THE ROLE OF DIGITAL INFORMATION MODELS FOR HORIZONTAL AND VERTICAL INTERACTION IN INTELLIGENT PRODUCTION.

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Abstract: *Intelligent production is the future of industrial production. They are leading the way to a new industrial era and best define the concept of the Fourth Industrial Revolution. And getting real-time data on quality, resources and costs provides significant advantages over classical production systems. Intelligent production must be built on sustainable and service-oriented technological and business practices. They are characterized by flexibility, adaptability and self-learning, resilience to failures, and risk management. The high levels of automation, on the other hand, become a mandatory standard for them, which is possible thanks to the flexible network of production-based systems that automatically monitor the production processes. Flexible systems and models that are capable of responding in real time allow internal processes to be radically optimized. Production benefits are not limited to one-off production conditions, and the capabilities include optimization through a global network of adaptive and self-regulating manufacturing components belonging to more than one operator.*

KEYWORDS: *FOURTH INDUSTRIAL REVOLUTION, INDUSTRIAL INFORMATION MODELS, AUTOMATION, PRODUCTION BASED SYSTEMS*

Industrial and information communication.

The introduction of intelligent production is a production revolution in terms of cost and time savings. Intelligent production brings many advantages over conventional production, or it is the transition to future smart production. The interaction between embedded systems based on highly specialized software and dedicated user interfaces that are integrated into digital networks create a whole new world of system functions.

In future, intelligent embedded systems will contribute to more efficient manufacturing and more manageable technological processes, with the principles of network econometrics undergoing full communicative change. This is also related to the impact of Web technologies on production technologies, which is shown in Fig. 1

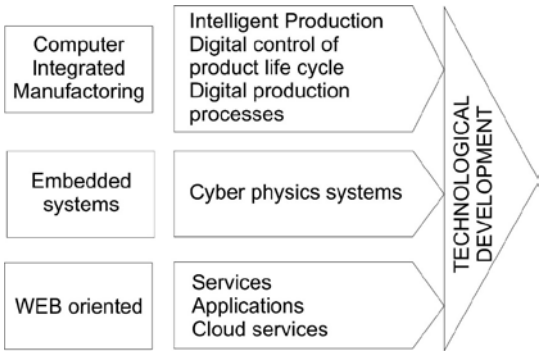

Fig. 1. *Web Impact of Web Technologies on Production Technologies.*

The connections of information technologies with people, machines and products have been rapidly realized thanks to the rapid development of technology transfer standards and a comprehensive information infrastructure. The current development and future development as a change in the requirements in information and communication technologies on the way to the Fourth Industrial Revolution is given in Fig. 2.

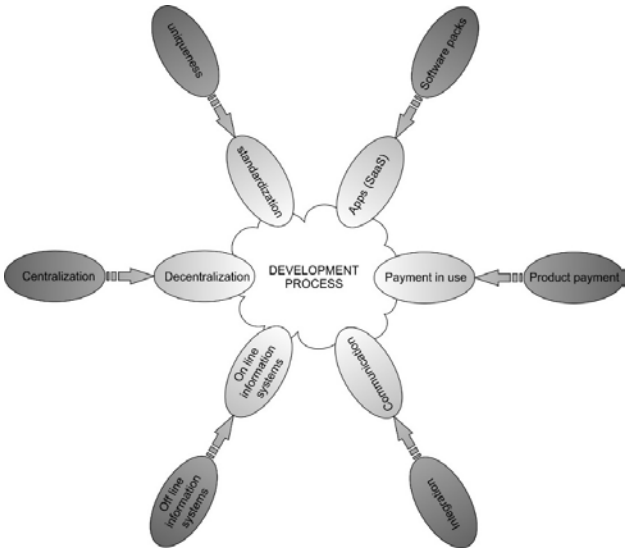

Fig. 2. *Change in the requirements to information and communication technologies*

Horizontal and vertical integration

There are conditions and opportunities, based on models and trends in the generated data, to make decisions in real time. It is also possible to build digital information integration models for horizontal and vertical action. Horizontal integration means the integration of various information technology systems in the production and automation equipment at different stages of the production and planning process in order to find a constantly optimal solution. Vertical integration means the integration of information technology in IT systems at different hierarchical levels in the production and automation equipment in order to find a consistently optimal solution.

The vertical and horizontal machine-internet, machine-human and machine-machine collaboration along the value chain, in real time, is the basis of the intelligent production system.

The interaction between embedded systems based on highly specialized software and dedicated user interfaces that are integrated into digital networks create a whole new world of system functions. Thus, in intelligent production, the ability to communicate and decentralize data processing, as well as optimization, is done through embedded systems equipped with

dedicated software and hardware. These embedded systems are connected wirelessly (partially) to the information networks of other systems of stakeholders, companies, and others with a view to exchanging data and accessing web-based services. All this requires interoperable communication interfaces and standardized protocols, continuously integrated IT systems, control and fast, real-time communication. Figure 3 shows the development of the IT architecture of intelligent systems.

