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Connection between industry 4.0 and smart factories

Learning Objectives

The main objective of this chapter is to show the connection between Industry 4.0 and smart factory. Once you have mastered the materials in this chapter, you will be able to:

– Understand why we are living the Fourth Industrial Revolution and what it is.
– Identify the technologies used with Industry 4.0.
– Discuss about the difference and Industrial Internet of Things (IIoT) and Industry 4.0.
– Understand what is smart factory and how can it facilitate our lives.
– Explain the relation between Industry 4.0 and smart factory.

Chapter Outline

This chapter discusses the connection between Industry 4.0 and smart factories. Current Industry 4.0 technologies and smart factories allows numerous developments. Today, manufacturers seek for a more advanced and useful factory structure to improve overall effectiveness and for cost-cuttings. Industry 4.0 remarkably changes products and production systems regarding the design, processes, operations and services. Smart factory at this point, can connect the digital and physical worlds. Also, smart factory creates a flexible environment. Industry 4.0 and the smart factory is the future because they integrate new technologies, improve work conditions, and increase productivity.
Keywords
Industry 4.0, smart factory, fourth industrial revolution, industrial internet of things, artificial intelligence, new technologies.

1 Introduction

In 21st century, information and communication technologies are developing and desire of demand is growing rapidly like a snowball effect. New technologies are born such as: Internet of the things (IoT), big data, augmented reality, artificial intelligence (AI), cloud computing and so on (Chen et al., 2018). Now companies, firms and many corporations use these technologies in a new level of industry called Industry 4.0. For the first time, Industry 4.0, which is considered as the fourth generation of industrial revolution, was presented to the people at the Hannover fair in Germany in 2011. New technologies are implementing by the manufacturing industry and enable the mix of physical and virtual worlds through cyber-physical-systems (CPS) contained. However, the Industry 4.0 simultaneously shows characteristic that represent the challenges regarding the development of cyber-physical-systems, reliability, security and data protection according to Jazdi (2014). Furthermore, it introduces what has been called “smart factory”. With these smart factory terms, factories can adopt the physical and cyber technology. The vision of future production contains more efficient manufacturing systems and makes predictable scenarios can be applicable. Smart Factory is consisted of three primary layers, namely perception layer, deployment layer and executing layer. As the smart factory slowly emerges by the time the roles that people take on will enhance from what they are currently doing in today’s factories. In addition, as factories progress more technologically, the number of indirect job opportunities will increase proportionally. In turn, new suppliers in the new industries will emerge and they will have to find and find new workers. At the same time, the components of today’s advanced automated plant machines will be equipped with sensors and communication systems in connection with Industry 4.0, thus increasing speed and efficiency. It will also allow the production of low-cost product. These smart factories will create the possibility of using simu-
lation, virtual reality and virtual prototypes and will enable us to learn more about the future of the product without being put on the market. Now, the most commonly used trend and systems are in Industry 4.0 and smart factories. These terms help us to meet the increasing demands of human beings in appropriate way and work efficiently while doing these works.

In conclusion, new level of industry, namely Industry 4.0 which is more digital, flexible and efficient is more usable and helpful for manufacturing products, service etc. Smart factories can be more effective to start small, test out concepts in a manageable environment, and then scale once lessons have been learned (Burke et al. 2018). Manufacturers can implement the smart factory in many different ways. Our future will blend more with technology and will be used in many sectors such as health, automotive, transportation, agriculture, etc. The smart factories and the fourth revolution of industry is a direct way for manufacturers to achieve in a competitive and dynamic marketplace.

