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The evolution of the manufacturing system implemented today and future trends

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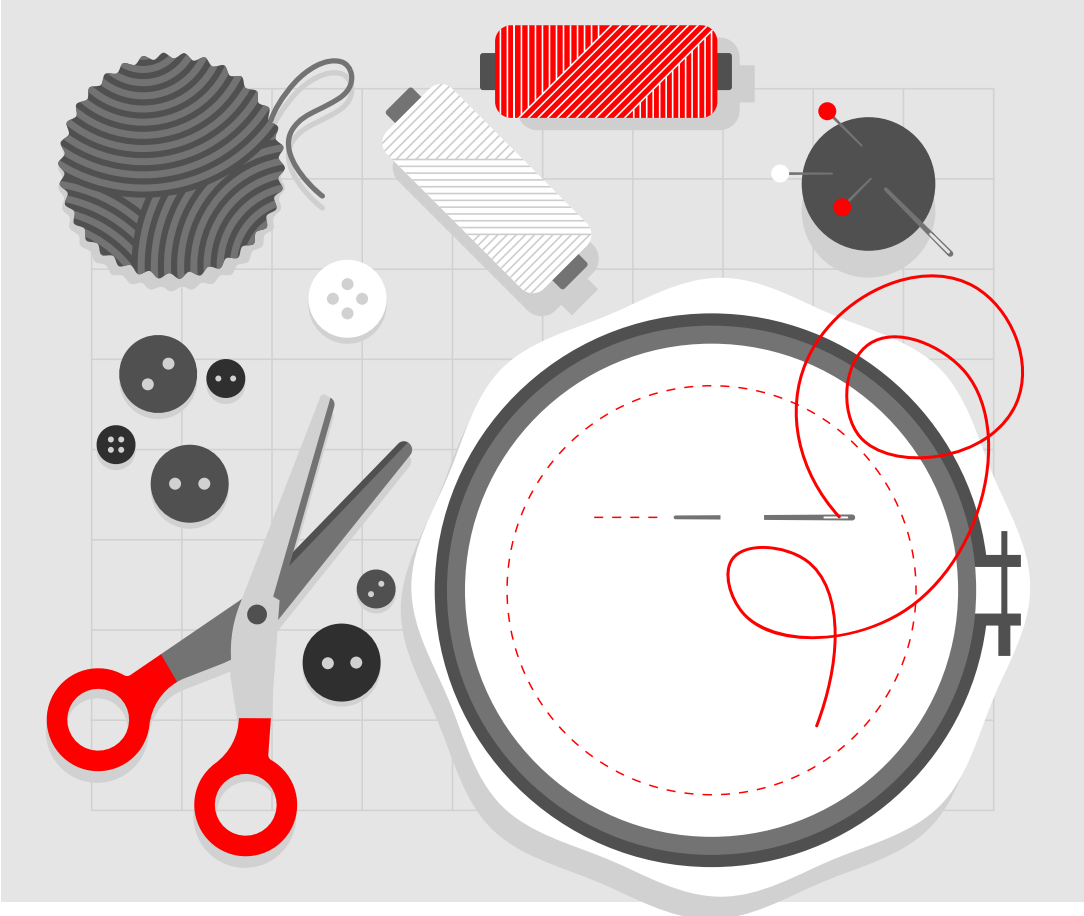

Course Title
The evolution of the manufacturing system implemented today and future trends
Proposed date/dates and proposed timetable

Language of instruction: English
Name of lecturer: Lect. PhD. Eng. CIORTEA Elisabeta Mihaela

Form of instruction	Number of teaching days	Number of teaching hours per day	Form of evaluation (if any)	Certification
Lecture	1	2		

COURSE AIMS:

- Analysis of the characteristics of flexible manufacturing systems in relation to the classic ones.

- Modeling an intelligent monitoring and control system, leading to the optimization of material and information flows of the company. A model of monitoring and control of the real system using intelligent systems is presented. The simulation of the production system proposed for analysis offers the possibility to follow and control the process in real time. The use of simulation models must be understood: the influence of changes in the structure of the system, the influence on the general controls of the manufacturing process, the influence of the parameters on the behavior of the system. The application of character consists in real-time tracking and control of the technological process. This is done based on the modular systems analyzed using mathematical, graphical-analytical models for sizing, configuration, optimization and simulation.

- The role of Industry 4.0 in the maintenance of production systems is highlighted. Due to the implementation of advanced technologies and ways of learning technological equipment, hard systems can adapt relatively easily to fluctuations in the manufacturing process over time. For the realization of the analyzed system we used specialized packages for the simulation of Petri nets, and the final implementation is done on a specialized database. The model is intended to be a source of support for the activities of companies wishing to adopt new technologies in the manufacturing system and to identify as few errors as possible due to ensuring the necessary maintenance and control imposed by the chosen technological process. The advantages are the prototyping and analysis of the whole system after the implementation of the tracking and the ability to control the whole system, which leads to the prevention and subsequent elimination of queues or possible accidents.

