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CHALLENGES OF CONCEPT INDUSTRY 4.0 IN THE CONTEXT OF INNOVATIVE BUSINESS SOLUTIONS

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Abstract: *People around the world are increasingly affected by the development and constant expansion of the Internet, which creates new possibilities for the global world. In order to human society development, it is necessary the expansion of information technology that surrounds us and we are increasingly using term Smart. Smart means an intelligent, sophisticated device that delivers a high level of functionality. What has ever been a vision, in this time has become a reality. Industry 4.0 is also called 4th industrial revolution. For all businesses and their stable market place, it is important to follow market changes and constantly develop. As the requirements of customers are becoming ever more exacting, and in order to achieve new competitive advantages based on changes in the industry, Industry 4.0 was introduced as a key way to future production.*

Key words: Industry 4.0; Smart Factory; Cyber Physical Systems; Smart Factory; IT trends

1 INTRODUCTION

Modern industrial enterprises pass through transformation in accordance with standard Industry 4.0. [12, 13] Standard Industry 4.0 is primarily a German way of accessing the new technologies in the production with a goal of efficiency improvement. Industry 4.0 is also associated with the name Smart Factory (SF). Individual businesses implemented in accordance with the SF standard may be linked to larger entities, such as virtual enterprises known as Cyber Physical Systems (CPS). [1,3]

Due to the complexity of such systems, it is necessary that Customer Relationship Management (CRM) has to be a part of production management – the system is then directly linked to Supply Chain Management.

Currently, most solutions exist only in the form of models or theories, maximally in the test run, where we can mention companies, for example, Trumpf, Festo, Bosch, Siemens (mainly German companies). Creation of such enterprises (SF) represents a completely new approach to the production realization, the structure of production units, the logistics and product lifecycle. [2]

2 CURRENT SITUATION OF INDUSTRY 4.0 STANDARDS IMPLEMENTATION

Current situation of Industry 4.0 standards implementation is still missing in practice. This is primarily due to the absence of a CPS system link between the customer and the supplier. In Fig. 1 is shown a basic model of the CPS system. [6]

In this way Industry 4.0 should communicate between customer and supplier and the production process, respectively logistics. And this can leads to the SP (Smart product) and also to the implementation of communication networks with linkage of SP into Internet of Things (IOT). [7] The realization of these things supposes the development and implementation of communication protocols to ensure safety communication. [4]

Successful implementation of functional production units (SF, CPS, and IOT) requires extensive structural and technological changes across the entire spectrum of production, logistics and consumption processes. Based on the information available, we can summarize the necessary goals that need to be met. By CPS creation, it is assumed that the different businesses are linked into individual units, and it is clear that is also necessary to define communication interfaces and standards and ensure their real implementation. Another problem with SF implementation is the lack of resources for management and administration of complex production systems. It is necessary to provide sufficient tools for planning and managing of such complex structures. By SF standards application, it is required a massive increase in the volume of communication in transmission systems. Together with the development and application of new production standards, it is necessary to ensure flexibility in the legislation and social policy of the whole society. It will also be necessary to develop lifelong learning programs to maintain workers in contact with the rapid development of society.

Utilization of a high degree of robotics and automation technology supposes a radical reduction in the number of operators in production and overall in the production process. Terms such as resource efficiency, energy saving, and raw materials recycling are among the most important from the perspective of Industry 4.0. It is obvious that to the implementation of a full–valued production system in compliance with Industry 4.0 leads a very long way. However, the transition from Industry 1.0 to Industry 4.0 was significantly longer because it runs a few centuries, which is also illustrated in Fig. 2.

As it was already mentioned, Industry 4.0 is based on the utilization of cyber-physical systems. The integration of IT technologies that connects products to the Internet enables achievement of new innovative services such as remote diagnostics, maintenance,

production process, etc., in a cost-effective and efficient way. It also helps to realize new business models, operational concepts, and more generally to focus more on customer and its individual demands. And when we sum up all of these facts, the priority goal of Industry 4.0 is to develop digital factories that have the goals that are summarized in Tab. 1.