2 Overview of Industry 4.0

Industry 4.0 also known as “smart manufacturing”, “industrial internet” or “integrated industry”, is the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the IoT, cloud computing and cognitive computing. Fourth Industrial Revolution concept comes from Germany because since Germany has one of the most competitive manufacturing industries in the world and is even a global leader in the sector of manufacturing equipment. "Industry 4.0" term was presented to the people at the Hannover fair in 2011 in Germany. It is a strategic initiative of the German government that traditionally heavily supports development of the industrial sector (Rojko, 2017). In connection with this, Industry 4.0 can be seen also as an action towards sustaining Germany’s position as one of the most influential countries in machinery and automotive manufacturing. Since that time, its introduction, Industry 4.0 is in Germany a common discussion topic in research, academic and industry communities at many different occasions. Industry 4.0 has a significant role in strategy to take the opportunities of digitalization of
all stages of production and service systems. Digitization of manufacturing process is the need for today’s industry. Digitizing manufacturing processes is not as effortless as connecting devices to Wi-Fi. Firstly, the manufacturing industry knows how to use oil and steel to move metal parts; not cloud computing and cyber-physical systems. Understanding Industry 4.0 and integration of it in local industries will help the developing countries to get their parts in the international division of labour (Alcin, 2016). Industry 4.0 capabilities can improve business operations and revenue growth, transforming products, the supply chain, and the customer experience. In addition to, Industry 4.0 makes possible enterprises to optimize their production operations and race internationally. Against all stages of the customer journey, Industry 4.0 can create new opportunities for innovation and growth. Customer experience in the age of Industry 4.0 would be driven not just by the physical object but by the information, analytics, and customization that make the customer’s interaction with that object more transparent, and the ways the company acts on the insights they gather (Deloitte Insights, 2018). Industry 4.0 technologies create the potential for interactions between every point of a network. In addition to these, Industry 4.0 brings in a new wave of connected manufacturers and smart factories. The word "revolution" denotes abrupt and radical change (Schwab, n.d.). Stages in the development of industrial manufacturing systems from manual work towards Industry 4.0 concept can be presented as a path through the four industrial revolutions (Rojko, 2017). The term "Industrial Revolution" was first popularized by the English economic historian Arnold Toynbee (1852–1883) to describe Britain’s economic development from 1760 to 1840. Revolutions have occurred throughout history when new technologies and novel ways of perceiving the world trigger a profound change in economic systems and social structures (Schwab, n.d.). The term Industry 4.0 stands for the Fourth Industrial Revolution. Development of productive technological capacity through creativity is a key factor for the growth, development and change of the condition of human society and the environment. Industry 4.0 comprise of putting everything together all advanced researches in biology, technology and industrial automation, for improving the current way of living. Technical advances also modify the way humans produce materials, service, product etc. The step
into production technology, which was entirely distinct from the past, is also called the industrial revolution. The First Industrial Revolution began by the end of the 18th century through the use of steam power and mechanization of production in England then spread to the other parts of the world. Henry Cort has created the first mechanical looms in 1784, emerged the starting contextualization of the First Industrial Revolution in time frame. What before manufactured threads on simple spinning wheels, the mechanized version achieved eight times the capacity in the same time. Mechanization of production is facilitated with water and steam power. In the first industrial revolution, steam engines were used for power. The use of these for industrial purposes was the greatest innovation for increasing human productivity. The Second Industrial Revolution also known as the Technical Revolution began in between 1870 and 1914 in US with discovering of electricity and assembly line production. The second industrial revolution took place in the midst of wave immigration, as masses of people moved to the United States, primarily in search of employment in the country's burgeoning industries (Sawe, 2017). During the Second Industrial Revolution, the existing manufacturing and production methods were developed. For example, steel replaced iron in the building business. It was strong and cheap. Therefore, it made possible to build rail lines at competitive cost and spread transportation. The steel industry was further revolutionized by the adoption of the open-hearth process. Steel also facilitated the construction of ships, skyscrapers and larger bridges. In 1870, carbon filament lamp was developed by Thomas Edison. This bulb is familiar to the electric bulb which we use today. The innovations and inventions of the technological revolution are the building blocks of modern life. The Third Industrial Revolution began in the 1970s through partial automation using memory-programmable controls and computers. First programmable logic controller (PLC) in 1969 and growing application of electronics and IT to automate production processes are the key developments of third industrial revolution. Since the introduction of these technologies, we are now able to automate an entire production process without human assistance. We are currently living the Fourth Industrial Revolution. The Fourth Industrial Revolution is not only connected machines, devices and systems. The most breathtaking revolution is definitely the Fourth Indus-
trial Revolution. It was coined as the main subject of the exhibition and highlighted the fourth industrial revolution as envisioned by German experts. It builds on the developments of the Third Industrial Revolution. New technologies are implementing by the manufacturing industry and enable the mix of physical and virtual worlds through cyber-physical systems (CPS) contained. This is the next step in production automation. Industry 4.0, appears to be modifying the way businesses function and, by extension, the stakes by which they are forced to compete. The value of the Industry 4.0 concept can be enhanced through a clarification of the role played by technologies that facilitate the physical manipulation of objects (Sniderman, Mahto & Cotteleer, 2016). This flexibility allows a dynamic configuration of different aspects of the value chain at the same time that combines an optimization of the decision model to cope with the real needs of the market (Correia, 2014). Up to now, most companies have used Industry 4.0 technology to make their production operations faster and cheaper or to reduce cost. The networking of all systems direct to "cyber-physical production systems" and therefore smart factories, in which production systems, components and people communicate via a network and production, is just about autonomous. The result of implementing Industry 4.0 is a system in which all processes are fully integrated and system in information in real time frame. The new digital industrial technology is rising at this point. Industry 4.0 is a transformation that makes it possible to collect and analyse data across machines, enabling faster, more efficient, and more flexible processes to produce higher-quality goods at reduced costs. Advanced digital technology is already used in manufacturing, but with Industry 4.0, it will transform production. It changes traditional production relationships among suppliers, producers, and customers as well as between human and machine. Organizations should decide how and where to invest in these new technologies and identify which ones might best meet their needs. In conclusion, Industry 4.0 technologies mean greater levels of automation for production and product inspection. In other words, it means more efficiency in terms of energy and raw material use. These new technologies are: Alternative energies and new materials: Discovering novel ways is to get energy from numerous sources, developing a new ecosystem to provide the health of the earth is creating new possibili-
ties. The Fourth Industrial Revolution is making possible us to get unlimited clean-energy through this upcoming technology. Developing countries, such as China, India, the US and, Middle Eastern countries, have forwarded the development and construction of large-scale solar energy and wind farms in recent years. Big Data: There is a technology that can conduct analysis is Big Data. There are still massive sets of untapped data in the industrial world. Inside the sources from the supply system is information from retailers, transport, invoices and more. Data from customer profiles, social networking profiles, orders, market forecasts and geographical schemes also plays a big role. In Industry 4.0, Big Data is a collection of data from traditional and digital sources inside and outside your company that represents a source for ongoing discovery and analysis (OTTO Motors, n.d.). Now, data is gathered everywhere, from systems and sensors to mobile devices. Using customer data to analyse information from the delivery system, retailers can meet the expectations of customers by anticipating their behaviour. The challenge is that the industry is still in the process of developing methods to best commentate data. To keep up with the data, rather than being mired in it, manufacturers will need to adopt more robust technologies than traditional data processing software. Digital Twin: Digital twin is a virtual model of a process, product or service. Digital twins can be utilized to show how an item is serviced. For the most part, this can be used in combination with AI tool sets, software analytics, and real-world data to create living digital simulation models that update and change along with their physical counterparts (Weallans, 2018). It was named one of Gartner’s Top 10 Strategic Technology Trends for 2018. A digital twin can use smart components and sensors to collect data about real-time status, working condition, or position are integrated with a physical item. The components are connected to a cloud-based system that takes and processes all the data the sensors monitor. This input is analysed against business and other contextual data. At a high level of digital twin technology ensures a digital representation of the past and current behaviour of an object or process. Also, the digital twin needs cumulative, real-world data measurements across an array of dimensions, including production, environmental, and product performance. Thomas Kaiser, SAP Senior Vice President of IoT, highlighted digital twin technology’s importance in this way;
“Digital twins are becoming a business imperative, covering the entire lifecycle of an asset or process and forming the foundation for connected products and services. Companies that fail to respond will be left behind.” Internet of things: Internet of Things (IoT)”Internet of Things” (IoT) was coined by Kevin Ashton in 1999 during his work at Procter & Gamble (Lueth, 2014). IoT is the connection of every device to the internet and each other. Gartner estimated 20.8 billion connected things will be in use by 2020. This is where hardware has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction (Duivenvoorden, 2017). Today, there is no doubt that the existence of the internet has a direct influence on everything. The IoT is predicted as one of the most important areas of future technology and is gaining vast attention from a wide range of industries. IoT is helping to release new age of digitalization across industries. Architecture for IoT-based smart factories, defines the main characteristics of factories with a focus on the sustainability perspectives. With the IoT, data, in addition to physical objects, are a source of value. This connectivity makes possible to build smarter supply chains, manufacturing processes, and even end-to end ecosystems. Using the IoT, a manufacturer can connect devices, assets, and sensors to collect untapped data. Firms will pay into in the IoT to redesign factory workflows, improve tracking of materials, and optimize distribution costs. There are five fundamental technologies are widely used for the deployment of successful IoT-based products and services: Radio frequency identification (RFID), wireless sensor networks (WSN), middleware, cloud computing and, IoT application software (Lee & Lee, 2015). RFID allows automatic identification and data capture using radio waves, a tag, and a reader. WSN consist of spatially distributed autonomous sensor-equipped devices to monitor physical or environmental conditions and can cooperate with RFID systems to better track the status of things such as their location, temperature, and movements (Rghioui, 2017). Middleware is a software layer interposed between software applications to make it easier for software developers to perform communication and input/ output (Lee & Lee, 2015). Cloud computing is a model for on-demand access to a shared pool of configurable resources (e.g., servers, networks, computer, storage, applications, services, software) that can be provided as Infrastructure as
a Service (IaaS) or Software as a Service (SaaS). The IoT facilitates the development of industry-oriented and user-specific IoT applications. The true value of the IoT for enterprises can be totally realized when connected devices are able to communicate with each other and integrate with vendor-managed inventory systems, customer support systems, business intelligence applications, and business analytics. Cybersecurity: Cybersecurity is the protection of internet-connected systems, including hardware, networks, programs, software and data, from cyberattacks. These attacks are in general aimed at accessing, changing, or destroying sensitive information; extorting money from users; or interrupting normal business processes and increase time for solving these problems. One of the biggest problems of cybersecurity is the frequently evolving nature of security risks. In a conclusion of security risks, investments in cybersecurity technologies and services are increasing. The utilizing of cybersecurity can help obstruct cyberattacks, data breaches and identity theft and can aid in risk management. Cybersecurity is important because in today’s connected world, everyone benefits from advanced cyber defence programs. Interoperability: Interoperability is the connection of cyber-physical systems, humans and smart factories. With this, these elements can communicate each other. Furthermore, information transparency: creating a copy of the real-world through sensor data to review information. Industry 4.0 technologies are taking a step the manufacturing industry with new means of efficiency, accuracy and reliability. Also, in doing so, manufacturing partners can effectively share information, error-free transmission and translation. In the realm of manufacturing, interoperability among a variety of systems, in or across industries, has been gradually accepted as one key feature along the life cycle of a product (Liao et al., 2017). Wearables: As the name suggests, a wearable device is a technology that is worn on the human body. Wearables are predicted to become increasingly significant in future as soon as possible. Companies like Apple, Fitbit, and Google etc. have started to evolve more types of devices that are small enough to wear and that contain powerful sensor technologies that can collect and deliver information about their surroundings. Wearable device models may depend with short-range wireless systems like Bluetooth or local Wi-Fi setups. Wearable technology has enormous potential, as was promised by smartwatches,
medical devices and virtual reality headsets. Wearable will move beyond the wristband into smart jewellery, clothing, and tattoos. Wearable usually incorporates smart sensors that can measure the wearer's personal data like heart rate, step count etc. All of this has contributed to a marketplace that experts predict will reach $53 billion in 2019.