- A theoretical approach to cloud systems with an impact on production systems. I call cloud computing systems because they form a relatively new concept in computing, representing computing services distributed as a whole, applications, access to information and data storage without the user knowing the physical location and configuration of the systems. The advantages of this approach are in particular computing speed and storage capacity without investing in additional configurations, synchronization of user data, data processing using web applications. The downside is that it wants to identify a solution for data security, which leads to distrust of users. The case study applies to a module of the production system because the system is complex.

- Integration of cloud systems and access with IoT devices. The IoT platforms addressed in the paper are Platform as a Service (PaaS) and Software as Service (SaaS). The analysis is presented by modeling a case study for discrete event systems. Because the general system is analyzed as a tiered cloud system, we will leave the general system as stochastic. Qualitative analysis aims to verify the structural and behavioral properties of the system, the existence of blockages, connection systems and security. Quantitative analysis measures the specific performance of the production system. The results show that this approach can be used to detect system crashes. Thus, manufacturers can resize production capacity and even optimize the entire production system. The activity of modeling and evaluating the performance of the production system plays an important role in theoretical research and technological improvement with IoT. The study presents the method of modeling and evaluating performance based on Petri nets and expressing the behavior of the entire

system. According to the informational diagram of the system, the constraining relationship between locations and transitions is identified, after which the extended graphical model is built, and then the method of behavioral expression is chosen to obtain a set of performance indicators. The study is designed to verify the effectiveness and efficiency of the system.

- The benefits of cloud production, the need to analyze RAMI 4.0 and, last but not least, IoT applications are analyzed empirically. The latter using high-performance platforms can lead to the modernization of automation, tracking and control systems, but also add to the optimization systems to increase performance. RAMI provides a 3D analysis of the entire production flow, a system that can be analyzed more efficiently, interpreted and intervened to ensure mandatory maintenance. Cloud manufacturing provides an overview of the entire manufacturing process with all the resources and resources used, as well as an overview of any interventions needed to optimize the production system. In order to be able to draw the most relevant conclusions in real time, we simulated such a system with the help of Petri nets. We chose Petri nets because they are easier to interpret, provide real-time information, changes can be made relatively easily, so that decisions can be made in the shortest time so as not to disrupt the manufacturing system. Because cloud production, the production system, and IoT platforms have been presented in previous papers on the same production system, in this paper I will review them and focus more on the relationship between cloud production and RAMI 4.0.

- A useful method of integrating secure intelligent systems based on Petri nets is being analyzed. The method allows tracking and control based on a smart system template, which can be implemented on an accepted blockchain platform and then integrated into the smart industrial system. One of the main advantages of the method is the visualization of errors in nodes, the tracking of workflows. Modeling intelligent production systems using Petri nets helps developers minimize logical errors - checking the properties of Petri nets, such as blockages - during modeling.

- The industry is undergoing major changes with the adoption of 5G technologies, and this will be determined by the economic value that creates a plus, as these technologies are implemented. One of the main factors in creating economic value is productivity, because at the industrial level an important role is played by increasing productivity.

COURSE CONTENTS (for each workshop):

- Synthesis on the analysis of manufacturing systems
- Prototyping manufacturing in the cloud
- Manufacturing analysis with discrete events using IoT platform
- IoT analysis of manufacturing using Petri Nets
- Aspects regarding maintenance of the manufacturing system in Industry 4.0
- Cloud manufacturing - the connection between RAMI 4.0 and IoT
- Analysis of Blockchain Integration with IoT
- Empirical analysis of 5G architecture smart manufacturing

TEACHING METHODS:

Lecture, conversation, exemplification.

LEARNING OUTCOMES:

- It outlines a clear picture of the analysis of manufacturing systems.

- We start from the idea: when using Petri nets, events are associated with transitions. Activities are associated with triggering transitions and marking places that represent the state of the system. In addition to its graphical representation that differentiates events and states, Petri nets allow the modelling of true parallelism and the possibility of progressive modelling using gradual refinements or modular composition.

- The basic concept of Petri nets is to offer the possibilities of modelling a network just like in a real network. As a method of graphical description, the readability of Petri nets allows the addition of resources to represent locations and to check for conflicts or errors in the system.

- By implementing the intelligent system in manufacturing processes, the goal is to increase productivity with minimal staff involvement and implement real-time tracking and control process.

Intelligent systems play an important role for complex production systems. Smart systems applications can create smart environments to increase productivity.

- At the industrial level, cloud manufacturing systems have the role of increasing global competitiveness, which will require the integration of systems between domains, hierarchical boundaries and phases of the life cycle. Many factors will contribute to shaping the future at the industrial level, but consensus-based standards are indispensable in this process. In this regard, I would like to present a way of acceptance through the use of cloud systems and at the production level.

- The aim is to examine the impact of designed mechanisms on cloud performance, such as equipment used, productivity and production costs, and delays.

