sciendo CzOTO 2020, volume 2, issue 1, pp. 316-323

MODERN IT SUPPORT SYSTEMS - CMMS IN THE PRODUCTION PLANT

doi: 10.2478/czoto-2020-0039
Date of submission of the article to the Editor: 6/12/2019
Date of acceptance of the article by the Editor: 5/02/2020

Piotr Kuryło[1] – *orcid id: 0000-0001-9820-1254*
Joanna Cyganiuk[1] – *orcid id: 0000-0002-7279-0692*
Adam Idzikowski[2] –*orcid id: orcid id: 0000-0003-1178-8721*
Dudziak Michał[3]
[1] University of Zielona Gora, **Poland**
[2] Czestochowa University of Technology, **Poland**
[3] Professional College of the Copper Region in Lubin, **Poland**

Abstract: In the present paper, the scope of the process line maintenance in the production plant has been presented. The issues associated with the basic functions and characteristics of the services dealing with this problem, which is crucial for the production plant, have been discussed. Modern CMMS (Computerized Maintenance Management Systems) have been discussed, while indicating their specific advantages, among others, the possibility of keeping records of machinery and equipment, maintenance schedules and various types of alarms, which may disrupt or suspend the operation of production facilities, so that these systems ensure the safety of fault-free operation of machinery and equipment.
Keywords: IT CMMS, production plant, maintenance, safety of machinery

1. INTRODUCTION

Due to growing quality and environmental requirements and market competition, it is necessary to constantly improve and develop production plants. It is not only about organic growth by increasing manufacturing capacities massively to meet increasing orders of customers but, most of all, through modernization and implementation of new technologies leading to the continuous and fault-free operation of the production plant.

Therefore, there is a need for modern IT support systems - CMMS (Computerized Maintenance Management Systems), enabling maintenance and continuity of production in the plant (Lopes, 2016; Wienker, 2016). The commonly used techniques more and more often overlap with computer software which supports the process of decision-making by those responsible for the efficiency and reliability of machinery and production equipment.

The software itself does not make the enterprise the leader in fault-free and safe operation, however, computerization implements facilities in many areas of production management. They include, among others, the possibility of management and control

of equipment, operation and maintenance manual, timely control and maintenance of equipment, tracing the history of work and failure of individual machines and many other important factors for cells and organizations dealing with maintenance in the production plant.
In the paper, the possibilities (advantages) of CMMS have been briefly discussed as well as the SWOT analysis has been presented, taking into account the implementation of such a system for the purposes of maintenance in the production plant to reduce the risk of unplanned downtime due to failure of machinery and equipment.

2. MAINTENANCE IN THE PRODUCTION COMPANY

Maintenance in production plants is an extremely important issue in both practical and theoretical approach to the operation of the company focused on an efficient production cycle as well as the costs associated with this cycle. One of the factors determining the success of the production company is stable operation of machinery and equipment used for production as well as the knowledge of their actual condition and capabilities. Maintenance is also daily, systematic work, associated with performing scheduled one-off or periodic tasks in order to prevent degradation of the technical condition of equipment and occurrence of failure or its removal, when it occurs, to restore its full functionality.
Maintenance services are responsible for maintenance in the production plant. These services are responsible for fault-free operation of machinery and equipment and their main tasks include (Ożadowicz, 2012):

- tasks with time priority: aimed directly at prevention or delay in the occurrence of failure,
- tasks with condition priority: directed primarily to detection of early symptoms or an initial stage of possible failure,
- tasks with the priority to find the damage: directed to recognition of hidden damage against destruction of equipment,
- tasks with the priority to operate the equipment: a conscious decision about the startup and operation of equipment until the moment of failure; most often determined by the physical inability to apply other actions or lack of necessary funds for this purpose.

Production companies use strategies allowing the continuity of operation of machinery and equipment. They include, among others, operational strategies, due to which it is possible to achieve the desired operating conditions of machinery and equipment in the production plant. Operational strategies (Fig.1) can be divided into three basic states (Pomietlorz-Loska and Byrska-Bienias, 2016):

- proactive – prior to error detection,
- preventative – scheduling periodic inspections or repairs,
- reactive – starting after the occurrence of failure.