Nanotechnology: Nanotechnology is a field of research and innovation concerned with building 'things' – generally, materials and devices – on the scale of atoms and molecules (AZoNano.com, 2005). A nanometre is one-billionth of a meter: ten times the diameter of a hydrogen atom. It helps us to find, cure, solve and predict in human body. Nanotechnology enhances the properties of tools and materials, such as; greater strength, lighter weight, more durable, better electrical conductors, increased control of light spectrum and greater chemical reactions. Nanotechnology is helping and serving to considerably develop, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and science, and among many others.

Decentralized Decision-making: It mentions the possibility of cyber-physical systems to make their own simple decisions and become as self-ruling as possible. Decisions are spread throughout the system to maximize response time and optimize flexibility while continuing to operate. Only in case of exceptions, interferences or conflicting goals are the tasks given to a higher level.

Artificial Intelligence (AI): Artificial intelligence (AI), as it is understood, describes the ability of machines to imitate human mental prowess. As AI emerges from science fiction to become the frontier of world-changing technologies, there is an urgent need for systematic development and implementation of AI to see its real impact in the next generation of industrial systems, namely Industry 4.0 (Lee et al., 2018). Machine learning enables predictions to be made based on large amounts of data. AI also brings to the manufacturing table is its capability and quality to open up completely new avenues in business. The advantages are numerous and can significantly reduce costs. With pre-empting a failure with a machine learning algorithm, systems can continue to function without redundant interruptions. By the end of 2018, there will be 1.3 million industrial robots working in factories around the world. The general approach about the future is that as jobs get taken over by robots, workers will be offered
training for higher-level positions in programming, design, and maintenance. Meanwhile, the efficiency of human-robot collaborative work is being improved as manufacturing robots are approved for work alongside humans. AI will play a major part in ensuring the safety of human personnel as well as giving robots more responsibility to make decisions that can further optimize processes based on real-time data collected from the production floor when the adoption of robotics in manufacturing increases. Furthermore, AI permeates the entire Industry 4.0 ecosystem. Machine Learning: Machine learning is the ability that computers have to learn and develop on their own through AI and without being explicitly told or programmed to do so. Machine learning focuses on the development of computer programs that can access data and utilize it learn for themselves. In the past decade, machine learning has given us self-driving cars, effective web search etc. developments. Amazon, Google, Microsoft, IBM and other companies, are racing to sign customers up for platform services of machine learning activities. Real-time Data Processing: A real-time data processing system is able to take input of quickly changing data and then provide output near immediately so that change over time is readily seen in such a system. In contrast, real time data processing contains a continual input, process and output of data. Real-time data processing is also called as stream processing because of the continuous stream of input data required to yield output for that moment. Collaborative Robot: A collaborative robot (cobot) is a robot designed to collaborate with human workers closely, and without the usually required security restrictions applied in industrial robotics typical applications. Cobots are programmed, configured and controlled locally in the factory, companies which choose the cobot’s route can retain ownership over their automated processes and the precious knowledge it takes to exploit them. This result comes with greater operational agility, flexibility, and greater competitive power in world markets. 3D Print: 3D printing is the action or process of making a physical object from a three-dimensional digital model, typically by laying down many thin layers of a material in succession. The 3D printer is controlled by a computer, depositing successive layers until they reach the wanted latest shape. Its use in prototyping, design iteration and small-scale production is already significant but we are now on the cusp of changing discrete man-