- It will assess how well the proposed mechanisms can adapt to sudden changes in the cloud, such as the availability of resources purchased in repositories. While a complete set of experiments will be performed, conclusions will be drawn so that the cloud manufacturing system is as efficient as possible.

- The reference points will require the available study system so that they can be seen. There are cases where the performance study refers to a system that is not available, it is necessary to develop a representative approximation of it, either in hardware or software.

- These approximations must be quite detailed and are normally called prototypes. Then, observations are made about such prototypes, possibly with the help of benchmarks such as artificial workloads.

- In all cases, the performance of the system is obtained by observing the behaviour of the system or its approximations in operation, ie when it is loaded with either real or referred user requests.

- However, studying the performance of a system is not only an important task during and after the implementation of the system, but also in the design stages to compare alternative architectural possibilities. This is especially true when the development of new systems is motivated by increasing demand for performance, such as in the field of computers or machines that have different computational components in the components.

- In the case of IoT systems, the results of modelling and performance evaluation are the basis for its design, planning and improvement. The modelling of an IoT system is based on the construction of an abstract stochastic model that describes the relationship between process and system performance and provides a quantitative analysis of system performance. Modelling and evaluation helps to identify errors that may occur in the network, so that you can intervene to improve overall performance in a very short time.

- The introduction of the Internet in the systems of analysis and control of the flow of technology required major changes in the general architectures of the company. The role of the Internet was to manage internal applications, to provide permanent access to the Internet, providing basic information for the most efficient integration with enterprise functions such as marketing, sales, logistics, production. As businesses began to take advantage of the capabilities of the Internet, new features and structures evolved over time.

- The complexity of system operations refers directly to the number and nature of inputs, outputs and other system components.

- Cloud computing is one of the most powerful systems in information technology today. It is characterized by hardware virtualization, fast supply with self-service, scalability, elasticity, accounting models
System parameters are used to represent system components and relationships; they can be classified in structure parameters as representations of system properties and design variables as factors that change over time.

- For the beginning of the presentation, I made a connection between my research, especially in terms of cloud manufacturing, analysis of IoT resources used in manufacturing systems and what can unite them in terms of research, namely RAMI 4.0. IoT is described in the literature as anything connected to a network that can communicate autonomously without additional human intervention. This concept used in production and other industrial processes allows machine designers to create intelligent equipment and machines so that they can track, record, display, monitor and adjust parameters autonomously. For the cloud we used the simple definition Cloud is an application available only for customers with active mobile Internet, which provides a solution for data storage. Cloud storage consists of archiving, organizing, and distributing data on demand between virtualized storage volumes that have been consolidated into hardware.

- The existing architectural model of the industry provides a good overview of the architecture of the industrial environment, but leads to certain limitations for users. To overcome these limitations, we proposed on the basis of RAMI 4.0 models a simple model of intelligent architecture from the factory, based on the concept of distributed systems with exact flows of information and data between them. The proposed architectural model allows a more reliable and simpler modeling of the intelligent factory.

- IoT is a development system that offers unlimited benefits, but there are many challenges for the centralized IoT architecture, so that all devices can be identified, authenticated and connected through centralized servers. This model can be used to connect a wide range of computing devices, will continue to support small-scale IoT networks, as it will not be able to provide the necessary conditions for the expansion of the IoT system in the future.

- Blockchain technologies are able to track, coordinate, trade and store information from a large number of devices, allowing the creation of applications that do not require a centralized cloud. Some companies want to apply blockchain as a technology to democratize the future of the IoT.

- The advent of IoT introduces several benefits to the system, including providing interconnection between objects and people.

- According to the literature, so far there is an expansion of cloud computing, so we tried to adapt the manufacturing system to the principle of using and developing a fair system based on bitcoin.

- In the presentation we used instead of bitcoin the information needed for the manufacturing process for a simple technological flow.

- For the last proposed topic, I will present some elements that lead to an access to the new technology. Traditional network architectures have several shortcomings in terms of flexibility, accessibility and dynamics that can lead to possible unwanted shortcomings in the manufacturing process.

- Factories need to be as flexible as possible, able to reconfigure different production lines so that they can cope with sudden changes in the market. The implementation of 5G architectures can help achieve the ideals of modular factories in which machines can be quickly reconfigured to optimize production. It plays a role in preventing problems by activating systems that automatically schedule maintenance or replacements for potential consumables, in order to determine a minimum downtime.

Many technologies need to mature in order to achieve new visions, with key components taking a major leap forward with 5G. Even if the architecture comes to ensure to a large extent the ascent, growth, development, there are some applications that must be chained in order to ensure success. These applications include digital systems, IoT, virtual reality, autonomous vehicles, robotics and last but not least security are an integral part of the proper functioning and implementation of 5G architectures.

The opportunities offered by 5G, but also the role it can determine will have an impact on the industry from several points of view, including a number of interaction and interconnected reasons.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA (if any):

RECOMMENDED READING (English language only):

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