International Journal of Commerce and Finance, Vol. 4, Issue 1, 2018, 84-95

HOW INDUSTRY 4.0 CHANGES BUSINESS : A COMMERCIAL PERSPECTIVE

Ayşe Göksu Özüdoğru, Esra Ergün, Djihane Ammari *(Ph.D. Students)*

Istanbul Commerce University, Turkey

Ali Görener *(Assoc. Prof.)*

Istanbul Commerce University, Turkey

Abstract

Industry is the part of an economy that manufacture components and goods which are highly automatized. This paper presents a general understanding about the Fourth Industry Revolution- Industry 4.0 approach from a commercial point of view. Firstly, the history of Industrial Revolution is explained and the roadmap to Industry 4.0 is shown. Industry components and the main understanding of Industry 4.0 is explained through the previous studies. Secondly, the most common usage, implementation areas and the challenging points are demonstrated. Commercial and industrial application examples of Industry 4.0 in different sectors and the possible implementation areas are defined based on countries and sectors. Finally, the commercial impacts of this new business model is given from the industrial and human perspectives.

Keywords: *Industry 4.0, Industrial Applications, Commercial Impacts.*

1. Introduction

Islamic Industrialization is the transformation of the nature according to human needs. The Industrial Revolution emerged in England in the 18th century. Later on, it began to spread through Western Europe and the USA. With the Industrial Revolution, the "development" indicators of the countries began to be determined according to their level of industrialization (Aksoy, 2017). The historical processes of the Industrial Revolution are expressed in the following.

1st Industry Revolution (Industry 1.0): The First Industrial Revolution began to show its influence through the mechanization of weaving looms in England between 1760 and 1830. With mechanization, pit coal and steam were used instead of wood. Increasing the power of movement created mechanization and the transportation of production to factory. Old-fashioned family businesses and small manufacturing facilities had left their places to big factories. In this period, which is called Mechanization Age, due to new inventions the use of steam as a source of energy played an important role in the spread of machine, as well as pit coal. The use of steam, coal, and iron as an energy resources and raw materials has also accelerated railway development.

Thus, it was made possible to move both raw materials and products of a greater variety, speed and quantity, farther away, and to spread the Industrial Revolution in Europe. While the mechanization of workmanship in the UK with the First Industrial Revolution led to a change in the production type and therefore in the the socioeconomic structure, the use of steam power technology in the printing process led to different developments in the field of culture and communication. The First Industrial Revolution has been one of the important steps of the world becoming a "smaller and more integrated" place (Kent, 2017).

2nd Industry Revolution (Industry 2.0): It emerged due to the use of electricity in the production systems, and the control of the electrical power through the assembly lines. The power-driven assembly line started first with the systems, which were setup for slaughtering processes in the abattoir. (Eğilmez,2017). This assembly line was first used in the 1870s in a slaughter housein Cincinnati, USA. In this slaughterhouse, monorail trolleys were used for the sliced meat pieces. With these monorail trolleys, when the workers stopped at fixed stations, the pulley system would bring the meat to each of them. In the following years Henry Ford and others wanted to implement this slaughterhouse application at the Ford Motor Company (Klemsan, 2017). Henry Ford started to manufacture cars by applying this practiceto his own factory (Karaoğlu, 2016). Henry Ford's mass production line system in automotive, and the fact that factories became electrically operated also quickly improved industrialization. Other new developments such as telephone, radio, typewriter, cheap newspaper paper have also shaped intercommunication while the steel production instead of iron, which dominated the First Industrial Revolution, has accelerated railway transportation and trade. Life styles have changed significantly. Socially and economically strong central states have been established. The industrialization, which had shown its impact in England and Europe in the First Industrial Revolution, has affected many regions of the world through spreading rapidly in countries such as the USA, and Japan with the Second Industrial Revolution (Ersoy, 2016).

3rd Industry Revolution (Industry 3.0): The Third Industrial Revolution has been described as the automatisation of production, while the First Industrial Revolution has been described as the mechanization of production, and the Second Industrial Revolution as the serialisation of it. In this period, the development of sciences such as computers, microelectronics, fiber optics, lasers, telecommunication, nuclear, biofarming, and biogenetics influenced the direction and form of production. Trade and industry had been globalized with developments is communication and transportation. One of the most important developments in this process had been the rapid depletion of world resources and the concept of sustainability coming to fore (Ersoy, 2016; Ersoy, 2017).