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ufacturing forever. Three major changes are starting to take place in additive manufacturing, or 3D printing that will lead to fundamental change: speed, quality, materials. As these fundamentals evolve rapidly, new opportunities will arise that take 3D printing ever closer to mass production. 3D printing brings design, manufacturing and service flexibility to many industries. Optimize Logistics and Supply Chains: A connected supply chain can set and accommodate when new information is presented. A connected system can adapt to the situation and change production priorities. By leveraging supply chain management capabilities, companies can deliver products and services to market faster, cheaper, and with better quality to gain an advantage. Thanks to this, cost is avoided and there is no delay in production. RFID: RFID stands for Radio-Frequency Identification. This acronym refers to small electronic devices that comprise a small chip and an antenna. The chip is capable of carrying 2,000 bytes of data or less. RFID is similar to barcoding, and in that data from a tag or label are captured by a device that stores the data in a database. Universal Product Code (UPC) bar code is replaced with smart labels, also called RFID tags, and percentage of using of RFID tags will be increase. RFID tags are smart bar codes that can talk to a networked system to follow all products that you put in your shopping cart. UPC bar codes were created to help grocery stores speed up the checkout process and keep better track of inventory, the system was so successful, and quickly spread to all other retail products. But RFID tags have many advantages. The crucial advantage of RFID tag is data can be read outside the line-of-sight, whereas barcodes must be aligned with an optical scanner. RFID systems contains of three components: an RFID tag or smart label, an RFID reader, and an antenna. An RFID tag includes an integrated circuit and antennas, which are used to carry of data to the RFID reader (also called as interrogator). Then the reader converts the radio waves to a more utilizable form of data. This technology can perform tasks such as: inventory management, asset tracking, personnel tracking, ID badging, supply chain management, etc. Most companies invested in RFID technology only use the tags to track items in their control. Many of the benefits of RFID come when items are followed up from company to company or from country to country. Human-Machine Interfaces: Human-machine interface (HMI) is another function that
demanding processing power. Easy to use, visual interfaces facilitate operator control of machines. High-resolution screens allow viewing the output of high-definition cameras inspecting goods as they are manufactured. Cloud Computing: Cloud computing is one of constructive blocks in foundations of the internet of the future which can allow the management of all these systems in a dynamic manner, swift and comprehensive, in the most varied volumes and ratios (Correia, 2014). Cloud computing is the technology that can storing, accessing data and programs over the Internet instead of your computer's hard drive. When someone stores data or runs programs from the hard drive, that's called local storage and computing. Cloud computing is very important for the continuing development of the Fourth Industrial Revolution. Cloud tech helps to pool and centralize information for your business, while also offering a platform for open source collaboration to expedite and refine research for entire industry gains. Cloud computing assistant business in all industries adapt to today's rapidly changing technology. With AI and automation being integrated more frequently into industry, cloud computing is a way for businesses to easily modify with the times without losing data. Smart Sensors: Development and spread of smart sensors is one of the major improvements in automation. A good working "smart sensor" definition comes from Tom Griffiths, product manager, Honeywell Industrial Measurement and Control (Cleveland, 2006). A smart sensor has also been called an intelligent transducer with the terms also expressed as a smart transducer or intelligent sensor. A smart sensor must communicate. Main job of those sensors is to aid manufacturers run the work smoothly and easily. Sensors will be at every stage of production will exchange data in real time which will then be analysed to guarantee the ideal operation. A key characteristic of intelligent sensors is that it processes the input signal at a logical level, on account of increase the level of information processing. The smart sensors can aid minimize installation and increase equipment uptime. Smart sensor takes input from the physical environment and handles data by performing predefined operations and functions. The specific input could be light, water, heat, humidity, motion, touch, pressure, or any one of a great number of other environmental factors. This technology integrates sensors and circuits to process information obtained from the environment with-
out a significant human interference, and this is the benefit of using smart sensors. Various kinds of smart sensors can be used for production tracking and historical trace requirements. Smart Factory: The term smart factory describes a vision of what industrial production will look like in the future. In this vision, the smart factory will be much more intelligent, flexible, automated, cheaper and dynamic in industry. Terms such as smart production, smart manufacturing, smart factory, and advanced manufacturing among others that may exist are synonyms for the same technological term used. Information technology (IT) and operations technology (OT) have made the transformation of the supply chain progressively and increasingly possible (Burke et al., 2017). Each factory has implemented a smart factory in distinct ways to reach a variety of goals. Some of the smart factories are about sustainability or zero-waste production. When the smart factory is success, it will represent an important shift for Industry 4.0, as the revolution will begin to roll out across multiple verticals. These are capable of producing a more rapid and effective decision-making of smart factories. There are some significant advantages also using these technologies. Using these new technologies makes you more competitive. To stay competitive, you have to have the systems and technology in place to allow you to ensure the same level of service (or better) to your customers and clients. Definitely, companies that invest in advanced, innovative Industry 4.0 technologies are better positioned to attract and retain new workers. They increase efficiency, boost collaboration among departments, allow predictive and prescriptive analytics, and allow people including operators, managers, and executives to make better decisions while managing their day-to-day responsibilities. It allows companies to address potential issues before they become big problems. Automation can help companies and manufacturers to be more proactive when solving potential maintenance and supply chain management issues. Industry 4.0 technologies helps companies operate and optimize all aspects of your manufacturing processes and supply chain.
2.1 Cyber physical systems

The term "cyber-physical systems" showed up in 2006, coined by Helen Gill at the National Science Foundation in the US (Lee, 2015). The roots of the term CPS are older and deeper. The increment of cyber-physical systems introduces the fourth stage of industrialization, generally known as Industry 4.0. Driven by the need to advance reliable systems for renewable energy, wireless health, advanced manufacturing, smart materials, and electrified ground and air vehicles, the research and progress effort for CPS offers an unprecedented opportunity to redesign and rethink numerous existing concepts and systems. The basic assumption in terms of cyber–physical production systems is reflected in the research and defining relations through the prism of autonomy, cooperation, optimization and response to the assigned tasks (Hozdić, 2017). In cyber-physical systems are addressed for systems purpose of industrial integration production. In an easy and overall way, it can be defined that the cyber-physical systems, are systems allowing to humans performing complicated tasks requiring a minimum of suitability and specialized education. Cyber-physical systems are more productive intelligent and efficient. They are composed from diverse constituent parts that associate together to create some global attitude. These constituents will include software systems, communications technology, and sensors that interact with the real world, often including embedded technologies. It is using computational capacity. The economic and societal potential of such systems is very greater than what has been realized, and major investments are being made global to develop the technology. One cyber-physical system will often contain components from many different manufacturers or service providers, and therefore many businesses are already contributing towards cyber-physical systems without being aware of it, as their products and services are integrated with others to create new cyber-physical systems. Also, cyber-physical systems are of great importance in the industrial production, in order to meet customer requirements. A cyber-physical system (CPS) is a unification of computation with physical processes whose behaviour is defined by both cyber and physical parts of the system. CPS is the intersection, not the union, of the physical and the cyber. We are now experiencing the Fourth Industrial
Revolution from the point of cyber-physical systems. These systems are industrial automation systems that facilitate much innovative functionality through their networking and their entry to the cyber world, thus changing our everyday lives importantly. Recent advances in manufacturing industry has paved way for a systematically deployment of cyber-physical systems, within which information from all related perspectives is closely monitored and synchronized between the physical factory floor and the cyber computational space (Lee, Bagheri & Kao, 2015). However, there are considerable challenges, particularly because the physical components of such systems introduce safety and reliability requirements qualitatively different from those in general-purpose computing. A collection of challenges not always found in a classical business information system or embedded system. Furthermore, physical components are qualitatively different from object-oriented software components. Standard abstractions based on method calls and threads do not work. To realize the full potential of CPS, we have to rebuild computing and networking abstractions (Lee, 2008). Sectors, family life, markets, etc. will have to be redefined because these changes will also strongly influence the society and people.

