Bulletin of the *Transilvania* University of Brasov • Vol. 11 (60) Special Issue No. 1 - 2018
Series I: Engineering Sciences

# COMPUTERIZED MAINTENANCE MANAGEMENT SOFTWARE

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***Abstract:*** *The paper contains a few knowledges about the maintenance activity to establish an optimal maintenance strategy with computer application. Maintenance activity is theoretically analyzed by finding a logical scheme for implementing a maintenance strategy and a brief description of the advantages of implementation a computerized maintenance management software. In the end will be presented the conclusions of using the computerized maintenance management software.*

***Key words:*** *maintenance, management, computer application.*

## *1. Introduction*

Maintenance is the set of technical, administrative and management measures taken during the lifecycle of an equipment, intended to maintain or restore it to a state in which it can perform the function necessary to ensure that the system functions as efficiently as possible. The term "maintenance" has multiple definitions, which try to highlight different aspects. The most important task of maintenance is to ensure the availability of long-term equipment.

The best ways [3] to support the maintenance process are:

- Team work;
- Productivity oriented on contractors;
- Total integration with spare parts and services provided by suppliers;
- Management support;
- Proactive planning and programming;
- Continuous improvement of the maintenance process;
- Continuously improving the procurement process of materials and services;
- Integrate the maintenance process into the organization.

Maintenance activity [7] includes several professions and targets all sectors of activity. Occupational diseases and maintenance-related health problems (asbestosis, cancer, hearing deficiencies and musculoskeletal disorders) are predominant. Maintenance workers are at risk of a whole series of accidents, are more exposed to heat in the summer (44% compared to 19% among other professions), cold in winter (44%

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compared to 17%) and a humid atmosphere (25% compared to 13%), hazardous substances, vapors and emissions. Maintenance workers are at risk of a whole series of accidents. It is estimated that about 15-20% of total accidents and 10-15% of total fatal accidents are related to maintenance operations.

## *2. Maintenance Strategy*

The maintenance strategy [5] selected for a machine must effectively use the following types of maintenance, individually or cumulatively. Figure 1 presents schematically the types of maintenance strategy approach.

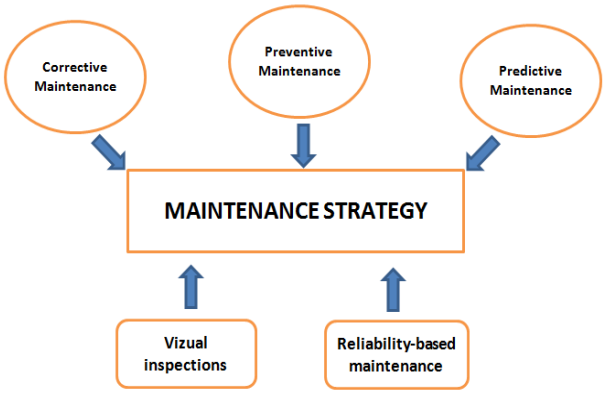


Fig. 1. *Types of approach to maintenance strategy*

The role of maintenance strategy [5] is to achieve and maintain the following:

- optimal availability of production facilities and auxiliaries to maintain the company's production capacity at the established performance level;
- optimum operating conditions for production / ancillary equipment / systems;
- efficient use and maximum capacity of maintenance resources;
- extending the life of equipment / systems;

### 2.1. Corrective maintenance

It is the type of maintenance that only intervenes on the machine after the fault has occurred. The activity focuses on repairing the symptom of the defect without looking for the cause. This type of maintenance has a low planning, the repair being incomplete.

### 2.2. Preventive maintenance

It is the type of maintenance performed at predetermined intervals or in accordance with certain predetermined criteria in order to reduce possible damage or degradation of the proper operation of a machine. It is a maintenance program that aims to eliminate or prevent corrective and / or reactive maintenance. A more comprehensive

preventive maintenance program will use the periodic evaluation of critical equipment / machines / systems to detect potential problems and immediately schedule the necessary interventions to prevent any degradation of the operating conditions.

Preventive maintenance is known in the art as maintenance based on time, systematic maintenance or scheduled maintenance.

### 2.3. Predictive maintenance

Predictive maintenance is a concept based on the use of measuring devices capable of monitoring the status of the equipment, which can be determined directly in function over a certain period of time. The concept of predictive maintenance is also known as status-based maintenance. Predictive maintenance actions are performed to diagnose and monitor equipment to detect early-stage malfunctions to reduce their likelihood of evolution over time and to avoid damage to equipment. Predictive maintenance is the means to improve and increase productivity, product quality and total efficiency of manufacturing and production systems. Unlike preventive maintenance, based on programming the time elapsed from commissioning/capital repairs/maintenance to organizing maintenance activities, predictive maintenance is based on their programming according to the actual operating parameters /indicators of the machine. The use of predictive maintenance as an important element of a firm's maintenance policy provides real-time data on the current mechanical state of each drive system and the performance of each process. These data are an important basis for organizing maintenance. It will be possible to avoid unplanned breaks in the production process by identifying problems before they become serious. It is possible to plan the shutdown, prepare the intervention team, order the necessary spare parts and minimize the standstill for repair.