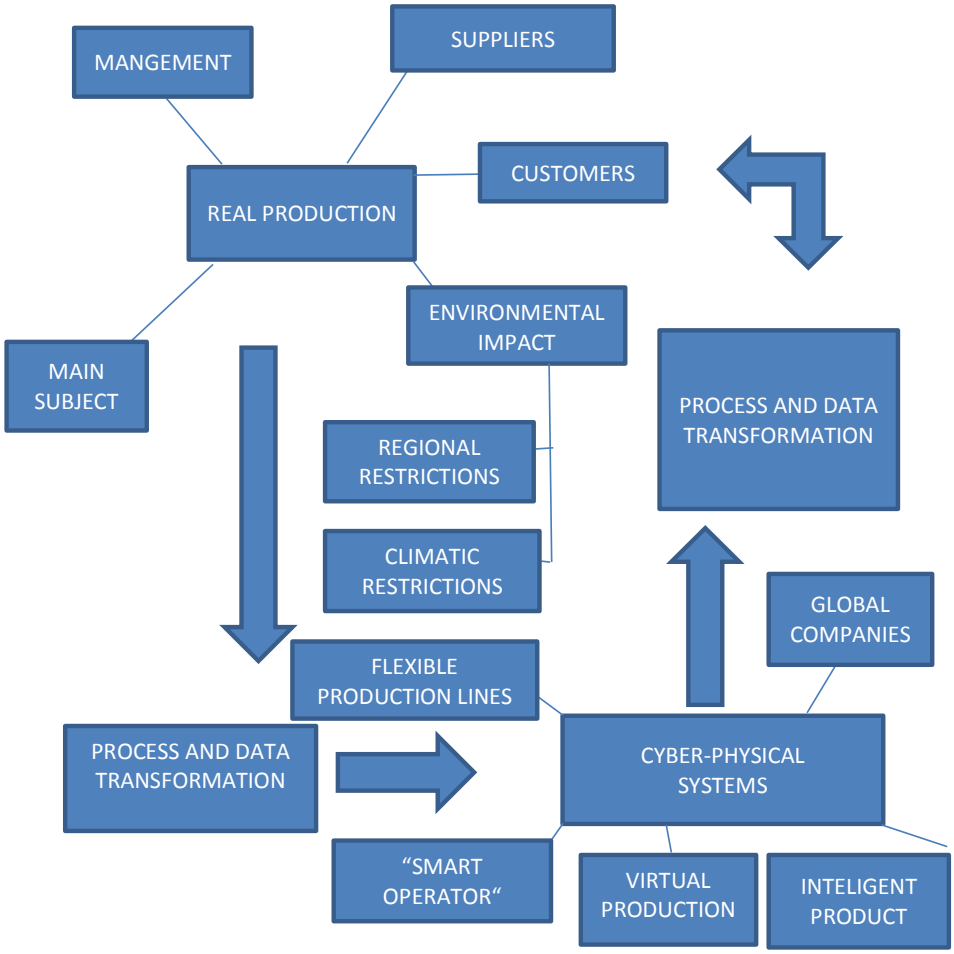


Fig. 1 Basic model of CPS system [5]