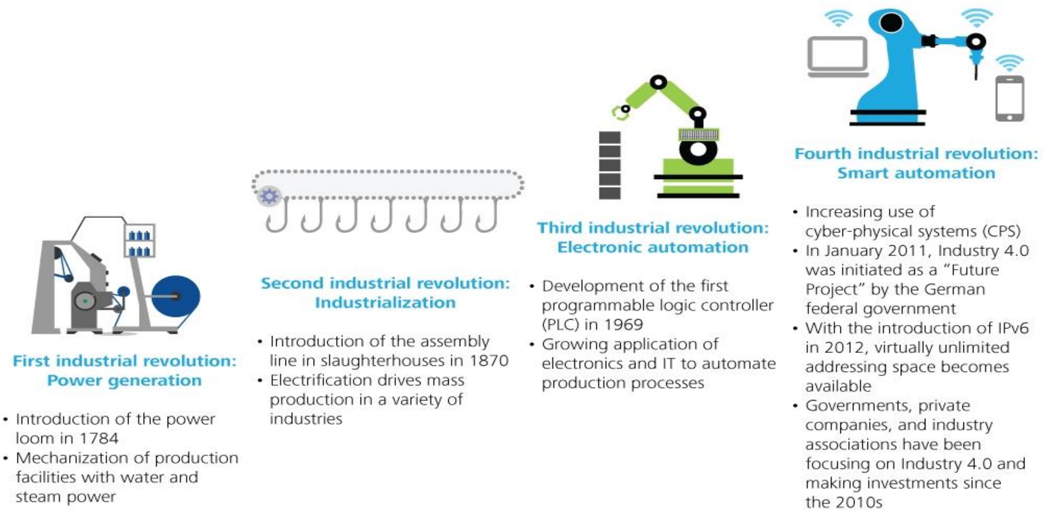

Fig 1. A history of industrial revolutions (Sniderman et al., 2016)

As shown in Figure 1, up to now, three major industrial revolutions have taken place. Today, the fourth industrial revolution, called Industry 4.0, is starting.

4th Industry Revolution (Industry 4.0): It plans all units directly or indirectly related to production working together in partnership, predicts the software of digital data's and the information technologies working integrated (Can ve Kıymaz, 2016). In the First Industrial Revolution coal, water, and steam power; in the Second Industrial Revolution oil and electricity were at the forefront as energy resources. However, in the Third Industrial Revolution with the problems of nonrenewable resources and environmental concerns, renewable energy resources such as the sun, and the wind had gained importance. Along with these developments providing innovations which were not possible before, with the effect of the factors such as the Internet of Objects and Services the Fourth Industrial Revolution which we are in has begun (Ersoy, 2016; Ersoy, 2017). Industry 4.0 is expected to have a crucial effect on the economy of many countries (Davies, 2015).

Industry 4.0 is an approach first introduced at the Hannover Fair in Germany in 2011. This new formation focuses on machines and production systems that operate autonomously on their own, without the need for human power. Industry 4.0 has officially begun by germany's setting this approach as its industrial policy with the Hannover Fair (Öztuna, 2017: 51). A working group has been established by the German Government to actualize this approach. This working group prepares a report every year and submits it to the German Ministry of Industry for the Industry 4.0 process to gain functionality. This working group is headed by Siegfried Dias, managing director of the Bosch company, and Hennig Kagerman, senior executive in SAP AG firm (Görçün, 2017: 142). The Industry 4.0 approach is called "Smart Manufacturing" in the US, "Made in China" in China, and "Innovation 25" in Japan (Stancioiu, 2017:74). Japan's Society 5.0 initiative is also exemplified by the human-focused technological development roadmap.

2. The Enabling Features of Industry 4.0

The term 4.0 is used in reference to the fourth industrial revolution (Mrugalska and Wyrwicka, 2017). Which is a concept aiming towards an end-to-end digitalisation of the value chain through integrating physical assets into digital systems and networking a wide range of contemporary technologies to create value (Geissbauer, 2016). According to Tupa et al. (2017) linking the production process sub-components via the Internet of Things (IoT) in addition to connecting all parts of machines through integrated data chains and operations is a concretization the concept of Internet + Manufacturing.

A new generation of digitalised data-based companies backed up by digital interfaces and data-based innovative services delivering physical products at the core is expected from the implementation of the vision and concept of industry 4.0 throughout the World. According to Hofmann and Rüsch (2017) Industry 4,0, encounters Cyber-Physical Systems(CPS) in concept. CPS focuses mainly on the establishment of intelligent machinery for manufacturing and new production processes along the value chain (Tupa et al., 2017). In the near future manufacturing factories will feel the challenge of coping with the need to provide a flexible production process and a faster product development, within complex industrial environments reffered to as Cyber-Physical Production Systems (CPPS) (Santos et al., 2017).

The industry 4.0 approach is based on the development of smart chains. According to this idea, the web-based network will support smart factories, from design to service and recycling, at every stage of the work on the product. In the era of medical, energy, media, law, automotive, biotechnology, computational linguistics, neuroscience, and ultimately information technology (IT) of all science, Industry 4.0 is one of the influences of the transformation process of this period (Magruk, 2016). According to Hermann et al. (2016) Industry 4.0 has four key components which were set based on a deep review of numeros academic publications in an attempt to be more objective.

Industry 4.0 key components are:

- Autonomous and Collaborative Robots
- Internet of Things
- Additive Manufacturing
- Cloud Computing
- Augmented Reality
- Big Data

- Cyber-physical systems (CPS) and Smart Factories

2.1 Autonomous and Collaborative Robots

Unlike automated robots, it is important to define what is an autonomous robot. First of all autonomous robots are composed of three main components. These components include; "Sensors" that follow the environment, "Processors" or "Artificial Intelligences" that take changes in it, and "Effectors" that decide how to react to the environment. Autonomy then depends on the ability of the robot to "work long without any external control" (McAllister, 2017). Industry 4.0 benefits from the benefits of autonomous robots. Examples of these industries are health, transportation and production. In England there is an industrial robot called "Eve" developed by artificial intelligence at Cambridge University. Eve's duty; is to provide drug discovery less costly and faster. This robot's solving the unknowns stems from Eve's artificial intelligence. Industrial robots are seen to have a direct impact on the quality of life and health of many people around the world. Another industry in which industrial robots are used is the manufacturing industry (Özdoğan, 2017).

