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Components of the Concept Industry 4.0

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Abstract—*This paper focuses on components of the concepts Industry 4.0. The basic components of the concept industry 4.0 are: Cyber-Physical System, Internet of Things, Internet of Service and Smart Factory. Industry 4.0 is a concept of interconnectivity of production machinery, machined products and semi-finished products and all other systems and subsystems of an industrial enterprise. Emerging Industry 4.0 technologies have a greater impact on Industrial enterprise and society and also known as digitization or full-scale automation. It is defined in relation to emerging technologies – advancements in IoT, big data and data analytics, robotics, autonomous systems, sensors and automation, and production methods, such as 3D printing. Industry 4.0 can be seen as a new trend in manufacturing (and relevant sectors). It is based on the integration of a set of technologies that enable ecosystems of intelligent, autonomous and decentralized factories and integrated products and services. Cyber-physical system is an important component of Industry 4.0 and is a combination of physical and virtual world. Internet of Things allows "things" and "object" as RFID, sensors, mobile phones integrate into unique links, which can work together with other objects to achieve a common goal.: Internet of Service allows provision of services via the Internet. IoS consists of participants, infrastructure services, business models and services themselves. Smart factories are defined as factories and machinery to assist people to complete their tasks. Smart factories are drivers of Innovation. These systems perform their tasks on the basis of information from the physical and virtual world. Examples for information from the physical world is as location or condition of the machine and examples for the information from the virtual world is as electronic documents, drawings or simulation models. The characteristics of Industry 4.0 are: Interoperability; virtualization; decentralization; real-time capability service orientation; modularity; convergence; cost reduction and efficiency and mass customization.*

1. INTRODUCTION

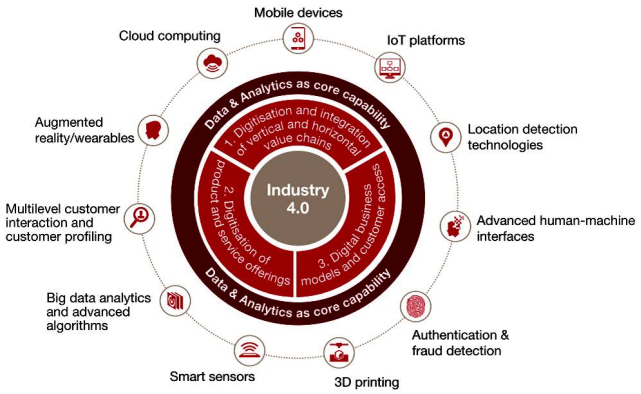
Industry 4.0 is a name given to the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Industry 4.0 is commonly referred to as the fourth industrial revolution It is often described as digitization or full-scale automation. It is also sometimes defined in relation to emerging technologies – advancements in IoT, big data and data analytics, robotics, autonomous systems, sensors and automation, and production methods, such 3D printing.

Industry 4.0 is a comprehensive concept as well as a new trend in manufacturing, based on the integration of a set of technologies that enable ecosystems of intelligent, autonomous and decentralized factories and integrated products and services. The term Industry 4.0 is linked to the smart collection and application of real time data and information by networking all individual elements, so as to reduce the complexity of operations, increase efficiency and effectiveness, and reduce costs in the long term.

2. FOURTH INDUSTRIAL REVOLUTION

Fourth Industrial Revolution is characterized by the fusion of digitalization and automation in order to make machines smart, interactive, and easy to use. These new technologies will be a central part of our lives and will have a tremendous impact on the way we work. There will be new types of robots, which are able to interact with humans. This technology will complement human activity, especially cognition, combined with other emerging technologies to give us entirely new computer models. We tend to think of automation as classically rigid, costing hundreds of millions of dollars, but we are moving towards small-scale modular networks of connected machines that can respond to dynamic changes in requirements and therefore present entirely new possibilities of making use of automation for SMEs in Europe and in developing countries. Skills are needed to bridge the gap between engineering and computer science, machine learning, and artificial intelligence. How we work will change and involve a shift towards higher quality jobs. There will be robotic and automation designers, intelligent system engineers, and ecosystems of automation technologies. There will be a new software business in automation says the report “Industry 4.0: Opportunities Behind The Challenge. Background Paper” of UNIDO.