3. CMMS

Ensuring the desired reliability of technical facilities and safety of fault-free operation of machinery and equipment at acceptable costs is associated with many specialist areas. These are, among others: technical diagnostics, work planning and scheduling, management of spare parts and operational agents,

budgeting, object life-cycle management etc. It is really difficult to handle all these areas in terms of information and work coordination. For this reason, IT systems, which are dedicated to maintenance management and the so-called technical assets arouse a lively interest.

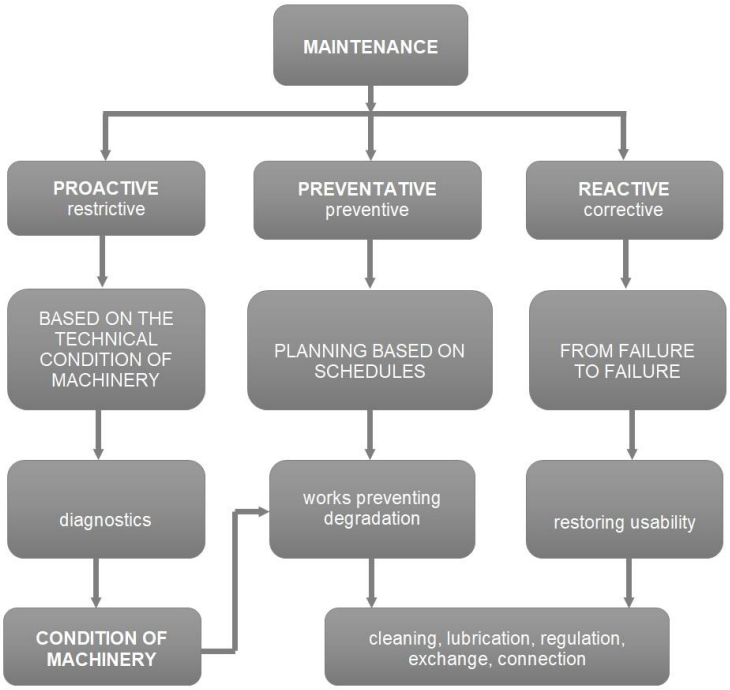

Fig. 1. Maintenance strategies

Source: own study based on (Pomietlorz-Loska, Byrska-Bienias, 2016)

CMMS, i.e. Computerized Maintenance Management Systems are IT systems devoted to collecting information about the operation and supporting work management. They usually integrate many modules associated with the possessed human and technical resources and organization of their work. They are designed to support broadly understood maintenance in production companies.

Among the functions performed by CMMS, among others, there are (Sitarsk and Żmujdzin, 2016):

- repair and maintenance management,
- management of scheduled works and tasks,
- management of spare parts and material management,
- creation and control of purchase,
- collection and analysis of data from the system and devices,
- cost analysis,
- reporting,
- history of objects.

Building an effective proactive system, using the CMMS software, consists of a range of interacting components, such as:

- register of machinery and equipment,
- maintenance schedule,
- spare parts and their distribution,
- estimation of maintenance costs.

In order to efficiently manage the machine park, it is necessary to possess its register including as much technical information as possible, from which it is possible to quickly learn, e.g. which equipment corresponds to which registration number, what is the condition of the machinery, where it is situated, whether it is a part of a larger whole, e.g. a process line.

The maintenance improvement process begins with registering all machinery, equipment and vehicles. At first, the group of machines is defined, according to the criterion of their similarity. Subsequently, machines are added to the register defining their serial numbers, symbols, location and other parameters. The register of machinery also stores information about the status of the operating hours counter, the date of the last and the next Technical Supervision Office test or electrical tests, if applied (Neuron Soft, 2019 (1)). A sample window of the CMMS software, presenting the register of the production plant equipment is shown in Figure 2.

One of the main registers of the CMMS software is the register of schedules (Fig. 3). This register allows for defining the tasks to be performed within a specified time or after working for a specified number of hours. The subject of the order can be a particular machine indicated, group of machines or general orders, which can be e.g. the command to prepare the report on the state of oil stocks.

When defining the order, it is possible to define the list of tasks to perform or import from the definition of maintenance placed in the register of machinery. The tasks, both in the definitions of maintenance and in operations added manually, can be directed to the specific target group, e.g. mechanics or automation technicians.

One of the advantages of the CMMS software is the fact that, after the completion of scheduled maintenance, the software helps to prepare the report (Neuron Soft, 2019 (1)).