2.2 Industry 4.0 and Industrial Internet of Things (IIoT) difference

The industrial internet of things, or IIoT, is the use of IoT technologies to enhance manufacturing, industrial processes, and applications. In addition, IIoT is a subset of IoT, aimed specifically at industrial applications. IIoT is about, as its core, connecting machines to other machines/data management and the optimization and fertility. It is connecting devices on the plant floor, allowing for the development of cyber-physical systems and inter-device communication, which provides alternative ways to generate and gather interesting data throughout the industrial space. First, General Electric talked about IIoT. The IIoT prominently illustrate the convergence of IT and OT. Obviously, IIoT technologies aid field service technicians detect potential issues in customer equipment before they become major issues, enabling techs to set aright the problems before they inconvenience customers. The IIoT system will send momentary alerts to stakeholders if the goods are
damaged or at risk of being damaged, giving them the chance to take immediate and preventive action to solution the situation. On the other hand, Industry 4.0 is a mixture of digitalization, new technology, and practical decisions focused on dramatically changing how we manufacture products through unprecedented flexibility, efficient production, and visibility at all level of production. Industry 4.0 focuses principally on the manufacturing sector. However, IIoT consist all sectors where industrial/professional equipment is used. Industry 4.0 is closely associated with governmental and institutional initiatives, and only winning traction in professional setting. Industry 4.0 is an increased visibility, flexibility, and efficiency across our production to be more competitive. In contrast, IIoT is an allowing force for Industry 4.0: connecting our devices, our data, our devices, and our people to utility our company and customers. Industry 4.0 consist not only the connection of assets and data management but the digitization of the entire value chain. By accepting both, it is easier to reach positive outcomes and sustain global competitiveness.