The exponential growth in digitization and internet connectivity is the backbone of the Fourth Industrial Revolution. It has the potential to propel societies forward, enable innovative business models and help governments address legitimate policy concerns. Digitization is transforming business models, the policy landscape and social norms.



Source: Industry 4.0: Building the digital enterprise

Figure 1: Industry 4.0 framework and contributing digital technologies

Leading industrial companies also expand their offering by providing disruptive digital solutions such as complete, data-driven services and integrated platform solutions. Disruptive digital business models are often focused on generating additional digital revenues and optimising customer interaction and access. Digital products and services frequently look to serve customers with complete solutions in a distinct digital ecosystem.

Fourth Industrial Revolution is going to have a massive impact on the economy as seen by, rise of the sharing economy, blockchain technology, and changes in manufacturing driven by 3D- and 4D-printing.

The sharing economy is a model in which people and organizations connect online to share goods and services. It is also known as collaborative consumption or peer-to-peer exchange. Two of the best-known examples of the sharing economy are Uber (transportation) and Airbnb (housing).

Blockchain is a digital “ledger” technology that allows for keeping track of transactions in a distributed and trusted fashion. It replaces the need for third-party institutions to provide trust for financial, contract, and voting activities. Bitcoin and other digital currencies are some of the most well-known examples of applications of blockchain technology.

3. CONCEPT OF INDUSTRY 4.0

Industry 4.0 is driven by 1) Digitisation and integration of vertical and horizontal value chains. 2) Digitisation of product and service offerings and 3) Digital business models and customer access

1) Digitisation and integration of vertical and horizontal value chains. Industry 4.0 digitises and integrates processes vertically across the entire organisation, from product development and purchasing, through manufacturing, logistics and service. All data about operations processes, process efficiency and quality management, as well as operations planning are available real-time, supported by augmented reality and optimised in an integrated network. Horizontal integration stretches beyond the internal operations from suppliers to customers and all key value chain partners. It includes technologies from track and trace devices to real-time integrated planning with execution.

2) Digitisation of product and service offerings

Digitisation of products includes the expansion of existing products, e.g. by adding smart sensors or communication devices that can be used with data analytics tools, as well as the creation of new digitised products which focus on completely integrated solutions. By integrating new methods of data collection and analysis, companies are able to generate data on product use and refine products to meet the increasing needs of end-customers.

3) Digital business models and customer access

Leading industrial companies also expand their offering by providing disruptive digital solutions such as complete, data-driven services and integrated platform solutions. Disruptive digital business models are often focused on generating additional digital revenues and optimising customer interaction and access. Digital products and services frequently look to serve customers with complete solutions in a distinct digital ecosystem.

The charactrestics of Industry 4.0 are: Interoperability; virtualization; decentralization; real-time capability service orientation; modularity; convergence; cost reduction and efficiency and mass customization

4. COMPONENTS OF THE CONCEPT INDUSTRY 4.0

Cyber-physical System: An important component of Industry 4.0 is a combination of physical and virtual world. This connection is made possible by the creation of the so-called cyber-physical system (CPS). Cyber-physical systems are integrating computational and physical processes, embedded computer and management processes retrospectively when serious physical processes complement of computer and vice versa. Development of CPS is characterized by three phases. The first generation of the identification technologies such as RFID tags, which are used for unique identification and tracking. The second generation of the CPS sensors equipped with a limited range of functions. CPS third generation are able to store and analyze data, are equipped with sensors and are connected to the network.

Internet of Things: The integration of the Internet of Things and Internet of service in the manufacturing process initiated by the fourth industrial revolution. Internet of Things allows "things" and "object" as RFID, sensors, mobile phones integrate into unique links, which can work together with other objects to achieve a common goal. CPS granted under the definition given above, it is possible these "things" and

"objects" deemed CPS. On this basis, the Internet of Things can be defined as a network in which CPS collaborate through unique links. Use of the Internet of things can be, for example, the Smart factories, homes or networks.