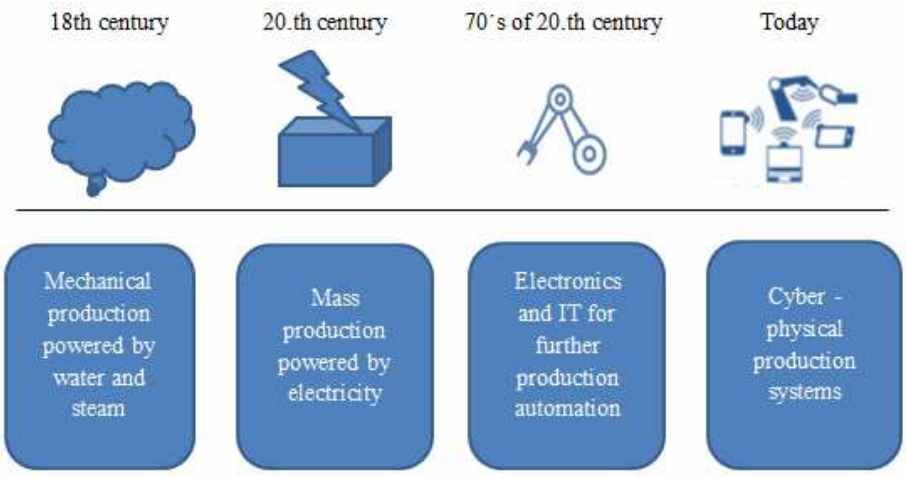
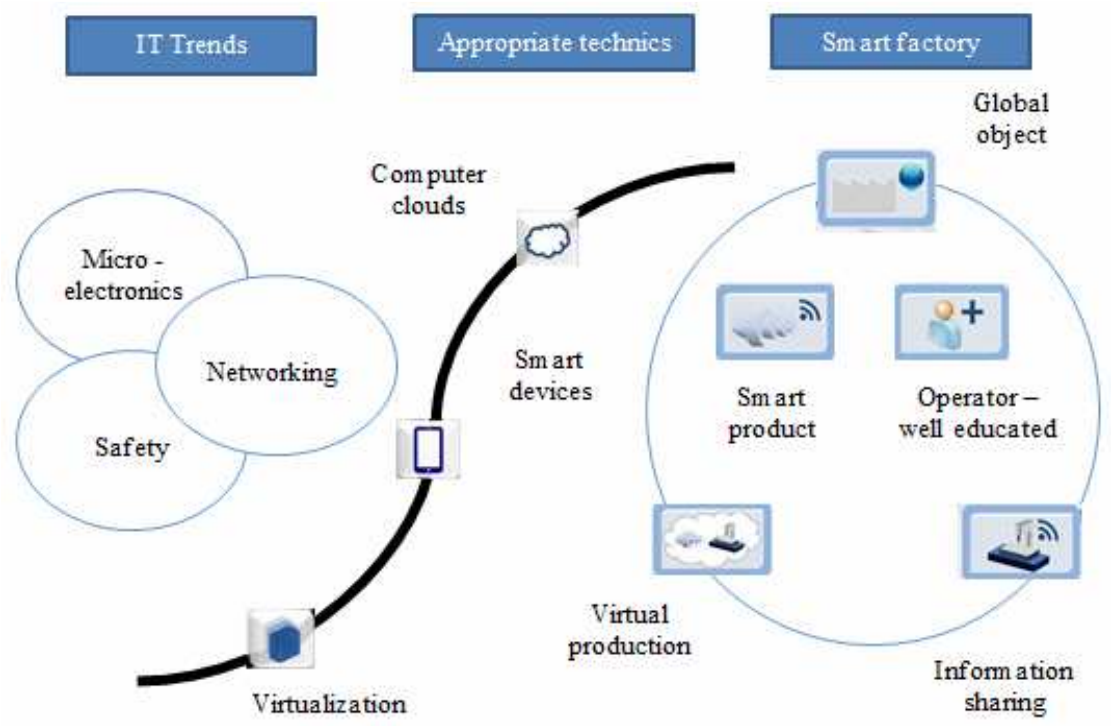


Fig. 2 Development cycle of industry [4]

Table 1 Digital factories and their goals

Goal	Characteristics
Smart networking	Automated systems and equipment, internal logistics systems, and operational supply will be linked with technologies. This will result in direct access to higher-level processes and services. It also opens space for completely new value-added innovations and business models that will optimally exploit resources and smart operation.
Mobility	Devices such as smartphones and tablets directly intervene into industrial automation. Such spatially independent access to processes and services of automated systems will allow a new dimension for the diagnostics, maintenance and operation of these systems.
Flexibility	Industry 4.0 will have high flexibility in development, diagnostics and maintenance as well as in automated systems operation. These systems will allow choosing the best offer from a large group of component, module and service suppliers. To so-called Big data will be automated access. Information will be available on request and linked to achieve an automated "diagnosis".
Integration of customers	With Industry 4.0 it will not be a problem to modify products and individual customer requirements. 21st century systems should be able to adapt to the requirements and abilities of customers of all ages. For example, modern vending machines will provide operation for people with disabilities to buy comfortably and without restrictions. Automated systems will support people in all situations and assist them.
New innovative business models	New development processes, infrastructures and services will emerge. Products will be modular and configurable so they will be able to adapt to market specifications. Industry 4.0 brings many challenges that we can handle in laboratory conditions and with research. For example, it is important to determine product safety, protect data, or guarantee the untouchability of know-how and privacy.

