

**EQUIPMENT CATEGORIZATION AS A BASIS TO IMPROVE
THE ORGANIZATION OF MAINTENANCE**

Juraj DRAHŇOVSKÝ¹

Abstract

Each enterprise must worry about its technical equipment. There are many concepts and strategies to improve the management of the maintenance, e. g. TPM, RBI, LCC, CBM, RCM etc. However, the basis for each one of these systems should be the equipment categorization. The purpose of categorization is to classify equipments according to the type of risk associated with their main function. This allows to focus attention on the parameters and the criteria used to assign the degree of risk when the equipment fails and to determine the proper method of maintenance.

Key words

Categorization, Maintenance Goals, Equipment, Maintenance Strategy, Solution Map

Introduction

Maintenance of equipments is one of the most important components of the management of production services. The goal of the maintenance is to ensure that the realised investments would be able to create sufficient profit during their useful life. The important aspects of the competitiveness of the companies are reliability improvement, safety, as well as reducing the costs throughout the period of their technological usability.

But this improvement is necessary to do systematically. First of all, the company must regularly evaluate how the individual equipments are involved in the economic results of the company and classify them into categories according to how this equipments are important.

The general principles for the categorization of machinery and equipments are (1):

- a machine or equipment is put into the category that best describes its function type of construction, the nature of the operation, the useful life, percentage of serviceability, etc.

¹ Ing. Juraj Drahňovský, PhD. - Slovak University of Technology, Faculty of Materials Science and Technology, Institute of Industrial Engineering, Management and Quality, Paulínska 16, 917 24 Trnava, Slovak Republic
juraj.drahnovsky@stuba.sk

- any classification of the machine or equipment to the category covers not only the machine or device that is completely made up, but also such a machine, which is pretty incomplete or unfinished,
- if it is determined that the machine or the equipment can be classified into two or more categories, then the category with most exact specification has priority over the categories with a general specification,
- if the machine, equipment, or production line consists of a different components, then the machine will be classify according to the component which gives it a decisive character and line will be classify according to the machines, which give it a decisive character.

Category determination

Category determination according to the dominant influence

Each object, system, subsystem, or the machine can be included in categories depending which component of the production process has a dominant influence on, e. g.:

- safety,
- environment,
- production,
- and others.

The objectives of the maintenance for the above categories may be as follows (Table 1):

THE OBJECTIVES OF THE MAINTENANCE

Table 1

<i>Equipment Category</i>	<i>Objectives</i>
Objects that enhance safety and respond to danger.	Permanent emergency of the equipment, must be in operation as required.
Objects that are a potential source of a fire, or a potential source of personal injury.	The minimum number of failures, risk of developing a failure must be low.
Objects that have a direct impact on the quality and capacity of production.	Emergency based on analysis of the direct and indirect costs.
Other objects that do not have a direct negative impact on the environment, security, or production.	Minimum direct costs.

Category determination according to the cost

Parameter that was chosen to determine the significance of any category must reflect the overall objectives of category (1):

- **category Safety/Environment:** cost for safety, cost of removing the consequences of the breakdowns,
- **category Production:** cost to repairs, cost of lost production, cost of logistics,
- **category Others:** cost to repairs, cost of logistics.

Category determination according to the effect on the production

The method according to the effect on the production is another method of the category determination which is more subjective than method according to the cost. The procedure for this method is as follows:

In the first step it must be sorted out the equipment into the categories Safety, Environment, Production and Others. All equipment to protect the safety (signal or locking systems) must be included on the top of the list of significance. For category Production we calculate the direct cost of equipment repair, and indirect costs arising from the loss of production, then their sum shall be determined by the relative importance of production equipments. For category Others we calculate cost including the price of labor and logistics cost, and accordingly we assign significance (1).

The strategy for selecting the types of maintenance

An interesting concept of strategic decisions about the type of maintenance was presented at the conference EUROMAINTENANCE. The method „Decision map“ was used as a technique to solve problems (2).

The concept has been implemented in three steps:

- Criterion analysis,
- Decision map,
- Decision support.

Step 1: Criterion analysis

In this step is performed Pareto analysis of important criteria. Duration of the failure (lockout duration) as the main matter of the production and frequency of failures as a major maintenance issue. The aim of this step is to determine how bad are the worst-performing machines in a given time interval, e. g. one month. Selected worst of both criteria are classified into subgroups high, medium, low.

Step 2: Decision map

The next step is to place equipment in decision map and accordingly to recommend decision on the choice of activities. In this map are shown characteristics of worst machines based on multiple indicators. The aim is to carry out such activities, which will lead to shift machines in the northwestern section where are low failure time and low failure frequency.

For the upper left section is the rule Operate to Failure (OTF) so use the maintenance type „fix-after-failure“. The rule for the lowest left section is to improve the skills, because the number of failures is high, but the duration of the disturbances is low. This means that the maintenance of these equipments is relatively simple and may be carried out by staff after training (SLU – Skill Levels Upgrading).

Problematic machines are machines located in the upper right section. Their failures are not frequent but if they are out of service, it means a big problem because its removal takes a long time. In that case it is appropriate to analyze the cause of the problem and then to monitor the status of the machine. There is applied Condition-based Maintenance (CBM). Machines, which are located in the lower right section, are the worst-performing machines in both criteria. These are the equipments that are more often in downtime than in normal operation. Equipments with these characteristics require change of the construction, thus, a

suitable type of maintenance is reconstruction (modification) – Design Out Maintenance (DOM) (2).