3 Smart Factories

Industry 4.0 encourages what has been called a "smart factory". "Smart" is about collecting data from the manufacturing process, and turning that data into information and then acting on that information. Industry 4.0 is a current trend in manufacturing that involves a combination of cyber-physical systems, automation and the IoT, which together create a smart factory. The smart factory is the concretion of all recent IoT technological developments in computer networks, data integration, and analytics to bring transparency to whole manufacturing factories. It represents a context-sensitive manufacturing environment that can handle difficulties in real-time production using decentralized information and communication structures for an optimum management of production processes. The introduction of IoT devices to the factory is the most powerful and effective ways to begin the transformation into a smart factory. The smart factory will substantially change how products are invented, manufactured and shipped. Machines take up the human role in factories. But still the human integra-
tion is inevitable with a digital, electronic, virtual world, so that our work is preceded by further development of production systems in terms of reliability, efficiency, safety, etc. (Hozdić, 2017). This contains AI, machine learning, and automation of knowledge work and machine-to-machine communication with the manufacturing process. It will improve worker safety and protect the environment by enabling low-emissions and low-incident manufacturing. The arrival of smart factory technology except significantly that how highly automated production machines and assembly lines change from producing one product to another. Smart factory is considered an important outcome of the Industry 4.0. A highly digitized and connected production facility that relies on smart manufacturing is smart factory. The smart factory is a flexible system that can self-optimize performance across a broader network, self-adapt to and learn from new conditions in real or near-real time, and autonomously run entire production processes (Burke et al., 2017). Visibility, connectivity and autonomy are defining of smart factory structure. The structure of Smart factory is the seamless connection of singular production steps, from planning stages to actuators in the field. The physical systems become IoT, communicating and cooperating both with each other and with humans in real time via the wireless web (Marr, 2016). The smart production environment, is structuring the smart factory. The structure of a smart factory can include a combination of production, communication technologies and information, some with the potential for integration across the entire manufacturing supply chain. For a smart factory, it must be supported by a background system that takes information from both the virtual and physical worlds surrounding it. The infrastructure can be operated independently in operational decision-making with less human intervention. Diverse markets spanning healthcare to consumer goods will adapt Industry 4.0 technologies primarily modelled in the smart factory. Used by manufacturing companies, a smart factory works by employing technology such as AI, robotics, big data, analytics and the IoT, 3D print, and can run largely autonomously with the capability to self-correct. Manufacturing processes will be organized differently, with entire production chains – from suppliers to logistics to the life cycle management of a product – closely connected across corporate boundaries. Individual production steps will be seam-
lessly connected. The processes impacted will include: Factory and production planning, Product development, Logistics, Enterprise resource planning (ERP), Manufacturing execution systems (MES), Control technologies, Individual sensors and actuators in the field. A smart factory, machinery and equipment will have the capability to advance processes through self-optimization and autonomous decision-making. In the vision of a fully connected smart factory, every facility is connected to the others and the entire enterprise is linked across departments and externally to customers and suppliers. In this way, needs and activities can be followed up and collaboration is enabled across the extended enterprise to enhance speed and efficiency. And the structure isn’t just confined to the four walls of a factory, it goes much further and influencing the entire supply chain. There are five key characteristics of a smart factory: connected, optimized, transparent, proactive, and agile (Burke et al., 2017). Possibly the most important feature of the smart factory, its connected nature, is also one of its most important sources of value. Smart factories request the underlying processes and materials to be connected to generate the data essential to make real-time decisions. The connected factory is a total reorganization of the approach to production with using existing tools. A smart factory which is working correctly can fitted with smart sensors so systems can continuously pull data sets from both new and traditional sources, ensuring data are frequently updated and reflect current conditions. An optimized smart factory allows operations to be executed with minimal manual intervention and working with high reliability. In addition, it contains automated workflows, synchronization of assets, improved tracking and scheduling, and optimized energy consumption. In the smart factory, the data captured are transparent: Real-time data visualizations can transform data captured from processes and fielded or still-in-production products and convert them into actionable insights, either for humans or autonomous decision making (Burke et al., 2017). In a truly working smart factory, the manufacturing process becomes transparent from beginning to end, and this transparency goes on the further side of the factory floor to the supply chain to the delivery process and stretches out to the user experience. A transparent network can make possible greater visibility across the facility and ensure that the organization can make more correct deci-
sions by providing tools such as role-based views, real-time alerts and notifications, and real-time monitoring (Burke et al., 2017). Employees and systems can anticipate and move before matters or challenges arise, rather than simply reacting to them after they occur in a proactive system. With this feature, factory include identifying anomalies, restocking inventory, identifying and predictively addressing quality, and monitoring safety and maintenance concerns. Agile flexibility enables the smart factory to adapt to schedule and product changes with minimal intervention. The developed agile factory prototype transfers agile software engineering techniques to the domain of manufacturing (Scheuermann et al., 2015). Also, an agile factory is component based, using trackable mobile work tables in combination with constant workstations. Accordingly, any product with its associated request is trackable during assembly-time which enables us to implement a customer feedback loop. The feedback loop allows replacement requests during assembly-time. Besides, agility can increase factory uptime and efficiency minimizing changeovers due to scheduling or product changes and facilitate flexible scheduling. These characteristic features afford producers greater visibility against their assets and systems, and let them to navigate some of the challenges faced by more traditional factory structures, ultimately leading to improved productivity and greater responsiveness to fluctuations in supplier and customer circumstances. Over the next years, to 2025, industry will use the smart factory concept to roll out, spearheaded by companies at the high end of manufacturing, such as automotive and select consumer electronics manufacturers. While automation and controls have existed, the entirely smart factory has only recently earned traction as a viable pursuit for manufacturers. Five big trends seem to be accelerating the drive toward smart factories. First one is rapidly evolving technological capabilities. Technology has a large share in our lives. We are now using the most advanced version of technology from large areas such as medicine, management, industry. Before a company can have a smart factory, it needs to detect equipment and processes that generate valuable data. Until recently, the realization of the smart factory has improved the products and made happier customers. Furthermore, the abilities of technologies themselves have grown even complexed: AI, cognitive computing, and machine learning have allowed systems to
commentate, adjust to, and learn from the data collected from connected machines. Furthermore, the abilities of technologies themselves have grown even complexed: AI, cognitive computing, and machine learning have allowed systems to commentate, adjust to, and learn from the data collected from connected machines. This capability to develop and adapt, coupled with powerful data processing and storage capabilities, enables producers to move beyond task automation toward more complex, connected processes and when producers achieved this hard task they use more technology to never lose. Next one is increased supply chain complexity and global fragmentation of production and demand. As producing has grown progressively global, production has fragmented, with stages of production extended within multiple facilities and suppliers across multiple geographies because companies want to grow. These shifts, coupled with the increased demand for local, and even individual customization; strong demand fluctuation; and increasingly limited resources, among other shifts, have made supply chains more complicated. Because of these changes, numerous manufacturers have found it significant to be agile, connected, and proactive to address ever-shifting priorities. Third trend is growing competitive pressures from unexpected sources. What is competition? It is an activity or condition of striving to gain or win something by defeating or establishing superiority over others. Race wins first in the sector. The increase in smart digital technologies has been threatened by completely new competitors to achieve digitalization and lower entry costs to take part in new markets or industries where manufacturers have never been before. Fourth one is organizational realignments resulting from the relationship of IT and OT. The increasing relationship of IT and OT has made it feasible for organizations to move many formerly plant-level decisions to the business-unit or enterprise level. Connected companies are becoming more visible because they are crossing the network beyond the four walls of the factory. Connectivity inside of the factory is not new and many manufacturers have long been stymied about what to do with the data they collect. This can brighten where inefficiencies obtain or where changes in one plant have resulted in complications in other facilities. The final trend is ongoing talent challenges. There are some multiple talent-related challenges. These challenges contain an aging workforce, an in-
creasingly competitive job market, and a scarcity of younger workers interested in or trained for manufacturing roles mean that many conventional manufacturers have found themselves struggling to find both skilled and unskilled labour force to keep their processes running. Many companies are making investments in smart factory capabilities to reduce the risk. Besides, this move can create a new set of talent-related outcomes, as automated assets typically need highly skilled personnel to operate and maintain; even the location of manufacturing facilities would need to take in consideration factors such as this. Also, these trends are not only about the government. Consumers will be more likely to seek out products that are using smart factories as their point of origination. In the near future, it will get to the point where consumers will avoid products that are crafted in traditional factories. If consumers have a choice they will choose the products that are coming from a factory that causes less influence and harm on the nature. Every smart factory could look dissimilar because of variations in line layouts, products, automation equipment, and other factors. Except that, simultaneously, for all the potential distinctions across the facilities themselves, the components needed to allow an accomplished smart factory are largely universal, and each one is important: data, information, technology, process, people, and security. Smart factory technologies will change the system entirely from the beginning and it will be more usable. Smart factories are becoming even smarter with AI, data analytics, AR and connected everything bring about an environment where self-correction, automatic streamlining and the elimination of expensive prototype development are entirely possible (Wright, 2018). Smart factory will make the interactions between humans, machines, and products become an extremely competitive and current area for market capitalization. With the foundations of smart factory based on IoT and cyber-physical system, diverse system technologies and architectures have emerged over the past few years. The AI bot monitors the whole production line and operation, collecting data from diverse sensors, machines and devices to teach it what the parameters of “normal” operations are. With the time, the AI bots experiences the intricacies of the factory and can advise on where to optimize or can even achieved this without human intervention. This fast, reactive process saves time and product loss, and rapidly becomes
proactive as the bot learns patterns and shapes, identifies triggers in advance. AI can then help with inventory review and monitoring market pricing. The result is having more direct demand prediction, along with the ability to buy at market lows. Other technology of smart factory is AR and it offers manufacturers a solution that can save them years in research and development, while also saving money, testing, rebuilding and retesting prototypes. AR devices can help with picking/kitting instructions, with potential productivity developments up to 40 percent. AR allows manufacturers to virtually ‘build’ a prototype and trial various materials, looks and feels, and make tweaks without ever making or using a single component. The biggest concern most manufacturers have when it comes to technologies such as AR, is the effect on specialist skills usually used in the concept stage. In addition to this, AR still requires expert opinion that only humans can provide to design and test the simulation as the engineering principles are still in effect. When AR is capable of to produce and test prototypes without physically building anything, and bots are able to augment with machines to optimize production and reduce risk, the results are smarter than ever. Many companies using augmented reality work instructions have reported 30+ percent productivity on specific operations. Companies which are using this technology have also realized improved quality for complex tasks. Factories have long relied on automation, but smart factories take this concept much further and are able to carry out without much human intervention. From early beginnings in 1954 when robots were used to automate the production robots have become steadily more developed. Using of robotics becoming ever more adaptive and responsive to their environment. Sensing devices, currently in development, will be able to communicate the need for new materials. In the next years, manufacturers will see the deployment of autonomous vehicles equipped with reliable sensing devices that will know when to collect and deliver production output. With big data, the volume, variety and rapidity of data produced through a myriad of connected devices in the smart factory will be of greatness greater than anything ever seen before. Within industry, Big Data is already being used to optimize production schedules for gaining real-time actionable intelligence has the potential to increase productivity, undertake pre-emptive maintenance and besides generate cost savings.
In the next years of data use, production information will be connected through to the supply chain from customer specification to raw material. Machine-to-Machine (M2M) communication systems are currently changing into systems of networks that transmit data to appliances. It contains a device (such as a sensor) to capture an event, status or fact which is relayed through a network to a software program that translates the captured event into meaningful information. There are two important enabling technologies for M2M communications are RFID and Near Field Technology (NFC). Implementation of these two technologies allows M2M communication in wireless mode, in this way opening a confined manufacturing space where the machines that are supposed to interact with each other do so flexibly and without unwanted interception but there are still in development. Additive manufacturing, or the other name 3D printing, is the process of starting production with slack material, either liquid or powder, and then building it into a three-dimensional shape using a digital template. 3D printing is already used to make some design items, such as medical implants, and to produce plastic prototypes for engineers’ designers, producers. These technologies that I described above must be bonded together to obtain, transfer, interpret, and analyse the information, and to control the manufacturing process as intended. Also, these technologies will know precisely what components need maintenance and helping to reduce the risk of equipment failure by the time. Using these technologies will make it possible to: Transfer large quantities of data in real-time and with minimum delay, connect a large number of individual devices in a very reliable manner and with the highest standards of data security, utilize more wireless technologies, both within the plant and for remote connectivity, Operate in an energy-efficient manner. A lot of money and time has been spent and will be spend to control production processes to deliver intended quality outputs. Through the usage of these modern technologies, the smart factory systems can learn and adapt in near real time, making possible factories that are far more flexible than those of the past. Producers are taking up seriously smart technologies to improve efficiencies in their factories. The adoption of the smart factory can be a crucial process that can transform the interaction of engineered systems just as the internet transformed the way people interact with information. A smart factory works by utilize
technology such as AI, robotics, analytics, big data and the IoT and can operate largely autonomously with the ability to self-correct. The use of these technologies even helps the manufacturer, the environment and even the nature. Manufacturers expect for smart technologies to drive a sevenfold increment in annual yield winnings by 2022. Some industries can wait for to almost double their operating profit and margin with smart technologies. The successful integration of Industry 4.0 and cyber-physical systems ensure significant benefits for the overall manufacturing industry. The smart factory logic contains automation of factory floors, M2M, robotics working 24 hours, seven days a week, and remote operations of components. When something is amiss, the ideal smart factory runs itself on a much larger scale, self-correcting where suitable and alerting for human intervention where needed. The main advantages of smart factories: Predictive maintenance: The visibility of smart factories enables manufacturers to catch problems or maintenance matters before they create an important effect on the rest of the equipment or the entire production chain. Systems can sense when problems are arising this can provide advanced warnings when pieces of equipment are about to fail. Furthermore, machinery can be fixed. Predictive analytics allow companies to ask proactive questions like, “what is going to happen,” and, “what can we do to prevent it from happening?” This sight of smart factories also evolves safety on the factory floor for employees by reducing the risk of accidents from malfunctioning equipment. Asset efficiency: Asset efficiency is a performance attributes describing the capability to optimally utilize assets in support of generating revenue or performing a task (Burke et al., 2017). Every direction of the smart factory generates data that, through continuous analysis, reveal asset performance issues that can require some kind of corrective optimization. This is one of the most evident benefits of a smart factory. Quality: Aspects of smart factories, such as digital twins, allow the constant following of the quality of products before they are released in the market. Smart factories are capable of implementing a corrective course of action on their own smart factory can predict and detect quality defect trends sooner and can help to detect discrete human, machine, or environmental causes. And a better-quality process also may mean a better-quality product. Lower Cost: The self-optimization characteristic of smart factories
helps facilitate processes and provides feedback for manufacturers to identify unnecessary or counterproductive steps on the whole production chain. With this knowledge, they can decrease costs related to excessive inventory or unexpected production volume. Safety and sustainability: The smart factory can also impart real benefits around labour wellness and environmental sustainability. Smart factories will become more robust and safer. Greater process autonomy may ensure for less potential for human error, including industrial accidents that cause injury. Undoubtedly, the role of the human worker in a smart factory environment may take on greater grades of judgment and on-the-spot discretion. Manufacturers can adjust increase yields, improve quality, and reduce waste. The Speed of Innovation: With data patterns from the initial production process through to client usage provides ample benefits beyond factory maintenance and business development getting better acquainted. This information can be used to inform engineering teams about components that reason production defects, boosting waste. Reduce workforce challenges: Automation helps manufacturer’s initiate and complete projects with fewer workers. Having real-time access to data across plural platforms frees workers to focus on their core responsibilities and increases their ambition for working. This allows manufacturers to innovate faster without investing in extra resources. It creates labour yields that result in fewer or more-productive man-hours. Streamlined and automated data: Smart technologies automate data gathering and ensure advanced production analytics, so executives can make more informed and intelligent decisions. In a smart operating environment, manufacturers can connect their operations technology with business systems to measure their key performance indicators counter business goals. As highlighted above, the main benefits of the smart factory is a more efficient, increased agility, maximum flexibility, improved predictability, proven productivity and transparent way of working, which leads to greater efficiencies. More importantly, benefits of being a smart factory of the future are not only customer facing. Although customer centricity is a substantial part of the modernization strategy, a thorough refresh of technology needs to be applied all along the organization. In addition, it is important for manufacturers to understand how they want to compete and align smart factory investments. In conclusion, the investment of building a
smart factory benefits producer by creating a safer and more trustworthy plant.

