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DIGITALIZATION OF PRODUCTION – A CHALLENGE FOR THE INDUSTRY AND EDUCATION

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Abstract

Today's industry relies not only on raw material processing, but also on information. The huge amount of data obtained during the production process of goods and services; as well as information about the context of the production processes has made it necessary to account for, methodize, analyze and react in order to achieve a competitive market share. Fortunately, this technological leap has been able to support the above process, but the presence of those new technologies requires adequate preparation from the point of view of human resources too.

Keywords*: digitalization, Industry 4.0, information technology, education.*

1. The Fourth Industrial Revolution

When, in the second half of the XXth century, computers were introduced into industry, a completely new dimension of production was achieved. Since that point, these hardware devices have not changed much, but by linking them in networks and allowing them to make decisions without human intervention, they have taken the control of manufacturing processes to a new level. Cyber-physical systems and the Internet of Things (IoT), have now given us the term; the Fourth Industrial Revolution (**Figure 1.**). Thus, the Smart Factory can be implemented within Industry 4.0: networked manufacturing equipment has access to more and more data, and with the help of the right algorithms, it can be transformed into a more efficient, more productive system with less waste. After all, the strength of Industry 4.0 is that we have the ability to generate, collect, and process even more data in an industrial environment.

It is clear from the above statement that the concept of Big Data is a cornerstone of today's industry and provides a continuous source of data for evaluation. Data flow can be obtained from systems, sensors and mobile devices located inside and/or outside the production unit, and data collection can take place from both conventional and digital sources. This large amount of data is one of the great challenges for today's professionals, as it requires the development of new data interpretation methods that select the relevant data and make decisions based on it.

It is also necessary to use the evaluated data. The Smart Factory is the entity that does this automatically: the equipment automatically optimizes the processes, which are perfectly connected to each other. This, of course, means not only physical contact, but also further data exchange without loss or distortion between any points in the production unit. It not only increases its productivity with the help of internal data but, because of the adaptation process, also has an effect on environmental changes.

The development of computer technology has made possible the increase of computing capacity, and one of the benefits of this has been the widespread use of computer graphics.

This has been combined with a large amount of data processing and tools have come to light

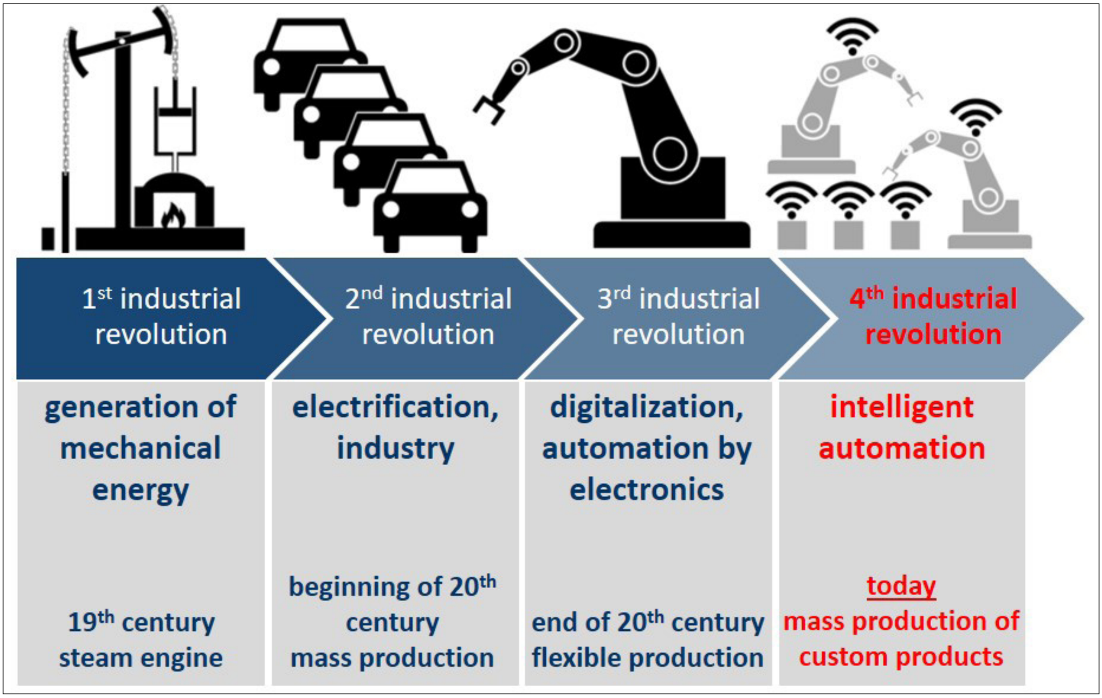

Figure 1. *The location of the 4th Industrial Revolution in the development of industry*