2.2 Internet of Things (IoT)

The term "internet of things" can be considered the initiator of Industry 4.0 by providing fullfledged access to internet through self-managing smart technologies (Qin et al., 2016). The potential for business-to-business application of IoT turns all physical machines into "smart things" by featuring small, inextricably linked internet-connected computers and utilizing real-time data providing sensors to detect equipment wear and tear. This strategic implementation of IoT will allow equipment maintenance, inventory control, and capacity planning will be ensured (Strange and Zuchella, 2017). This comes in handy especially when it comes to geographically dispersed value chains, international production transaction costs and labour division in global factories (Buckley and Strange, 2015).
It is a system that enables the sensors of the objects in the physical world to connect internally with the wireless connections on the wired side (Banger, 2017). The concept of internet for objects was first spoken by Kevin Ashton in 1990, but this concept was included in Industry 4.0. The reason for being included in Industry 4.0 is that intelligent readers are embedded in many devices or machines and have the ability to generate and incorporate data on the wireless network without the need for people. Nowadays it is possible to attach smart readers to many products. The company "Mimo", which produces baby products, has installed a sensor on infant babies so that consumers can monitor their babies 'breathing rhythms and babies' movements instantly. Texas Instruments explains the areas of use of the Internet concept of objects. These areas are; wearable technologies, smart homes, cities, countries, health sector and manufacturing sector. While the Texas Instruments firm has identified the sectors, it has also talked about sample uses in the sectors. Here are the technologies that will be applied in the future with the Internet of objects; smart clocks, light and heat control of houses, energy optimizations, intelligent city lighting, traffic control, employee safety, remote patient tracking, drug tracking, real time casting and asset tracking (Özdoğan, 2017).

2.3 Additive Manufacturing

Layered production; rather than traditional manufacturing methods, is the process of combining materials to make objects from three dimensional model data arranged in layers. Layered production is the technology that transforms virtual reality into physical reality (Banger, 2017). The prototype preparation process in traditional manufacturing methods is both costly and time consuming. 3D printers used in layered production provide the advantages of rapid prototyping, personal low cost production opportunity, and the emergence of new ideas with individual creativity (Öztuna, 2017). The researchers at Wake Forest University in North Carolina, USA, produced 3D printers. Researchers have developed a machine that can produce organs, tissues and bones with this 3D printer (Özdoğan, 2017).

2.4 Cloud Computing

Cloud computing is an internet based computing approach. By connecting computers to the internet network, various jobs are shared over a large network. Organizations like General Electric, Siemens, HP and Facebook use cloud computing (Banger, 2017). Cloud computing addresses the issues with remote big data storage; for example, the cost and capacity required to store large data sets. In addition, cloud providers (such as Atlantic, Amazon, Google and Microsoft etc.) distribute and serve analytical tools which can process information in enormous quantities (Gilchrist, 2016).

2.5 Augmented Reality

Augmented Reality (AR) technology maintains the incorporation of virtual elements into the current physical environments' view to be able to create a real mixed reality (Mota et al., 2018).
AR is a living, direct, or indirect physical appearance that is enriched by computer-generated audio, image graphics, and GPS data in real-world circles and contents. At General Electic's research center in Brazil, he is experimenting with increased reality to help employees build and maintain equipment for offshore oil and gas platforms (Öztuna, 2017).

2.6 Big Data

Today, large amount of information can be collected, executed and produced daily with the help of the capabilities of computing tools. There is a technology by which we can carry out analysis and that is Big Data (Witkowski, 2017). Big data; is a large set of data that can not be achieved with typical database software in terms of capturing, storing, managing and analyzing data (Banger, 2017, p: 87). With more and widespread cyber-physical systems in a manufacturing area, Big Data technologies has been increasingly considered as a leverage for industries to streamline production management (Liang et al., 2018).

2.7 Cyber-physical systems (CPS)

Cyber-physical systems (CPS) is a concept of integrating the dynamics of physical processes with those of software and networking in order to monitor and efficiate the physical production process (Asare et al., 2012). It is an established connection of machines involved in the production process via the internet bringing virtualilty and real time together (Hofmann and Rüsch, 2017). According to Asare et al. (2012) Cyber-Physical Systems refer to "integrations of computation and physical processes. Embedded computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa". Technically; the machine related information is synchronised with a specific virtual space resulting into sharp control, total transparency and maximum efficiency in the production process (Hofmann and Rüsch, 2017; Thuemmler & Bai, 2017).
The CPS structure breaks down into two main paralaly employed networks aiming to achieve a state of total control over the production process (Qin et al., 2016). The first network is named Interconnected Infrastructre Components network, while the second one is named Cyber Network which makes use of the intelligent controlers (Hofmann and Rüsch, 2017). Both networks are fully integrated through control processing units along with numeros communication devices (Qin et al., 2016).
The advantages of a CPS as an Industry 4,0 component could be clealy noticed throughout the production stages (Thuemmler and Bai, 2017). According to Hofmann and Rüsch (2017) the secondary data recieved from components is converted into information, and the cyber-twin of each component captures records which helps to move towards auto-awarness and auto-prediction in a CPS enabled company. At another production stage, advanced machine data could be aggregated to monitor and generate a cyber-twin (with additional self-comparison capabililty) of each machine through the use of controller parameters (Lee et al., 2015). Coming to a satge where machine level information provides self-configurability and self-maintainability to the factory ensuring a near zero downtime production, optimized production plan and effective inventory management (Qin et al., 2016)