### 2.4. Visual inspections

Actions consisting of periodic inspections in installations, monitoring, functional tests, etc., as well as periodic monitoring of installations to obtain information on their technical condition. It checks the fulfillment of the conditions necessary for the normal operation, establishes the need for maintenance or restoration of performances.

### 2.5. Reliability-based maintenance

Reliability-based maintenance (MBF) is the final stage of a complex maintenance program. The MBF integrates preventive and predictive maintenance types, with all the responsibilities involved at each stage. The global function of a system with such a configuration and how well it focuses on reliability-based maintenance is the true measure of success. Each of the components of the equipment allocated to an active center can operate with a high degree of confidence, resulting in a better production forecast, greater employee satisfaction and increased profit margins. Once reliability-based maintenance has been implemented, the result will be a fully integrated

maintenance system that involves a different approach to problem solving and allows a consistent increase in the reliability of the equipment.

### *3. Algorithm for Optimally Select the Type of Maintenance*

All equipment or installations requiring maintenance must be related to the amount of revenue or its importance. As long as the equipment are different importance, the type of maintenance chosen for them should not be the same. The maintenance strategy determines the position of equipment (value and importance) to achieve a minimum lifetime cost, with maximum reliability and maximum availability. The efficiency of maintenance work depends on the type of maintenance and the strategy for doing this.

Figure 2 shows an algorithm that can be used to optimally select the type of maintenance for a specific equipment.

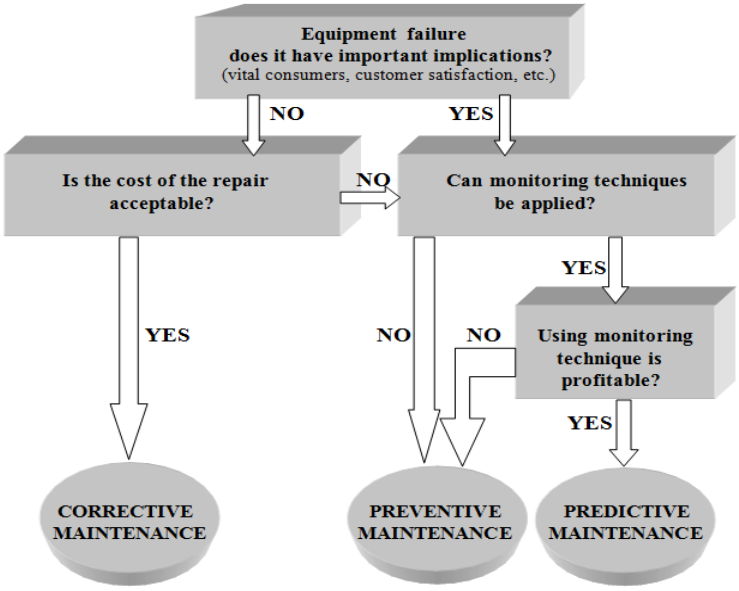


Fig. 2. *Algorithm for optimal selection of maintenance type*

### *4. Efficiency Indicators*

In article "Efficiency indicators for maintenance activity" [4] are presented these indicators and they role. The role of efficiency indicators is to "quantifying the quality of the service provided by the maintenance team". The values of the efficiency indicators may be different, but they can be useful in:

- ✓ making the optimal decision;
- ✓ comparing the performances obtained in the respective year with those of the previous years;
- ✓ testing the benefit of a maintenance strategy;

- ✓ knowing the effect of liberalization of energy markets on maintenance service;
- ✓ assessing the effectiveness of any improvement and budget required for maintenance work for the coming year.

Indicators that express the efficiency of maintenance activity are numerous, but in practice can be selected less or only one.

**Technical indicators**

- number of interventions
- the use of the equipment over its lifetime
- availability of equipment
- stock of spare parts

**Economic indicators**

- the specific cost of maintenance
- the specific cost of using spare parts stocks
- share of repair cost in total cost
- productivity indicators

**Time indicators**

- average response time
- average repair time
- planned maintenance time

### *5. Maintenance Management*

The Maintenance Framework [6] describing the maintenance management as the leadership and organization, planning and scheduling, preventive maintenance, condition monitoring, execution of maintenance repairs, root cause failure analysis and spare parts management.

Maintenance management [6] can be used to achieve improvements in safety and reliability, improvements to operating procedures and strategies and the establishment of capital and operating regimes. Successful implementation of a maintenance management system can lead to improvements in cost effectiveness, asset reliability and availability complemented by a comprehensive understanding and management of risk.

The maintenance activity must be managed to pass from corrective maintenance to reliability-based maintenance. It must prevent malfunctions, not repair the failure.

When failures can't be prevented by maintenance actions should be developed strategies to minimize effects.The predictive maintenance is the first step to implement an efficient maintenance management.