that have allowed lifelike modelling of products, production equipment and even production units. With the help of these, the virtual models were born, the examination and evaluation of which enables the examination of the products/services even before they are manufactured and implemented. This has led to cost reductions for products and a significant reduction in the time-to-market.

These models allow for the virtual commissioning of production systems, thus avoiding at an early stage a number of errors that could occur during the linking of different physical systems, as well as allowing for early development of controls before the hardware part of the system is physically completed. Nowadays, we can talk about extended computing devices that enable the application of cyber-physical models [1] and in which the integration of computing devices, networks and real production systems takes place. The automation of these systems has actually led to monitoring, controlling and optimizing real processes and systems through feedback. An example is the ABB RobotStudio software package [2], which allows building virtually a robotic cell and to program and coordinate the devices within the cell.

In this case, the same control software is built into the modelling tool as that which controls the real robots, therefore the control program can be transferred from the virtual world to the real production line without any problems when the real cell is built.

In addition to all this, today's developments have led to the integration of computer hard-ware and software into equipment that is not primarily for the computational / control task, but also for adaptation and learning purposes.

Based on the above, it is important to process the information. However, a prerequisite for this is that the information is available without time and space constraints. The Internet of Things (IoT) - which is a network born by connecting devices, mobile devices to each other and to the Internet - aids this. Thus, data provided via cloud-based services, in principle without restrictions, from various sensors and databases provide the input information to the computer devices, based on which they can plan their operation automatically, in advance or in real time. Because these devices can instantly exchange information or even help each other's work, the Internet of Things can be considered a mobile, instantly connected decentralized computing system.

The four technologies listed (Big Data, Smart Factory, Cyber-Physical Systems, Internet of Things) already existed separately in the early 2000s. Now is the time for the four pillars of the Industrial 4.0 era to work together: computing processes allow error-free data flow using the Internet of Things by interconnection of users, cyber-physical systems and intelligent manufacturing devices (**Figure 2.**).

The application of algorithms has undergone a major change in the last decade: it has moved from traditional IT systems to mobile devices and/or cloud services and can be used as market-mature products in the networked new industry.

A schematic picture of Industry 4.0 is presented by Clearpath Robotics, a subsidiary of OTTO motors in Germany, which clearly shows the reflection of real and virtual plant, the flow of information from outside the plant (**Figure 3.**). It also lists the technologies that, as feedback, have a positive effect on production and product quality: social machines, smart products (capable of providing information feedback during their lifetime, thus influencing design and construction), augmented reality operators (e.g., using special glasses to display additional information tied to real equipment), virtual production in an environment without spatial constraints.

Figure 2. *Industry 4.0 is a close and interconnected collaboration of four technologies (Big Data, Smart Faculty, Cyber-Physical System, Internet of Things)*