Considering Industry 4.0 and smart factory, many manufacturers and companies seem to be overwhelmed by challenges. An enterprise, despite the positive factors of smart factories, it can make a big choice for adapting new technologies and system and do this for evolving itself. Even a small change in the manufacturing process can be a severe decision for an enterprise, because it may harm the enterprise’s reputation with its customers as well as the quality and speed of its production. A smart factory with fully implemented, consequently, involves not only setting it up but also preparing for the challenges it may show up. Whether or not to invest in smart factory, manufacturers may be thinking about some of the potential challenges associated with incorporating new technology and processes in organization. This, in turn, composes a risk to the sustained uptake and growth of smart factory. In a smart factory also expands the enterprise’s attack surface, which may not be always fully considered in traditional security measures, e.g. and probably one of the most urgent concerns is how to guarantee the cyber security of the smart factory. By implementing connected technologies, as their nature, also factories are opening their gates to security problems. Smart factories are required to expand far beyond the walls of their own facility because of their connected structure. Naturally, this increased connectivity brings new operational risks and unknown security challenges. Probably one of the most urgent concerns is how to guarantee the cyber security of the smart factory. Manufacturers who have implemented Industry 4.0 technologies suffer many of the same cyber-security threats as other industries. However, not all cyber-security breaches in the manufacturing industry are a result of malevolent attacks. When planning for Industry 4.0 implementation, manufacturers should also consider training and preparing their staff on the importance of cyber-security measures. This method can help manufacturers to prevent from accidental data losses and improve the overall security strength of the facility. The other challenge about smart factory is unpredictable costs. Because of automation, there can be several unpredictable costs that may exceed the actual cost. Some of these costs could contain research and development costs of automating a process, preventative maintenance costs, and the
cost of training employees to set to work automated machines. In general, the latest technological innovations are the most expensive. Cash-strapped companies can slow down updating their production due to the increased costs of new technologies, such as setting up robots on a production line and training workers' use. Moreover, once a company try to making a transition to a particular technology, the time, effort and cost of doing so can force the factory from updating itself yet again when technology changes in a few years.

