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ASPECTS REGARDING MAINTENANCE OF THE MANUFACTURING SYSTEM IN INDUSTRY 4.0

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Abstract: This paper highlights the role of Industry 4.0 for the maintenance of manufacturing systems. 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 system subject to analysis we used the specialized petri nets simulation packages, 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 those of prototyping and analysing the entire system after the implementation of tracking and being able to control the entire system, which leads to the prevention and subsequent elimination of queues or possible accidents.
Keywords: Industry 4.0, maintenance, learning technological equipment, simulation packages

1. INTRODUCTION

This paper is a continuation of a study for automated manufacturing system. In this paper we wanted to highlight why Industry 4.0 is needed for maintenance engineering? And how to introduce new strategies in maintenance management [1]. Today we addressed the technologies found in Industry 4.0, namely cloud information management and viewing on IoT devices. As the new Industry 4.0 technologies have appeared, the equipment is maintained within the deadlines written in the technical documentation.

Industry 4.0 can be used as a term corresponding to the very rapid evolutions of current technologies. Due to the approach of advanced analysis and learning methods of technological equipment, hard systems can adapt to fluctuations in the manufacturing process over time. Even if, according to the literature, it is a few years since the research approached IoT modules, only that they began to be accessed in industry, but with empirical studies. IoT uses evolving technologies with advanced cloud-based software to produce large amounts of data in real time. [1]

Petri nets are considered from the point of view of discrete event dynamic systems as the tool for modelling and analysis of production systems.

Advantages in modelling and analysis of manufacturing systems using Petri nets are those generated model can be used to analyse the behavioural properties for performance evaluation system for the systematic construction of the control system.

Graphics provided by Petri nets enables visualization system activities, improving the system specifications in order to avoid complex mathematical notation, interpretation queues, errors or possible accidents that may occur in the system.

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 turned to the simple definition Cloud is an application available only to customers with active mobile Internet, which offers a solution for data storage. Cloud storage consists of archiving, organizing and distributing on demand data between virtualized storage volumes that have been consolidated into hardware. [3][6]

2. ASPECTS INDUSTRY 4.0

Resulting diagrams obtained through introducing timeframes specified in the technical documentation of machinery optimizing transport system by removing machinery entering the repair.

Analysis of time intervals necessary to maintain equipment that result from simulation and system optimization considering regarding layout optimization of transport to reach the entire manufacturing system. This maintenance can be managed carefully controlled in terms of time and tracked by the control subsystem implemented in the manufacturing line or machining centers so that the losses are not great in the course of the manufacturing process, for example by stopping the whole manufacturing line.

Industry 4.0 involves a major transformation of the entire production by unifying digital technologies and the Internet with the classic industry.

The new solutions dedicated to the industry are specially designed to offer manufacturers flexibility in integrating Industry 4.0 technologies - computing, processing and display solutions.

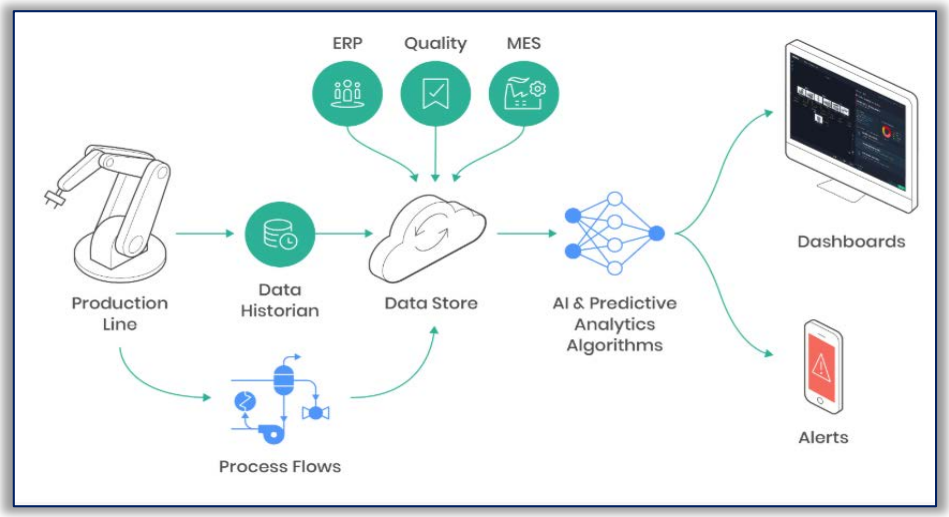

Figure 1. Maintenance architecture [2]