The key issue in order to stick to order fulfillment time and ensure product quality is fault-free operation of production equipment, compliant with standards. However, when the failure occurs, the priority is to remove it as soon as possible. It frequently turns out that the records of the damaged equipment are incomplete, e.g. there are no spare parts in production, and, after previous repairs, there is a large number of “abbreviations” not included in the diagrams. Therefore, in this moment, a strong tool in the hands of the person handling current repairs and planning possible periodic or preventive maintenance inspections is the register of the history including detailed descriptions of any failure, activities related to the operation or warnings reported by employees. In the registry of the CMMS software history it is possible to store information about failure, operational activities, warnings, conducted maintenance as well as modifications made to the specific equipment and machinery. (Neuron Soft, 2019 (1).

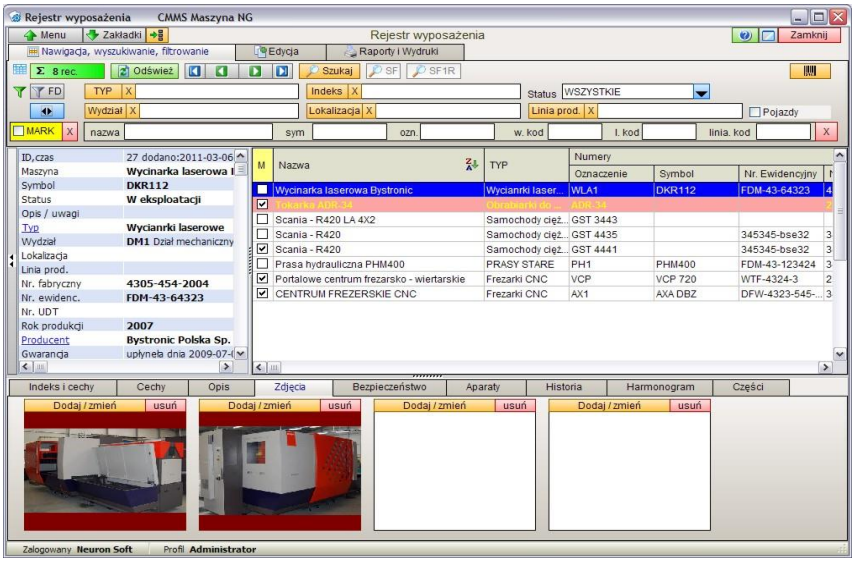

Fig. 2. The window of the CMMS software – the NG machinery – the equipment register (Neuron Soft, 2019 (1))

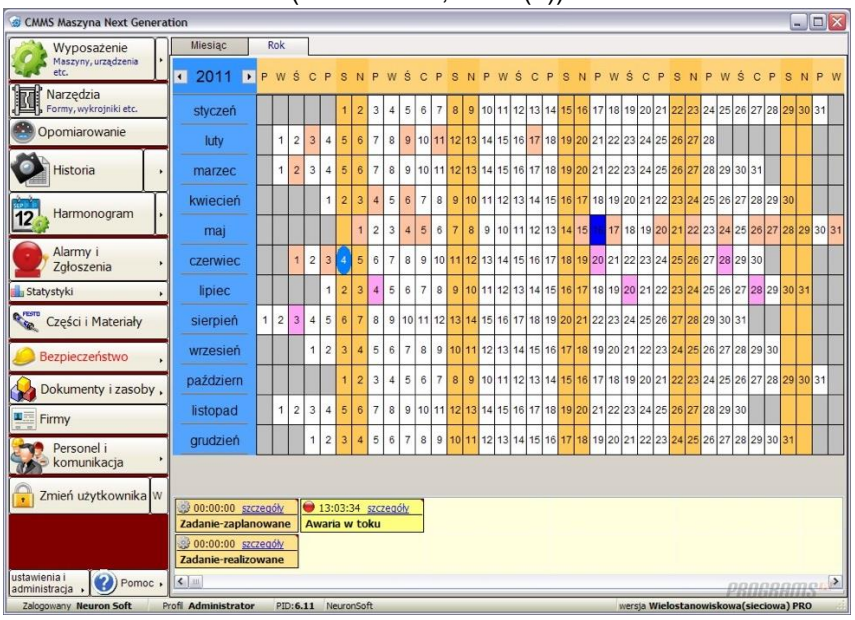

Fig.3. The window of the CMMS software – the NG machinery – monthly schedule (Neuron Soft, 2019 (1))