2.8 Smart Factories

CPS, IoT and Internet of Services (IoS) are certainly core components of Industry 4.0. Which, are at the same time closely linked as CPS uses IoT and IoS as a way to communicate (Zezulka et al., 2016). In concept, Smart Factory englobes all components of Industry 4.0 in a production process. Thus, In a smart factory, products are smoothly running through the production process and easily locatable at anytime (Hofmann and Rüsch, 2017). Which, is a description of a cost-effective yet flexible mass production. The production process becomes then sustainable and profitable at once (Hermann et al., 2016). Hence, this concept throws a great deal of responsibility on employees as for being decision makers and task supervisors at the same time (Thuemmler and Bai, 2017).

3. Application Perspective of Industry 4.0

Digital transformation or Industry 4.0 in the manufacturing industry leads to extensive changes in all areas of value creation, resulting in more efficient production processes, stronger customer-centricity and new marketing and business models. Or, in other words, in efficiency, agility, and innovation (Gens, 2016; Schulte, 2016).

Nevertheless, some leading organizations are investigating developments that offer them an advantage over their competitors:

- Kaeser, for instance, offers a compressor network-based "Compressed air-as-a-service," morphing from product to service provider.
- As part of a pilot project, Henkel distributes intelligent, self-learning robots that perform cooperative activities with employees.
- Infineon follows its products perfectly throughout the global value chain because integrated value chains accelerate response times in case of failure, allow faster learning and thus increase quality.

The above examples show that the digital age has been around for a long time. Organizations should optimize opportunities for their businesses. By 2019, IDC estimates that 75% of world-class industrial enterprises will transform the value chain through digital network-connected processes and objects, thereby increasing response speed and productivity by 15% (Schulte, 2016). Semiconductor manufacturer Infineon is a successful example of optimizing the value creation process. Components of microelectronic operators are produced in various areas, starting with an example in Dresden, up to 1,200 individual steps in Malaysia before installation and in Singapore for testing, packaging and transportation for customers (Gens, 2016; Schulte, 2016).

More than 50 pilot projects related to Industry 4.0 are in progress in Bosch. In the pilot project at the Bosch Rexroth Factory in Hamburg, people, machines and products work together to demonstrate the live production of tomorrow's production. Many assorted products can be produced on the same line. The machine tells how to produce the products side by side and the machines produce it in this way. With RFID technology in use, the status of products and shipping containers can be observed at any time. It is easier for employees to do business with the help of help devices. For example, technicians can see their handbooks in their glasses and release their hands. While robots save employees from dangerous and demanding jobs, intelligent production lines are testing their own performances themselves. In case of any malfunction, they are notified by the service. These technologies can also be used during product testing. One aim is to consolidate the entire international production network in the future. The goal is to bring the information technology and factory automation together and use the internet to optimize the production and transport networks. At the same time, the products will be a moment. Thus, the products will always carry the basic features (Turk et al., 2014).

The 145-year-old Wisconsin-based company is transforming from a bathtub and toilet manufacturer into a digital leader in the smart home revolution. While the new smart fixtures can make life easier for homeowners and businesses, Kohler can offer products that will help them to continuously improve their products to better meet customer needs. Kohler partnered with Microsoft to create KOHLER Konnect, an Object Internet (IoT) platform for adding intelligence and interactivity to kitchen and bathroom products. Kohler's range of smart products will include toilets, bathtubs, water filters, and taps that learn about their preferences for bath water and room temperature, bath odor, activity times and more. In June 2016, Kohler will present KOHLER Konnect at the Chinese Kitchen and Bath Fair and open his first smart products in China in January 2018. Smart Kohler products will soon be on the market in 2018 and other global markets. Hosts can interact with KOHLER Konnect using personalized presets, voice commands, hands-free gesture control, and a KOHLER Konnect application for iOS and Android devices. In commercial environments, Kohler smart toilets and sinks in hotel and office buildings can communicate with building management systems and send alerts when toilets or faucets require maintenance. They can also provide real-time reports on water consumption. In short, Kohler smart cans and toilets connect to the Azure IoT Hub over Wi-Fi, which acts as a command center to process messages, trigger actions, and collect information about the health of the system. Some of the Azure IoT services clean, catalog, and analyze data and then send it to the appropriate Kohler business systems for response (Microsoft Story, 2018).