Internet of Service Internet of service allows provision of services via the Internet. IoS consists of participants, infrastructure services, business models and services themselves. Services are offered and merged into value-added services from different vendors, and communications via various communication channels. This approach allows different variants of distribution in the value chain.

Smart Factory Smart factory is also referred to as key advantages Industry 4.0 Smart factories are defined as factories and machinery to assist people to fulfill their tasks. This objective is fed on the basis of information obtained online, so is every moment possible to ascertain the status of the device, the position and the like. These systems perform their tasks on the basis of information from the physical and virtual world. Information from the physical world as location or condition of the machine, the information from the virtual world as electronic documents, drawings or simulation models. Based on the above definitions CPS and IoT can be described as the factory where CPS communicates through the IoT and helps to achieve its stated goals. Industry 4.0 Smart Factory Technical System

Table 1:Concept and components of Industry 4.0

Industry 4.0	
Concept	**Components**
1) Digitisation and integration of vertical and horizontal value chains. and 2) Digitisation of product and service offerings 3) Digital business models and customer access	1) Cyber-physical system 2) Internet of Things 3) Internet of Service 4) Smart Factory

5. MAJOR DIGITAL TECHNOLOGIES

Digital technologies have spread rapidly in all over the world. Six major digital technologies are:

1. Fifth-generation (5G) mobile phones
2. Artificial intelligence
3. Robotics
4. Autonomous vehicles
5. Internet of things
6. 3D printing

Fifth-generation (5G) mobile phones-5G wireless networks are the next generation of mobile networks. 5G networks are expected to outperform current 4G networks by providing data at a speed several hundred gigabits per second (G bit/s). Accommodating 5G will require using parts of the spectrum that have not previously been considered commercially useful, in particular above 3 gigahertz (GHz), and in the millimeter band that stretches from 30–300 GHz. It will also require new kinds of antennae Developments in smart phones have increased capabilities about 25 percent per year in the past five years. Even though mobile itself is hardly a new technology, it is its combination with the internet that makes it a disruptive force and one of the technologies with potentially the greatest impact for the developing world. Developing countries will need to closely follow developments taking place in 5G and start preparing for its eventual rollout.

Artificial intelligence -Definitions of artificial intelligence (AI) differ widely, but generally refer to computer systems that can perform tasks that normally require human intelligence— including visual and speech recognition, decision making, and language translation. Faster computing, “big data,” and better algorithms have helped propel recent breakthroughs in AI. Advances in AI will prove to be disruptive, resulting in new opportunities for collaboration between humans and machines, as well as a loss of traditional jobs such as legal analysts, financial and sports reporters, online marketers, anesthesiologists, diagnosticians, and financial analysts.

Robotics-. Among OECD countries, Japan, the US, Korea and Germany are the most “robotised” countries in the OECD and together account for almost 70% of the total number of operational robots. In terms of the adoption of industrial robots by sector, the use of industrial robots is the most highly concentrated in transport equipment with almost 45% of the total stock of robots, followed by electronic, electrical and optical equipment, with almost 30.Thirteen (13) Robots have been deployed in the Democratic Republic of Congo, in Kinshasa, to manage traffic

Autonomous vehicles-Autonomous vehicles (AV), or self-driving cars, attract major research spending from car companies as well as internet firms. Their proponents argue that they will reduce road accidents (for instance, through lane-keeping systems, auto-parking, and cruise control), ease congestion, reduce fuel consumption, improve the mobility of the elderly and disabled, and free up commuting time for other tasks.