A very important role in the CMMS software is the alarm module (Fig. 4). This module allows for controlling and reminding, e.g. of the approaching date of maintenance of the machinery by signaling the previously established message on the computer screen, thus protecting the machine park against unscheduled downtime. The alarm form in CMMS shows all the scheduled activities for the set number of days – e.g. 30 in advance and all overdue activities. Separate software starts along with staring the computer, checks whether there are any overdue or planned activities and informs about that and if it does not find anything, it does not signal its work (Neuron Soft, 2019 (1)).

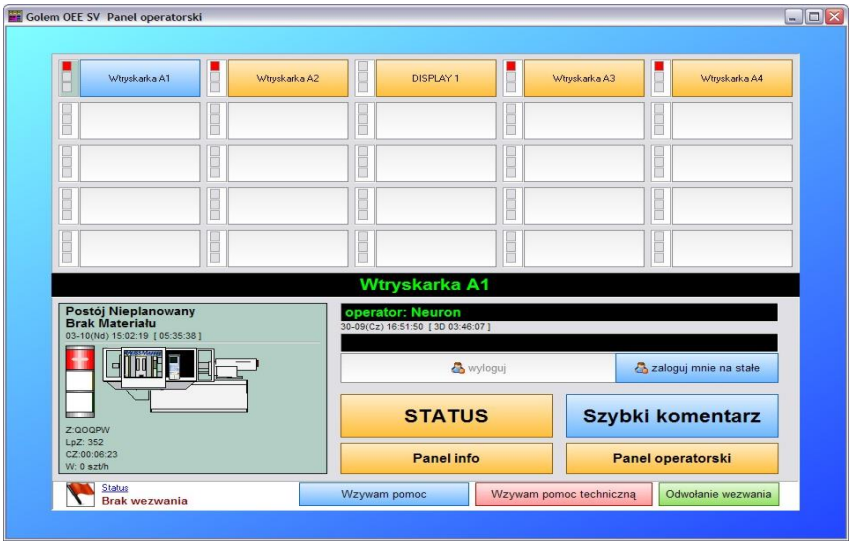

Fig.4. The window of the Golem software – the alarm status of an injection molding machine (Neuron Soft, 2019 (2))

In the vast amount of the CMMS software, the classic warehouse of parts with orders, revenues and expenditures, has been implemented. However, this software has additional functions, e.g. the spare part register available in the software allows for registering parts with the indication where the specific part is in the specific moment. In addition to the name, symbol and price of the part the register also includes the position for the order number. The second register associated with parts is the register of their outflow. The parts used for the specific repair or overhaul are added to that and its main purpose is to track their wear in terms of specific machinery or events, which allows the determination of detailed costs associated with the operation (Neuron Soft, 2019 (1)).

The exact calculation of maintenance costs in CMMS is possible through its integration with the complex system of IT support for production and only when providing the strict order: document – activity – document. Specialized software with extended application for estimating costs, due to the possibility of identification of unit costs for each event, allows the estimation of maintenance costs both for the indicated machinery and the groups of machines and departments, according to the user's expectations (Neuron Soft, 2019 (1)).

4. THE SWOT ANALYSIS OF THE CMMS IMPLEMENTATION

Although the implementation of CMMS seems to be time-consuming, costly and difficult work, it is not, actually. These systems have become more and more common nowadays and their implementation significantly contributes to reduction in cost-intensiveness of the machine park maintenance. Even a slight improvement in machinery operating time may generate profits at the level of the annual maintenance budget.

However, the implementation of CMMS in the company is not an absolute necessity and the companies which have not implemented such systems can cope in the market as well, although, definitely not as much as the enterprises which invest in the optimization of maintenance.

Table 1 illustrates the SWOT analysis of the implementation of IT CMMS in the production plant, allowing the identification of pros and cons of the introduction of CMMS in the company.

Table 1
The SWOT analysis of the CMMS implementation

STRENGTHS	WEAKNESSES
- Reduction in failure. - Analysis of the reasons for failure. - Full control over equipment. - Optimization of working hours of maintenance services. - Controlled purchase. - Savings in costs. - Savings in time. - Securing the safety of continuity of operation of the machine park	- Specialized Staff needed to operate IT systems. - Implementation costs.
OPPORTUNITIES	**THREATS**
- The company's development. - The possibility of establishing new contacts. - Increased production. - Reduction in equipment failure. - Improving the market position.	- Introduction of the latest IT systems providing greater opportunities. - Competition.

