the future.

Kaynakça

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