Cloud services are readily available and location-independent, used to store and calculate data generated in IoT. Cloud services are best suited for the IoT environment due to various factors, such as easy availability, managing resource constraints, different policies. Cloud servers can provide services in the form of software, storage, computing power, platforms.[6]

IoT benefits from all the benefits, capacity and unlimited objects of the Cloud to change its modern needs. IoT uses numerous cloud features, such as stashing, and evaluates information to reduce professional pressure. Cloud exploits IoT by treating information in an indispensable way and getting answers to authentic problems.[4][5]

3. MODEL ANALYSIS

For the analysis of the model we used Petri nets. By simulating the state model with Petri nets, the description of the system behaviour is obtained. By studying the model of the given system, new information can be determined without additional costs. Defects in equipment or components over time vary depending on the law of distribution, reliability. The failure occurs when the degradation level exceeds the permissible limit.

Maintenance is defined as a strategy to maintain the availability or operational conditions of an installation, using all possible methods and means to ensure optimal working conditions. Maintenance contributes to improving the operational safety of system equipment.

The maintenance program, with the intervals corresponding to the pre-established plan, must be adapted to the situations and lead to the achievement of the real objectives of the manufacturing system.

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. The graphical tool can simulate and analyse the behaviour of discrete systems, efficient events. This tool is applied in information protocols, software engineering, and flexible manufacturing systems to help reduce processing time and improve error finding and system reliability management. This is a tool that allows the detection and counting of faults, in order to replace components after repeated failures, describe the state of the system and automatic shutdown to reset the monitoring and preventive maintenance system.

For the analysis of the system regarding the optimization of the transport in the model, start from a simple system and we try the analysis based on the maintenance activity of the equipment.

Industry 4.0 involves a major transformation of the entire production by unifying digital technologies and the Internet with the classic industry. The new solutions dedicated to the industry are specially designed to offer manufacturers flexibility in integrating Industry 4.0 technologies - computing, processing and display solutions. An automated and interconnected production is based on an integrated system of equipment, machines, employees, mobile devices and IT systems, able to communicate inside and outside the factory.

Challenges for condition-based maintenance include:

— determination of equipment information,

— evaluation and analysis of information,

— fast transmission and visualization of information.

We grouped these three challenges in the paper as being managed in the cloud and analysed with technologies and equipment offered by IoT, after which normal manufacturing flows can be resumed. Thanks to the modern technologies offered by Industry 4.0, maintenance can be done easily without significantly disrupting the

manufacturing flow. The new IT solutions and means used during the production processes bring four major advantages related to:

— time, can be allocated to activities that produce value. Employees become more productive in the context of an optimized system.
— cost, the data are accurate, resulting in well-documented information and good planning.
— flexibility, any change can be easily adopted due to the flexible system open to new opportunities, which allow the optimization of processes based on data analysis.
— integration, the production process takes place with a low number of interruptions, due to the integration of the systems used making possible the development of the product and the manufacturing process.

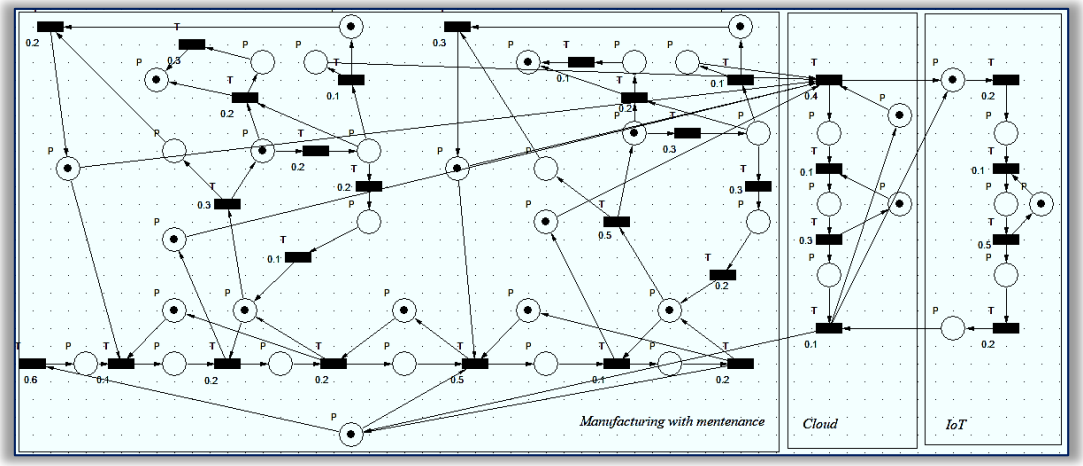

Figure 2. Petri net control system maintenance with the two processing centers, cloud, IoT

Maintenance for industry 4.0 is a method of preventing failure by analyzing production data to accurately identify problems that may occur.