The presented SWOT analysis clearly indicates that the strengths of the CMMS application and the related opportunities allow for obtaining substantial benefits in providing the continuity of production and fault-free operation of equipment. Therefore, intensifying the strengths of the system implementation presented in Table 1 and eliminating the weaknesses to a minimum provides great opportunities for development and increase in profits and the product quality, thus, increasing the dynamism and competitiveness of the company in the market, also ensuring security and continuity of production.

5. CONCLUSIONS

The present analysis indicates that there is a full justification for the implementation of modern forms of computer-aided maintenance in production plants. An important issue is the implementation of innovation to support and control continuous and fault-free operation of machinery and equipment.

Modern maintenance management has become the priority in the effective production process. Full control over the production system is provided by IT CMMS. To create a modern and competitive production plant subordinated to customer requirements and strict quality standards, it is essential to bear the costs of the system implementation. However, these costs are negligible compared to the results achieved in the course of the software operation.

The priority is to provide the product on time and in adequate quality, and this is just enabled by the IT- aided maintenance system - CMMS.

It is worth pinpointing that the introduction of Computerized Maintenance Management Systems (CMMS) allows full control over the course of the process line

in the production plant and reduces the risk of the occurrence of unscheduled shutdowns due to failure. All the opportunities provided by the CMMS software contribute to an increase in performance and reduction in the number of unplanned shutdowns and, thus, an improvement in the image of the company as a modern production plant. They are also connected with the protection of work in progress and acquisition of new customers. A range of functions included in CMMS, among others, schedules and alarms, efficiently help to control the process of operation of machinery and production equipment.

REFERENCES

Burnos, A., 2019. *W gąszczu danych utrzymania ruchu*, accessed on 10.10.2019, https://www.log24.pl/artykuly/w-gaszczu-danych-utrzymania-ruchu,2289.

Jamkhaneh H., Pool J., Khaksar, Seyed M., 2018. *Impacts of computerized maintenance management system and relevant supportive organizational factors on total productive maintenance*, Benchmarking - an International Journal, 25, 7, 2230-2247.

Lopes, I. Senra P. Vilarinho S., 2016. *Requirements specification of a computerized maintenance management system - a case study* , Sixth International Conference on Changeable, Agile, Econfigurable and Virtual Production (Carv2016), Book Series: Procedia CIRP, 52, 268-273.

Neuron Soft, 2019 (1). *CMMS Maszyna Next Generation*, accessed on 10.10.2019, http://www.neuron.com.pl/pliki/cmms_poradnik.pdf.

Neuron Soft, 2019 (2). *GOLEMPOP*, accessed on 10.10.2019, http://www.neuron.com.pl/golemnh/index.html.

Ożadowicz A., 2012. *Utrzymanie ruchu*, 9/2006.

Pomietlorz-Loska M., Byrska-Bienias K., 2016. *Metody i techniki zarządzania utrzymaniem ruchu: studium przypadku*, in: Knosala R. (ed.), Innowacje w zarządzaniu i inżynierii produkcji Vol. 2, Opole, Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją.

Rastegari A., Mobin M., 2016. *Maintenance decision making, supported by computerized maintenance management system*, Conference: Annual Reliability and Maintainability Symposium, Book Series: Reliability and Maintainability.

Sitarski K., Żmujdzin M., 2016. *Analiza porównawcza funkcji systemów klasy CMMS – wyniki badań*, in: Knosala R. (ed.), Innowacje w zarządzaniu i inżynierii produkcji Vol. 2, Opole, Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją.

Wang C. Li H. Yap J., Boon H., 2019. *Systemic approach for constraint-free computer maintenance management system in oil and gas engineering*, Journal of Management in Engineering, 35, 3, 04019007.

Wienker M., Henderson K., Volkerts J., 2016. *The Computerized Maintenance Management System An essential Tool for World Class Maintenance,* Symphos 2015 - 3rd International Symposium on Innovation and Technology In The Phosphate Industry, Book Series: Procedia Engineering, 138, 413-420.