It is subject to natural and man-made conditions that affect the depths of ports, docks and channels. As a result, the harbor base is constantly changing in unpredictable ways. Knowing the depth of the harbor can prevent not only safe harbor entry and docking, but also low berths on docks that are deeper than you might think. Each additional centimeter sketch equals 150 tons of additional product that can be shipped. In Norway's technology company Kongsberg Gruppen, leading developer Azure is discovering ways to offer a smarter solution to determine the optimal transport loads by connecting multiple systems to monitor the depth of the bed for the cloud. Modern boats already use underwater sensors for navigation. Nilsen's eureka moment was the fact that these depth data could be taken in real time from multiple ports and shared among companies using a transport company or even IoT Hub. This will enable advanced analytics and machine learning in the larger data set so that logistics specialists can estimate the dock conditions at the loading port and at the same time the unloading port. This will enable customers to optimize port operations, thereby increasing profitability and security and reducing the marine footprint of the maritime industry (Microsoft Story, 2018).

Schneider Electric solutions play an important role for oil and gas companies that can have thousands of pumps spread across a large geographical area. For these companies, managing all the pumps efficiently is the key to business success. The Schneider Electric development team explored ways to incorporate artificial intelligence (AI) and machine learning into Realift to incorporate this foresight capability. Using Machine Learning gives Realift the ability to analyze readings from various elements and sensing patterns of a rod pump mechanism that shows a possible mechanical failure or deviation of the pump from optimal operating conditions. In this case, the controller can change the operating parameters of the pump to prevent or mitigate the effects of unexpected changes. Or, if necessary, shut down the pump without any damage and inform the company that repairs are necessary - protect the machine and prevent possible environmental damage. The deployment of predictive models to edge devices helps Schneider Electric to meet customers' business goals, safeguard their valuable industrial assets, and boost workplace safety (Microsoft Story, 2018).

4. Commercial Impact

Industry 4.0 is considered as the next phase in the digital transformation of the manufacturing sector. The typical example of Industry 4.0 is a machine that can predict failure and start maintenance processes autonomously or self-organized logistics that react to unexpected or unusual changes in operation (Sung, 2017). Many institutions have prepared lists of different technologies that will run o Industry 4.0. The new technologies and tools they generate seem limitless (Schwab, 2017). Industry 4.0 and technologies that this revolution brings together will affect many business areas of the field.

4.1. Business Effect

Industry 4.0 will have a significant impact on the global economy, so it is very large and multidirectional, making it difficult to separate the next specific effect from each other. Industry 4.0 has four main influences on inter-industry business (Schwab, 2017):

- changes on customer expectations,

- improvement on asset efficiency by increasing data efficiency,

- new partnership establishments as learning about the importance of new forms of cooperation,

- digital transformation of operating models into new business models.

Industry 4.0 is one of the key factors in the growth of income levels and state value added GDP, although its application also requires substantial investment. However, the return on investment is estimated to be high (e.g. UK production is expected to increase by 20% by 2020) (Gilchrist, 2016). Connection use for new insights and optimizations can be applied to a production process and the overall supply chain. This industry is one of the basic concepts of a technological movement called the fourth industrial revolution. Industry 4.0 producers focus on yielding a strong return on investment (ROI).

Industry 4.0 is rapidly transforming the physical world of machines, virtual world of information technology, and the Internet. It focuses on the integration of all the industrial areas provided by IT. The technologies improve flexibility and speed by providing a higher variance in more individualized product, efficient and scalable production and production control. Advanced intelligence on machines and machine-to-machine communication result self monitoring and real time results with more automated processes. Open web-based platforms will create new opportunities and increase the competition.

Systems that facilitate instantaneous vertical or horizontal connectivity, allowing data to flow freely throughout the organizational structure, require continuous investment and improvement. It is important to remove barriers between supplier systems and adopt a more open approach to communication and control platforms. The innovative companies are increasing their competitiveness and their innovation by letting to join different collaborative outsiders on these open source communities network such as external experts, scientists, suppliers, customers, companies of the same industry, competitors, stakeholders, etc (Battistella, 2012), which requires to improve new business models to work and to communicate with its own creativeness and challenges.

A machine's work should allow easy connection to smartphones or tablets. The software can speed up the design and commissioning of automation systems by connecting the control unit to the 3D modeling software. A motion controller can send commands and receive feedback in a model, which allows the machine design to be optimized with motion control during the mechanical design phase. This allows the machine to be tested and programmed before commissioning. To install the machine, the virtual machines can be tested and improved before the parts are ordered. Rather than capture and analyze several months of data such as energy consumption, yield rates or machine stops, Industry 4.0-enabled platforms integrate data into normal factory management reports. This will be equipped with details that will enable manufacturers and machines to implement rapid process and production changes to fulfill the vision of producing products profitably for specific customer needs (Ford, 2015; Tubbs, 2015). In concept, Smart Factory englobes all components of Industry 4.0 in a production process. Thus, in a smart factory, products are smoothly running through the production process and easily locatable at anytime (Hofmann and Rüsch, 2017).Which, is a description of a cost-effective yet flexible mass production. The production process becomes then sustainable and profitable at once (Hermann et al., 2016).