Figure 3 shows the diagram of the occurrence of a defect [2]. It is possible to observe the moment of occurrence of a fault - O, the moment when it can be detected - P and the moment of damage - F. The P-F interval is the interval between the point at which a potential failure becomes detectable and the point at which it evolves into a functional failure. The fault detection and diagnosis process requires access to certain significant system size / parameters that give information on its status at all times.

To extend the life of a equipment, point P must be eliminate from P-F curve. This can be made by training maintenance personnel, effective work procedures, etc.

Tackling maintenance issues, establishing procedures and maintenance strategy for a system should therefore take into account both the monitoring and diagnosis of each component, but also the influence of the variables. The most well-known monitoring and diagnosis techniques are: vibration monitoring, thermography, lubricant fluid analysis and electrical system specific methods (Impedance Measurement, Insulation Resistance Measurement, Phase Harmonic Range Analysis).

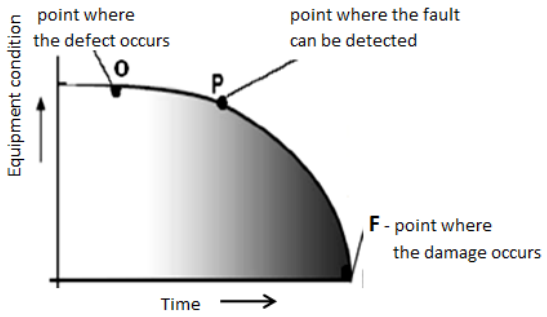


Fig. 3. *Early Identification of a defect [2]*

### *6. Computerized Maintenance Management Software*

Computerized maintenance management system (CMMS) [7] is a software package that maintains a computer database of information about an organization's maintenance operations. This software help managers of maintenance to optimize their activity and to do right decision. CMMS data [7] may also be used to verify regulatory compliance and allows for record keeping, to track completed and assigned tasks in a timely and cost-effective. A CMMS offers multiple core maintenance functionalities [7]. With improved technology and increasing competition, more and more companies are switching to CMMS vs using manual methods to track and organize information. The different components of a CMMS [7] include but are not limited to:

- Equipment data management
- Preventive Maintenance
- Work order system
- Scheduling/Planning
- Vendor Management
- Inventory Control
- Purchasing
- Budgeting

CMMS packages [7] may be used by any organization that must perform maintenance on equipment, assets and property. Some CMMS products focus on particular industry sectors, other products aim to be more general. CMMS packages [7] can produce status

reports and documents giving details or summaries of maintenance activities. The more sophisticated the package, the more extensive analysis facilities have available.

Many CMMS packages [7] can be either web-based, meaning they are hosted by the company selling the product on an outside server, or LAN based, meaning that the company buying the software hosts the product on its own server.

Although most CMMS products contain similar modules and features, some vendors boast a variety of unique services, special functionality, different pricing schemes [1]. From this list of feature and cost differences, the process of finding the right software to meet the budget and needs is hard to realize. Throughout this assessment, may have the perspective of your entire team at all organizational levels that will be involved.

Needs Assessment Process [1] can be broken down into four main quadrants.

### 6.1. Objective

Determining what you want to get out of your software is a very important step in ensuring that you get the "right solution". The right solution implies a perfect match between product features that you need and your maintenance software budget. Because there are so many reasons an organization may want to implement software, it is important to determine which benefits are the most important.

### 6.2. Feature Search

Find the software features that will ultimately produce your identified objective(s). There are many sites dedicated to CMMS information and content. These websites are jam packed with feature overviews and CMMS benefit descriptions that will help you to be better acquainted with maintenance software terms and features.

### 6.3. Functionality

Separate from the actual features that a maintenance software has to offer are its functionality and architecture.

- *User friendliness* - is the degree of how simple, clean, and easy to use the software is;
- *Web based vs Installed* - is the primary difference between these two systems is where they are hosted;
- *Customizability* - Being able to customize your work order forms, account look, reports, etc. may be very important for a business, however be prepared for the work involved to set up a fully customized system. You may want to allocate more money for setup services so you won't be tasked with doing all the heavy lifting yourself.

### 6.4. Budget

After you've determined your ultimate software goals and the basic features and functionality that you require, must make a preliminary budget. When is creating a CMMS budget [1] need to include annual license fee, training and setup system.

## *7.* Conclusions

The implementation of the Maintenance Management concept aims to improve productivity, efficiency by reducing the number of accidental equipment drops and customer satisfaction by implementing a culture of continuous improvement. To achieve this goal, it is necessary to use practical and modern tools for optimizing the activities, and it is necessary to inform the process.

The computerized maintenance management system is an important tool for companies to support the maintenance management activities. CMMS doesn't have to be complicated or expensive. For small to medium businesses vulnerable to inefficient operations and equipment failures, making the transition to a cloud and mobile-enabled solution is a worthwhile investment.

Since the first year of implementation and use of the program, maintenance costs are reduced by about 10%, as the team gets familiar with the application, increasing the experience and developing the database, up to 30%.

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