Internet of things- The “internet of things” (IoT) refers to the interconnection of objects to internet infrastructure through embedded computing devices, such as radio frequency identification (RFID) chips and sensors. IoT products can be classified into five broad categories: wearable devices, smart homes, smart cities, environmental sensors, and business applications. IoT is quickly redefining service delivery and unlocking opportunities in multiple areas. Smart fitness sensors and trackers are transforming health care and improving personal fitness and health. Embedded sensors accurately relay moisture, air and water pollution levels, and resource levels, allowing for closer monitoring of environmental problems. Factories and supply chains use

smart sensors to improve the efficiency of manufacturing and distribution of goods.

3D printing-3D printing, a process whereby machines can print objects from digital files or scans, consists of adding successive layers of material to make a three dimensional (3D) object This technology has transformational potential for manufacturing, since it enables users to create smaller batches of highly customizable products at declining prices. In recent years, 3D printing has advanced to printing of body parts (titanium jaws, spines), exoskeletons, rocket parts, and even food. As prices have fallen, consumer-oriented devices have appeared on the market in recent years, allowing individuals to make three-dimensional solid objects locally, often using a computer-assisted design (CAD) file that can be downloaded from the internet. The "ink" used in the printer is usually plastic, but other materials—including epoxy resins, silver, titanium, steel, and wax—are also available. The revolutionary aspect of 3D printing lies in its digital nature: physical objects become digital information that can be remixed, reformulated, improved, and shared.

Block chain is a digital "ledger" technology that allows for keeping track of transactions in a distributed and trusted fashion. It replaces the need for third-party institutions to provide trust for financial, contract, and voting activities. Bit coin and other digital currencies are some of the most well-known examples of applications of block chain technology. Fourth Industrial Revolution have a massive impact on the economy as seen by, rise of the sharing economy, block chain technology, and changes in manufacturing driven by 3D- and 4D-printing.

The sharing economy is a model in which people and organizations connect online to share goods and services. It is also known as collaborative consumption or peer-to-peer exchange. Two of the best-known examples of the sharing economy are Uber (transportation) and Airbnb (housing).

The transition of traditional sectors to the digital economy is taking place at rapid pace, modifying established business models and generating new demands on innovation. According to *Workshop: "Innovation and the digital economy: What role for innovation policies?" 14 June 2017, Paris, OECD Headquarters*

-Networks and platforms are becoming ever more important and many manufacturing companies are trying to establish their own platforms;

- Innovation in a number of sectors increasingly requires combining different competencies as digital elements are added to traditional products as exemplified well by car manufacturing.

-Digital innovation has ambiguous impact on competition, as it tends to give rise both to active start-up creation connected to product innovation and low entry barriers, and to "winner-take-all" market structures due to economies of scale and network effects.

Successful platform companies and competitors see their customers and clients as assets worthy of innovative investment.. In Uber's business model, for example, smart apps make both the company's customers and drivers more valuable to both. As platform companies like Google, Apple, Facebook, Uber, Amazon, Airbnb, and LinkedIn relentlessly disrupt — and redefine — mainstream industries, the network effects is their "secret sauce" for success. Network effects increasingly determine innovation opportunity, value creation, and growth in digital markets. Network effects turn users into assets. Enabling network effects empowers users/customers to both directly and indirectly create new value. Network effects are special economic phenomena because they make their contributors more valuable to everyone in and on the network.

6. CONCLUSION

Components of the concepts Industry 4.0. are: Cyber-Physical System, Internet of Things, Internet of Service and Smart Factory. Industry 4.0 is a concept of interconnectivity of production machinery, machined products and semi-finished products and all other systems and subsystems of an industrial enterprise. According to *the Industry 4.0: Opportunities Behind The Challenge. Background Paper* If Industry 4.0 is to contribute to creating new wealth and further improve living standards, as the previous industrial revolutions, we have to:

1. Highlight the benefits of Industry 4.0, for people, planet and prosperity,
2. Make major efforts to train and educate people. Make technologies available and affordable so that they can be used in all countries
3. Ensure digital inclusion
4. Move from competition to connection and collaboration Take a customized approach to prepare for Industry 4.0
5. Implementation and Exploitation of the potential of Industry 4.0 to address climate change and conserve the environment

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