The Siemens electronic manufacturing facility in Amberg (Germany) produces special Programmable Logic Controls (PLCs) in a state-of-the-art intelligent plant named 'smart factory' where an integrated platform is created for production, product management, and automation systems. Intelligent machines coordinate the 950-products supply chain with more than 50,000 different variants, of which about 10,000 materials are supplied from 250 suppliers. By combining intelligent machines with data-components and employees, innovation cycles can be shortened, productivity can be improved, and quality can be improved: The Amberg factory currently registers only 12 hurdles (500 in 1989) at a million and has a 99% confidence rate (Davies, 2015). In addition, even though the number of employees has not changed, the production capacity has increased by eight cards with the advantages of Industry 4.0 applications (Duda, 2016). An example of the usage of Big Data platforms in logistics is the so-called DHL. The device called as "Resilience360" is a supply chain device, designed to manage the risk. The company can support customers with information about supply chains. The benefit of the collected and the evaluated data is to protect and to improve the logistics performance (Witkowski, 2017).

4.2. Human Effect

Besides the important positive effects of technology on economic development and growth, it is required to address the possible reverse impacts on the employment and the job opportunities, at least in the short term (Schwab, 2017). Industry 4.0 is not just about local cyber-physical systems or local industry processes, also covers the suppliers, manufacturers, logistics service providers and workers. One of the first concerns expressed by the first practitioners of Industry 4.0 is the lack of skilled workers (Gilchrist, 2016).

While it is still early to speculate on employment issues with the advent of Industry 4.0, it is safe to accept that workers will need to acquire multidirectional or information-based set of skills. This may help employment rates go up and create new business areas, but it will also alienate a big sector of laborers. The sector of workers whose work is perhaps repetitive, and routine will face a challenge to survive with current jobs (Sung, 2017).

Certain humanitarian production tasks, such as heavy lifting, precision positioning and visual quality control, will be replaced or supported by technology which is more safe and effective than humans, and that can communicate with each other smoothly. Human workers need to learn working side-by-side and they must learn to work with robots. Advanced automation will enhance employees' ability to colloborate on safe machines with human-like physiology that works closely with them. This will affect and change the working behaviour of traditional blue-collar workers that will become more complex with wearable devices, increased reality and other technologies. It is difficult to predict if Industry 4.0 will work for skilled workers, but the need for more focus and flexibility and adaptability, and potentially less expertise and craftsmanship will be very different (Mesnard, 2017). Hence, this concept throws a great deal of responsibility on employees as for being decision makers and task supervisors at the same time (Thuemmler and Bai, 2017).

The transformation of the economy brought by Industry 4.0 means that business processes such as procurement, manufacturing, maintenance, delivery and customer service will be connected through Industrial IoT systems. These highly flexible value networks will require new forms of cooperation between companies, both nationally and globally. To protect the industry base and create new jobs, governments around the world are investing billions of dollars in Industrial 4.0 projects and R & D, and they provide subsidies and tax incentives for Industry 4.0 investors. On the one hand, governments and private sectors of countries with high labor costs (e.g. EU countries and the US) are investing in Industry 4.0 to increase industrial sectors seized by low labor cost countries ; On the other hand, low labor cost industries and their governments (e.g. China, India and Cambodia) are responding to this trend by investing in Industry 4.0 (Security Research, 2018).

One of the worst concerns about Industry 4.0 is security, while the other is the loss of work as a result of the widespread use of robotic systems. In fact, it would be enough to look at the period of the Third Industrial Revolution to see if this loss is not realistic. During this revolution, especially automotive automation increased while unemployment did not increase. On the contrary, economic growth in the Third Industrial Revolution led to the emergence of new and innovative business areas, the emergence of new professions (such as the maintenance and repair of automation robots and machines), and increased job opportunities. Therefore, it would be sensible to enter the same expectation for Industry 4.0. Every development recorded around the world brings with it a change process. But in this process of change always new opportunities arise. It is envisaged that Industry 4.0 investments will increase employment in the short term by 6 per cent and in the long run, demand for qualified work force, especially in IT and mechatronics, will increase significantly. These expectations are likely to change the expectations of the states or of the individual's education system (Şimşek, 2017).

In Industry 4.0 era, processes are becoming complex, which leads to an increase of jobs with higher qualifications and a loss in jobs requiring lower qualifications. For this reason, enterprises need to qualify their employees for more strategic, coordinating and creative tasks with higher responsibilities. (Hecklau et al., 2016).

5. Conclusion

This paper indicates a review on Industry 4.0 and presents an overview of the components, major implementation areas and findings of Industry 4.0. We believe this paper will contribute to the literature to give an integrated understanding of the industry revolution and the final impacts with Industry 4.0 from both business and human perspectives on commercial world based on the findings in research.

The development of the industry is an integrated process between human and machine through its own complexity. It is the new world vision, of which the real world depends on the digital world using the following driving power: cloud computing, internet of things, big data, cyber-physical systems and others. And it is a vision of developing smart chains from design to production, from services to recycling in the approach of digital communication in each step of the work.

In parallel, uncertainities about the technological boundries, complexity of the systems, position of the human with new work styles cause questions and bring new areas to be worked on this revolution with all dimensions. Industry 4.0 will accelarate industry to increase the efficiency and the growth in productivity with human to machine collaboration.