Only the future shows how businesses will react on concept Industry 4.0. For example, international companies will have to handle with a high volume of data with high efficiency.



3 MEGATRENDS LEADING TO INDUSTRY 4.0

Megatrends represent the direction of long-term economic, commercial and cultural changes in society. At present, as main megatrends are indicated the trends that can be seen in Tab. 2.

Industry 4.0 will be characterized by great development in three areas:

- genetics,
- Artificial intelligence.
- Nanotechnology.

Table 2 Main megatrends

Megatrend	Characteristics
Demographic changes	They express as aging population, growing of birth rates in developing countries, which results in economic migration.
Individualism	It is a global phenomenon that reduces gender gaps, leads from mass markets to micro-markets and its goal is a proposal for a regional supply (do it yourself economy).
Social and cultural disparities	It describes the form of modern and traditional way of life, competing value systems in the world, resulting in the creation of hybrid social cultures.
Health and life expectancy	People are becoming more aware of the health importance, supported by new technologies, healthy way of eating; resulting in the emergence of new markets (pharmaceuticals, biotechnology, neurotechnology and nanotechnology).
Changes in gender roles	Women are increasingly more aggressive in the economy, social life, and naturally also create new market opportunities.
New mobility patterns	Global mobility is becoming more and more important and barriers are removing. Traffic infrastructures, modes of transport are being changed, and vehicle propulsion systems are changing.
Digital culture	Digital Culture, New Web 2.0, Internet Services, expanding Virtual Reality, Industry 4.0.
Learning from nature	Biology, respectively bionics will become science areas, the intelligence of natural socio-systems leads to new social and organizational forms for human society.
Artificial intelligence	The revolution in information technologies, ambient intelligence (social and emotional elements of artificial intelligence), and the development of neuroscience, artificial intelligence and robotics is a trend aimed at transparent society (sensory systems and image processing).
Technology convergence	Information technology and nanotechnology will become an important driver of technological convergence.
Globalization 2.0	Settlement in the direction of Asia, a new role for western culture, a global strategy with a simple adjustment for regional or local needs, further globalization of capital flows.
Knowledge economy	The main strategies are learning and education as a basis for future development, innovation as the main factor of competitiveness.
Business ecosystems	The main goals are breaking the boundaries between different markets and businesses, creating of new networks for creation of new values.
Change of the working world	The main goals are automation from production to handling, transport, processing and utilization of knowledge.
New consumption patterns	The basis is the position of Third World countries on welfare (China, India and Russia).
Lack of energy and resources	There is a lack of strategic resources (fossil fuels, water, minerals, and metals), the utilization of alternative energy sources, and the revolution in energy efficiency.
Climate change and environmental pollution	The problem is the growing volume of CO_2 that causes global warming, environmental problems in developing countries, the problem is also recycling and increasing corporate responsibility.
Urbanization	There are an increasing number of megacities, the development of appropriate infrastructures.
New political configuration of the world	Expressions are the constantly growing power of China and India, the renaissance of Russia, the revolution in Africa, and the crisis of western democracy.
Global security risk	Expressions are cultural and religious conflicts, weapons of mass destruction in developing countries, global terrorism.

The purpose and function of the product will change, as well as the production and assembly systems.

As an example we can mention the automotive industry. The current trend in the automotive industry is the gradual movement of research and production networks to suppliers. Material and energy prices are growing constantly (not only in the automotive industry). And therefore the rapidly growing segments in the industry are low-cost products. But the design, production and innovation of such low-cost products requires completely new materials, production methods, technologies, and innovation processes. Key and emerging technologies are in Fig. 4.