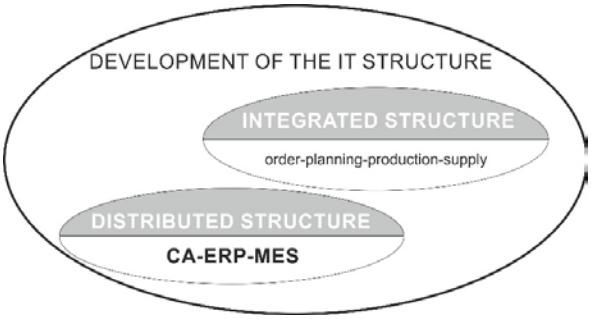

Fig. 3 *Development of the IT architecture of intelligent system*

As a result, data and services can be used in real time, creating great flexibility and ability to meet customer requirements. It is also important to follow the development of the information technology architecture shown in Fig. 4

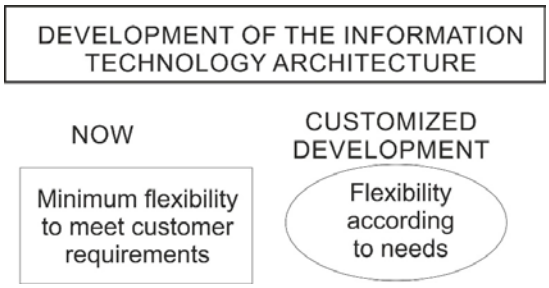

Fig. 4. *Development of the information technology architecture*

Software packages.

In building Cyber Physical Systems (CPS), depending on their intended complexity and type, different types of software are used. Fig. 5 shows the directions of software development. **Firstly,** these are the most used software tools included in; Product development (CAD/CAE), process planning (CAP, CAM), order management (CRM, ERP, /PPS, SCM), operational management (MES, BDE, QM) and service (IPS). **Secondly,** these are the software packages built in recent years by industrial companies, which enable them to track their entire value chain, bringing them closer to the requirements of the (CPS). **Thirdly,** the trend of software development towards web services and platform connectivity is outlined. Many companies, technology centers and research institutes work in this direction. This may also be the case for digital business software. A portfolio of software based systems is developed, which is based on a Backbone Data Platform and includes the modules;

Product Lifecycle Management (PLM) module. It allows you to virtually completely create and optimize new, unproduced products. Enables you to effectively manage the product lifecycle from the idea and its design to its production, maintenance and recycling.

Manufacturing Execution System/ Manufacturing Operations Management (MES/MOM) module. This module is highly scalable, offers a variety of functions and allows production to be combined with quality and transparency as well as to speed up the production process. This complete solution maintains the entire value chain of product development, planning, production, growth and operation.

Totally Integrated Automation (TIA) module. It is an open system architecture that covers the entire production process and provides effective interaction of all automation components. This comprehensive approach to totally integrated automation includes;

-Industrial Communication
-Industrial Security
-Integrated Engineering
-Industrial Data Management
-Integrated Security.

Technological building blocks of the Digital Single Market.

The most important technological building blocks of the Digital Single Market defined by the European Union are;

- New Generation Networks (5G)
- Computer Cloud Services.
-Internet of Things.
-Technologies for processing large information arrays.
-Cybersecurity.

These are areas of extreme priority in terms of rapid development of the necessary directions for the Fourth Industrial Revolution.

Conclusion.

On the basis of the above, the following conclusions can be drawn:

The connections of information technologies with people, machines and products have been rapidly realized thanks to the rapid development of technology transfer standards and a comprehensive information infrastructure.

The vertical and horizontal machine-internet, machine-human and machine-machine collaboration along the value chain, in real time, is the basis of the intelligent production system.

3. A portfolio of software based systems, based on a Backbone Data Platform, is proposed and includes the modules;

- Product Lifecycle Management (PLM).
- Manufacturing Execution System/ Manufacturing Operations Management (MES/MOM).
- Totally Integrated Automation (TIA).

References.

[1]. Clark, K.B. and T.Fujimoto (1991), "Product Development Performance: Strategy, Organization and Management in the World Auto Industry", Harvard Business School Press, Cambridge

[2]. Hong, P., Doll, W., Nahm A., li, X., Knowledge sharing in integrated product development, European Journal of innovation management, Vol.7, 2004, pp.102-112

[3]. Palmintera, D. (2005). Technology transfer: Accelerating economic development through University technology transfer, Economic Development America. Available on the WWW: http://www.eda.gov /EdAmerica/winter2015/transfer.html