References

Alçın, S. (2011). Üretim İçin Yeni Bir İzlek:Sanayi 4.0, Journal of Life Economics, 3(2), 19-30.

Aksoy, S. (2017). Değişen Teknolojiler ve Endüstri 4.0: Endüstri 4.0'ı Anlamaya Dair Bir Giriş. Katkı Dergisi (4), 34-44.

Asare, P., Broman, D., Lee, E., Torngren, M., & Sunder, S. (2012). Cyber-Physical Systems a concept map, http://cyberphysicalsystems.org/ (18.09.2017).

Baena, F., Guarin, A., Mora, J., Sauza, J., & Retat, S. (2017). Learning factory: The path to ındustry 4.0. Procedia Manufacturing, 9, 73–80.

Banger, G. (2017). Endüstri 4.0-Ekstra. Ankara: Dorlion Yayınları.

Battistella, C., & Nonino, F. (2012). Open innovation web-based platforms: The impact of different forms of motivation on collaboration. Innovation, 14(4), 557-575.

Buckley, P. J., & Strange, R. (2015). The governance of the global factory: Location and control of world economic activity. The Academy of Management Perspectives, 29(2), 237-249.

Can., A. V., & Kıymaz, M. (2016). Bilişim Teknolojilerinin Perakende Mağazacılık Sektörüne Yansımaları: Muhasebe Departmanlarında Endüstri 4.0 Etkisi. Süleyman Demirel Üniversitesi Sosyal Bilimler Dergisi (CIEP Özel Sayısı), 107-117.

Davies, R. (2015), Industry 4.0 -Digitalisation for productivity and growth, European Parliamentary Research Service Report.

Duda, G.İ. (2016), "Ali Rıza Ersoy ile Röportaj", Global Sanayici Dergisi, Temmuz 2016 Sayısı, http://www.sanayicidergisi.com/soylesi/savunma-otomobil-ve-beyaz-esya-sektorleri-sanayi-40a-yaklasti.htm (12.11.2017).

Eğilmez, M. (2017), Endüstri 4.0, http://www.mahfiegilmez.com/2017/05/endustri-40.html (23.10.2017)

Ersoy, A. R. (2016). Siemens'in Endüstri 4.0'a Bakışı ve Çalışmaları. Elektrik Mühendisliği, December 2016, 459, p.48.

Ersoy, A. R. (2017). Industry 4.0 Presantation, https://www.darussafaka.org/haberler/2017/endustri-40 (20.05.2017)

Ford, M., (2015), Industry 4.0 Who Benefits?, SMT: Surface Mount Technology, 30, 52-55

Geissbauer, R., Vedsø, J.,& Schrauf, S. (2016), A Strategist's Guide to Industry 4.0, Alfredo Passos, https://alfredopassos.wordpress.com/2016/12/09/a-strategists-guide-to-industry-4-0-by-reinhard-geissbauer-jesper-vedso-and-stefan-schrauf/ (04.06.2017).

Gens, F (2016), IDC Report, IDC Publications.