In Industry 4.0, maintenance has emerged rapidly so that the implementation of industrial technologies to optimize maintenance programs and obtain real-time risk alerts can reduce costs, maximize uptime and improve production efficiency. Advantages offered:

— Real-time monitoring of conditions. Technologies help create the availability and processing of the necessary information. The data is recorded and displayed in real time. Data viewing is not limited so it is accessible on screens, dedicated stations and in the cloud.
— Flexible evaluation and analysis possibilities. The data are evaluated using customized rules and methods depending on the equipment, the type of manufacture, so that the limit values are eliminated, they are considered unimportant.
— Notifications. Along with the development and implementation of new solutions, maintenance maintenance must be taken into account. This has a well-defined role in the manufacturing process and if it is given attention and the rules are followed, it can lead to process optimization. If it is considered insignificant, it can lead to large losses both by damaging the machine or even the manufacturing cell, but it can also attract costs due to production losses.

After the automatic identification of the maintenance load is based on the preset parameters, the information is sent as digital information. All notifications are automatically recorded, stored and analyzed so as to analyze the information flow and the production flow to manage any additional costs.

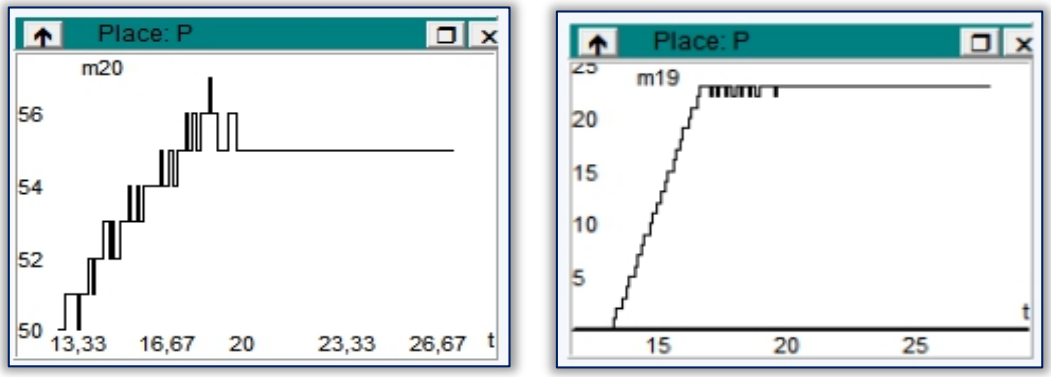

Figure 3. Correlation between effective maintenance and transmission of maintenance information to equipment 1

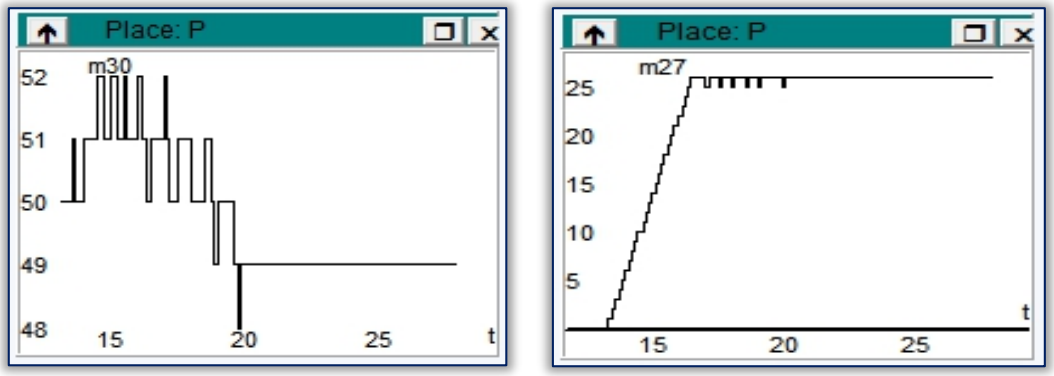

Figure 4. Correlation between effective maintenance and transmission of maintenance information to equipment 2

Industry 4.0 allows manufacturers to implement and maintain, and can continuously improve the maintenance cycle. The cloud-managed maintenance library can lead to continuous improvement of repair times

4. CONCLUSIONS

Using analysis of the control diagram obtained for a simple transport system between deposit and two machining centers using technical instructions accompanying the technical processing centers on the maintenance of equipment is developed a method to optimize the transmission system.

Considering the defects that can occur and eliminated the regular maintenance of machinerytransport and processing centers eliminates errors and accidents that may occur and thus obtaintransport optimization after analyzing the entire system.

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