As it was already mentioned, technologies will play a decisive role in the competitive environment. Industry 4.0 will have all the prerequisites for fulfilling these attributes.

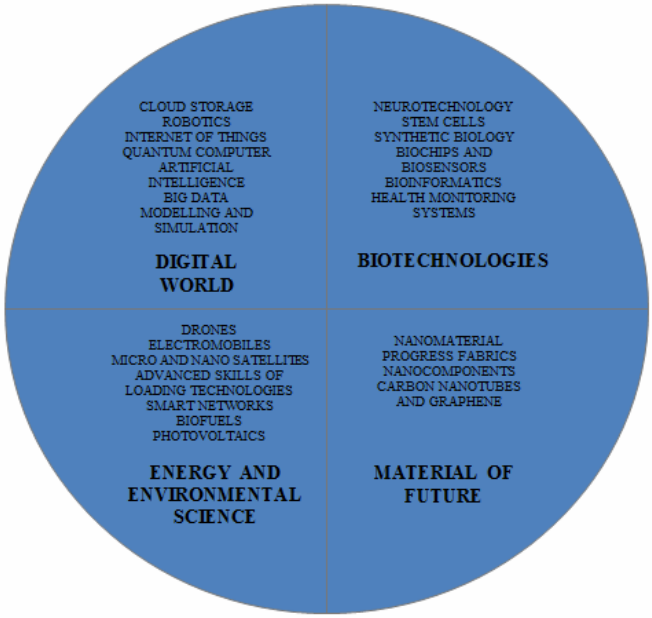


Fig. 4 Key and emerging technologies [10]

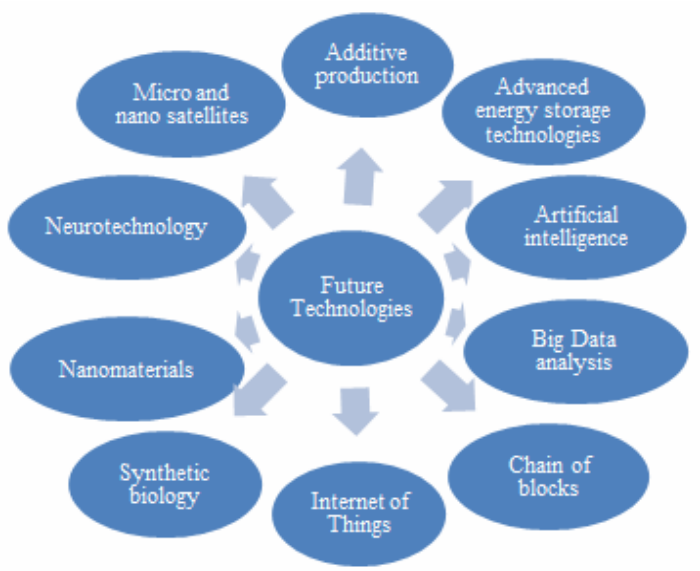


Fig. 4 Key and emerging technologies [10]

If will Industry 4.0 integrates successfully, the main advantages for companies will be mainly:

- Increased productivity.
- Increased flexibility.
- Increased competitiveness.
- Increased profitability.
- Increased safety.
- Improvement in the field of ecology.

4 CONCLUSION

Industry 4.0 is a German Government project aimed at the development of science and industry. This initiative responds to current changes and problems and represents a solution leading to a new production system. Automation, digitization and the Internet will be the basis. This concept was introduced in 201 and since it is constantly improved and changed. Although we can talk about high level of robotization, we still need the cooperation between human and machine throughout the production chain.

By connecting IT with top-level production technology, a comprehensive CPS model will be created that will control the production process and calculate an optimum production program that also count with the input material. All machines from handling equipment, conveyors to finished products will be linked through the Internet of Things. Employees through smartphones or tablets will be linked to production for effective collaboration and communication. The production process will be supported and optimized through Smart Maintenance. [8]

The main goal of this concept will be to adaptive reaction to fluctuations in demand, maximization of added value for the customer, flexible response to unexpected situations, minimization of material consumption and increased productivity. This will ensure that businesses will be competitive in the 21st century.

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