Gilchrist, A. (2016). Industry 4.0: the industrial internet of things. Apress.
Görçün, Ö. F. (2017). Dördüncü Endüstri Devrimi-Endüstri 4.0. İstanbul: Beta Yayınları.
Gubán, M., & Kovács, G. (2017). Industry 4.0 conception. Bulletin of Engineering, 10(1), 22–25.
Hecklau, F., Galeitzke, M., Flachs, S., & Kohl, H. (2016). Holistic approach for human resource management in Industry 4.0. Procedia CIRP, 54, 1-6.
Hermann, M., Pentek, T., & Otto, B. (2016). Design principles for industrie 4.0 scenarios. Proceedings of the Annual Hawaii International Conference on System Sciences, 2016–March, 3928–3937.
Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. Computers in Industry, 89, 23-34.
Karaoğlu, Ö. (2016)., https://tr.linkedin.com/pulse/endustriyel-devrimler-tarihi-ve-end%C3%BCstri-10-ozkan-karaoglu (23.10.2017).
Kent, E. (2017). Endüstrinin Gelişimine Bakış, Türkiye'nin Endüstri 4.0 Platformu: http://www.endustri40.com/endustrinin-gelisimine-bakis/ (25.10.2017).
Klemsan (2017). Klemsan Electric Inc. Web Site. http://www.klemsan.com.tr/News/Index/en-US/363 (23.10.2017).
Lee, J., Bagheri, B., & Kao, H. A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. Manufacturing Letters, 3, 18-23.
Lu, Y. (2017). Industry 4.0: a survey on technologies, applications and open research issues. Journal of Industrial Information Integration, 6, 1-10.
Liang, Y. C., Lu, X., Li, W. D., & Wang, S. (2018). Cyber Physical System and Big Data enabled energy efficient machining optimisation. Journal of Cleaner Production, Article in Press.
Magruk, A. (2016). Uncertainly In The Sphere Of The Industry 4.0 Potential Areas To Research. Business, Management And Education, 14(2), 275-291.
McAllister, A. (2017). Stranger Than Science Fiction: The Rise of A.I Interrogation In The Dawn Of Autonomous Robots And The Need For An Additional Protocol To The U.N. Convention Against Torture. Minnesota Law Review, 101(6), 2527-2573.
Mesnard, X. (2017), AtKearney web site, https://www.atkearney.se/about-us/world-economic-forum/industry-4-0-jobless-future-for-manufacturing (16.03.2018).
Microsoft Customer Story, (2018), http://customers.microsoft.com/en-US/story/schneider-electric-process-mfg-resources-azure-machine-learning (10.02.2018).
Microsoft Customer Story, (2018), http://customers.microsoft.com/en-US/story/kongsberg (16.02.2018).
Microsoft Customer Story, (2018), http://customers.microsoft.com/en-US/story/kohler-konnect-azure-iot (17.02.2018).
Mrugalska, B., & Wyrwicka, M. K. (2017). Towards lean production in industry 4.0. Procedia Engineering, 182, 466-473.
Mota, J. M., Ruiz-Rube, I., Dodero, J. M., & Arnedillo-Sánchez, I. (2018). Augmented reality mobile app development for all, Computers & Electrical Engineering, 65, 250-60.
Özdoğan, O., (2017), Endüstri 4.0 : Dördüncü Sanayi Devrimi ve Endüstriyel Dönüşümün Anahtarları, Pusula Yayıncılık.
Öztuna, B. (2017). Endüstri 4.0-Dördüncü Sanayi Devrimi ile Çalışma Yaşamının Geleceği. Ankara: Gece Kitaplığı Yayın Evi.
Qin, J., Liu, Y., & Grosvenor, R. (2016). A Categorical Framework of Manufacturing for Industry 4.0 and beyond. Procedia CIRP, 52, 173-178.
Robinson, N. (2015). What is Industry 4.0? https://theleadershipnetwork.com/article/future-manufacturing/industry-4-0 (25.01.2018).
Santos, M. Y., e Sá, J. O., Andrade, C., Lima, F. V., Costa, E., Costa, C., ... & Galvão, J. (2017). A Big Data system supporting Bosch Braga Industry 4.0 strategy. International Journal of Information Management, 37(6), 750-760.
Schulte, M. A. (2016). Digital Transformation in the Manufacturing Industry, Industry 4.0: From Vision to Reality , IDC Publications.
Security Research (2018), Industry 4.0 Market & Technologies 2018-2023, https://homelandsecurity research.com (30.01.2018)

Siemens.(2015). http://cdn.endustri40.com/file/ab05aaa7695b45c5a6477b6fc06f3645/ End %C3%BCs tri_4.0_ Yolunda.pdf (23.10.2017).
Stancioiu, A. (2017). The fourth industrial revolution- "Industry 4.0". Fiability & Durability/Fiabilitate si Durabilitate, 1, 74-78.
Stock, T., & Seliger, G. (2016). Opportunities of sustainable manufacturing in industry 4.0. Procedia CIRP, 40, 536-541.
Strange, R., & Zucchella, A. (2017). Industry 4.0, global value chains and international business. Multinational Business Review, 25(3), 174-184.
Schwab, K. (2017). The fourth industrial revolution. Crown Business.
Şimşek, T. (2017), Endüstri 4.0 ile Geleceğe Bakış ve Beklentiler, http://www.endustri40.com/ endustri-4-0-ile-gelecege-bakis-ve-beklentiler/ (03.06.2017).
Sung, T. K. (2017). Industry 4.0: A Korea perspective. Technological Forecasting and Social Change, Article in Press.
Sniderman B., Mahto M., & Coteleer M. (2016). Industry 4.0 and manufacturing ecosystems. Deloitte University Press. http://dupress.com/articles/industry-4-0-manufacturing-ecosystems-exploring-world-connected-enterprises / (01.02.2018).
Thuemmler, C., & Bai, C. (Eds.). (2017). Health 4.0: How virtualization and big data are revolutionizing healthcare. New York, NY: Springer.
Tubbs, A. (2015). Connect the potential of Industry 4.0 with real manufacturing, https://www. valin.com/resources/articles/connect-potential-industry-40-real-manufacturing (02.03.2017)
Tupa, J., Simota, J., & Steiner, F. (2017). Aspects of Risk Management Implementation for Industry 4.0. Procedia Manufacturing, 11, 1223-1230.
Türk, A., Kartoğlu, C., Kırcı, B., Tos, K., Çabul, G., Pırnal, S. C., & Kurum, E. (2014). Endüstri 4.0. Ekoiq, (December). http://ekoiq.com/wp-content/uploads/2014/12/ekoiq-ek-d.pdf (02.02.2018)
Witkowski, K. (2017). Internet of Things, Big Data, Industry 4.0–Innovative Solutions in Logistics and Supply Chains Management. Procedia Engineering, 182, 763-769.
Yıldız, A. (2018). Endüstri 4.0 ve akıllı fabrikalar, Sakarya University Journal of Science, 22(2), 546-556.
Zezulka, F., Marcon, P., Vesely, I., & Sajdl, O. (2016). Industry 4.0 ??? An Introduction in the phenomenon. IFAC-PapersOnLine, 49(25), 8-12.