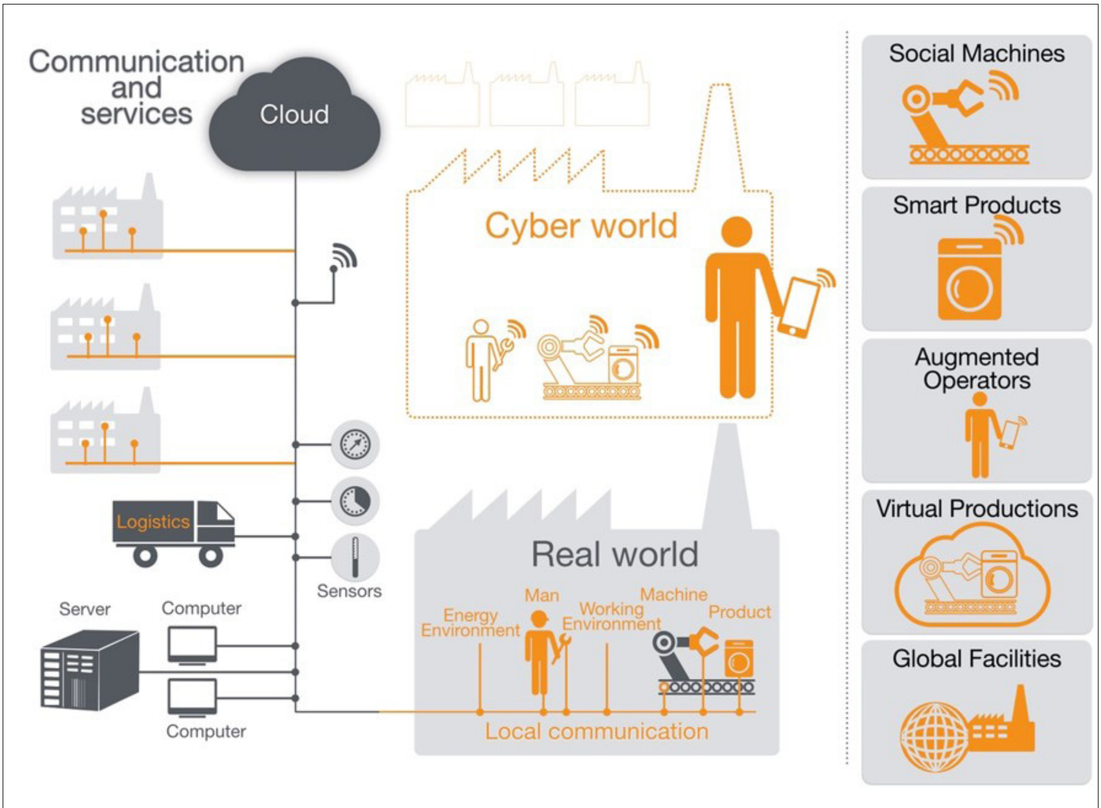

Figure 3. *Manufacturing unit and technologies of Industry 4.0* [3]

2. The challenge for education

The technologies and plant-level approaches listed here clearly support the goal of Industry 4.0: to achieve custom products on mass production lines. To achieve this, a company must not only be prepared at the level of technology, but also have the appropriate human resources to properly supervise and serve them.

In view of the above, Romania faces a difficult (but necessarily short) path, as the European Commission's 2019 Human Capital.

Digital Inclusion and Skills report (data from 2017) puts Romania at the bottom of the agenda in terms of demonstrating workers' digital competences (page 6): 26% have no digital competence at all **[4]**. In addition, these competencies are essential to achieving the goals of Industry 4.0.

The level of digital competence can only be increased by education among employees, which in turn can be achieved through a public initiative such as formal education in schools (e.g. use of computer) or by digitizing public offices. In the latter case, the wider population is forced to get closer to computer equipment in order to manage their life efficiently. In addition, the private sector can also contribute to the teaching of digital competences: in this case, however, we can no longer talk about such a wide-ranging education, but as a profit-oriented initiative, different industries can further narrow the digital competencies taught.

However, on 7 April 2015, Government Decree 245 established the National Strategy for Digital Romania 2020 (*Strategia Națională privind Agenda Digitală pentru România 2020*) **[5]**, and establishes a central office (*Agentia pentru Agenda Digita Digitala a Romaniei*), which oversees the implementation of the strategy. The Romanian industry does not feel the impact of this, as the strategy does not have a direct focus on it.

In the field of school education and adult education, the general development of digital competencies (e.g. the use of the Internet) is given priority in the strategy, but in today's digital age, the document does not provide focus for other digital knowledge that is essential for employees.

The need for these actions is not only urged by governments, but also by the economic sphere. For example, Joe Kaeser, President and CEO of SIEMENS AG, explained in July of this year, in the document Five Activities for a Stronger Europe **[6]**, published on the company's website, that by 2024, more than 50% of employees will need advanced digital skills to have a competitive industry in Europe. If this is a need for Europe, it is a multiple case for the Central and Eastern European region.

Accordingly, vocational education and university education can and must play a key role in adult education and life-long learning and retraining in order to catch up with digital competences.

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