4 Relation between Industry 4.0 and Smart Factory

Industry 4.0 is a binder term in production and networks the entire value chain. This means it connects machinery, products, people and systems so as to allow processes that are largely automated. The term smart factory is a new manufacturing trend with end-to-end, modern, connected technology. Industry 4.0 and the smart factory is really the future because integration of new production technologies geared towards improving work conditions, to increasing productivity and enhancing the production of quality plants. Around one-fifth of German companies have applied primary Industry 4.0 projects at present. The forerunners are major companies with an IT budget of over than ten million euros. The smart factory of Industry 4.0 can ensure a remedy and solution for handling the complexity through the establishment of intelligent products and production processes. As Industry 4.0 moves from potential to reality, it’s obvious that no single company or organization can do it alone. Each smart factory would wish transformation support across solution design, technology, and change management dimension. Furthermore, to power up smart factory, manufacturers should create and collect ongoing streams of data, manage and store the massive loads of information generated, and analyse and act upon them in varied, potentially sophisticated ways. Investing in a smart factory configuration can enable manufacturers to diversify themselves and function more effectively and efficiently in an ever-more complex and quickly shifting ecosystem. Materialization of smart factory will be possible with the increased adoption of IoT and CPS. Smart factories modify considerably as companies that use them utilize components
and processes that are specific to their respective products. In addition, smart factories can still be distinguished by certain shared characteristics that set them apart from traditional factories. Smart factory will make the mutual effect between humans, machines, and products become an extremely competitive area for market capitalization. The principle of a smart factory can not only be applied locally, but machines at different locations all over the world can be connected to create one big, virtual factory. To become a mainstream in this time, Industry 4.0 and the smart factory need more standardization and more transparency. Now, smart factories can adapt to workflows in real-time, by machines communicating with each other machines, and humans. By connecting all of the parts of the manufacturing process, a producer can facilitate and speed up the process of building and testing applications against every platform. This system brings together people, operations and products to make possible continuous delivery of value to a company’s customers. Even though, the smart factory plays an important role in Industry 4.0, it faces many challenges including structural, operational, and managerial independence of the shop floor and enterprise constituent systems, interoperability, plug and play, self-adaptation, reliability, energy-awareness, high-level cross-layer integration and cooperation, event propagation and management, and industrial big data analysis (Access, 2017). The reasons for most companies to shift towards Industry 4.0 and automate manufacturing include: Increasing productivity, minimizing human/manual errors, optimizing production costs, focusing human efforts on non-repetitive tasks to improve efficiency. The Fourth Industrial Revolution is forcing companies to re-examine the way they do business that’s why some manufacturers could decide to compete via speed, quality, and cost, and may invest in smart factory abilities to bring new products to market faster, increase quality, and reduce per-unit costs. Business leaders will need to figure out that they are dealing with a changing environment. They need to challenge the assumptions of their teams and keep innovating and adjusting for developing. Business and the global economy will evolve by smart factory and Industry 4.0 and these terms includes the convergence of innovative technologies, methods, materials and products. Another dimension of Industry 4.0 is the use of new smart factory machines that adapt to the requirements for the part be-
ing made. And so, this makes possible a highly flexible, lean, and agile production process enabling a variety of different products to be produced in the same production facility.

5 Conclusions

Each revolution requires an advanced technology tools and systems. Industry 4.0 is a new era and it can be highly flexible in production volume and customization (Shrouf et al., 2014). Industry 4.0 presents a new wave of revolution and smart factories. Smart factory and Industry 4.0 are the key of business world, trade, government, and numerous sectors. New advanced technologies are implemented on manufacturing industry. Due to these developments, there will be more efficient global business world. While using these implementations, resources, workers, and other helpers will use beneficial with advantages. In further, smart factories emerges a more convenient area in industry and other sectors and thanks to this our world will more liveable for our future generations. Moreover, smart factory presents efficient and powerful solutions and improvements like automation reduces the using of energy, AI helps humans, AR creates new aspects, 3D printing shows new designs. Industry 4.0 is a mixture of digitalization, new technology, and practical decisions. Industry 4.0 also presents flexibility, efficient production, and visibility at all level of production. Industry 4.0 and smart factory when are binding together, our ecosystem which we have in, will more effective and efficient in an ever-more. Global economy will evolve by smart factory and Industry 4.0 and, these terms includes the convergence of innovative technologies, methods, materials and products. In connection with this both terms, these improvements also can facilitate and speed up the process of build and test applications against every platform. Manufacturers take seriously these developments to improve their business. In addition, manufacturers as well as suppliers must work to adapt infrastructure and education as they embrace the technologies of Industry 4.0. In conclusion, the successful integration of Industry 4.0 and smart factory ensure significant benefits for the overall industry and humans.
6 References


OTTO Motors. (n.d.). 5 Key Industry 4.0 Technologies Changing Manufacturing. [online] Available at: https://ottomotors.com/blog/5-industry-4-0-technologies


Key Terms

<table>
<thead>
<tr>
<th>Industry 4.0</th>
<th>Smart factory</th>
<th>Industrial revolutions</th>
<th>Industry 4.0 technologies</th>
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</thead>
<tbody>
<tr>
<td>Cyber physical systems</td>
<td>Internet of things (IoT)</td>
<td>Artificial Intelligence (AI)</td>
<td>Smart factory structure</td>
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<tr>
<td>Integration of new production technologies</td>
<td>Manufacturing Industry</td>
<td>Smart factory logic</td>
<td>Industrial Internet of Things (IIoT)</td>
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Questions for Further Study

What are the components of Industry 4.0? Is there a global competition among companies?
Is governments have a role in developing smart cities? If your answer is yes what are the roles of government?
What is the difference between Industry 4.0 and lean manufacturing?
How does e-learning affect your organization?
Home automation is modular so you can ease into automation one room at a time. Will home automation be a major lifestyle adjustment?
How is 5G going to affect IoT? Explain Internet of Things architecture.

Exercises

Imagine that you are a manufacturer and have a factory, which revolution year do you prefer to live in to achieve your goal? Please define your business goal by giving examples.
Suppose that you are opening a start-up company and you have to gain profit. How can Industry 4.0 help your company to achieve in manufacturing industry?
The technologies which are triggered by Industry 4.0 are discussed in this chapter. Imagine that you are a manufacturer and have a factory. Choose five of these technologies for your factory and explain why you choose these technologies.
Think that you are living in 2050 and all factory structure has been changed by technological developments. Are smart factories have a significant environmental impact? The use of smart factory and Industry 4.0 will affect the business world. As an innovative manager in your company please discuss why would you implement the smart factory technologies? What are the features of cyber physical systems and is it affecting Industry 4.0?

Further Reading