If some machines are characterized by the middle failure frequency and middle time of failure then the rule is to apply preventive maintenance – most widely used in the world is Total Productive Maintenance (TPM) (1).

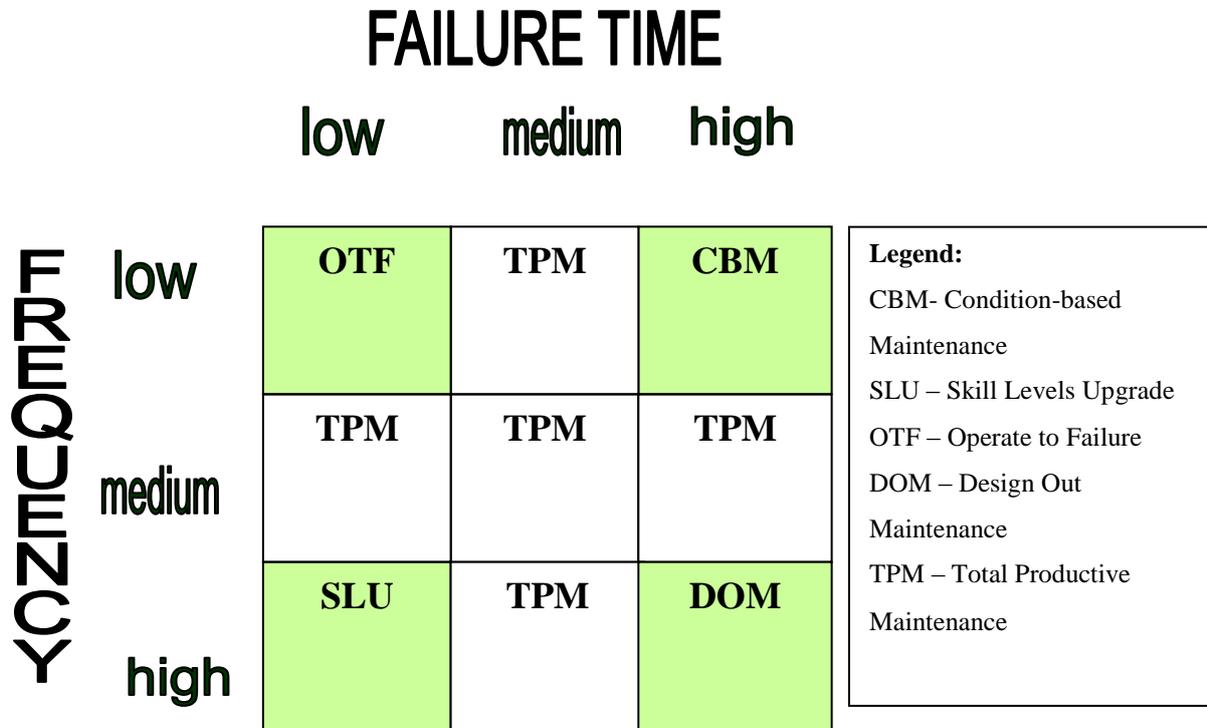


Fig. 1 Decision map (1)

Step 3: Decision support

Subsequently it is determined the cost of each proposed activity or expected savings of financial means after implementation of these activities. Every decision must definitely be endorsed and supported by the management company. On average, maintenance costs are in Western Europe 12-14 % of their gross domestic product. Costs arising from the fact that the implementation of each repair is associated with expending resources and the loss of a performance for which is an equipment intended (3).

The research results

In the academic year 2011/12 was made an analysis of machinery and equipment in one large industrial plant. Machines are divided by sections and for each section was created categorization of machinery and equipment, which was in force since 2008. These were subsequently divided in accordance with individual sections. A number of machines was at each section which were classified according to categories (A, B, C). This classification was done generally for the entire enterprise.

Category C (within the entire enterprise) is machinery and equipment, which do not affect the quality of production and the production itself. Category C represents 22.30 % of the total approx. 13k machines and equipment. There is applied a Corrective Maintenance.

The category B includes those machines and equipment that are already relevant for the company (having impact on the quality of the production and operation of production). They make up the majority of the total number of machines and equipment, which is 48.25 %. The risk of failure in these machines is acceptable only in respect of a security issue and emissions. There is intended a Preventive Maintenance for a part of these machines and equipment. For other machines is not intended any type of maintenance, because for these machines and equipment is not always possible to identify the same type of maintenance.

Category A is 29.45 % of machinery and equipment which are essential for enterprise. They affect the quality of the products, operation of production, safety and overall production. Disturbances of these machines mean high risk of dangerous emissions and the risk of explosion and therefore threats to staff.

For this category A and part of B machines is not intended any type of maintenance, neither a strategy for how to deal with failures, prevention, general maintenance work. This machinery and equipment belonging to these two categories together represent 77.70 % of the total.

Conclusion

After classifying under different categories and subsequently determining the correct maintenance strategy was evaluated that on the basis of changes in categorization could be save about 31.000 €, which represents 5.9 % of total maintenance costs in this industrial plant. However, there is required a systematic approach to managing maintenance of machinery and equipment.

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Reviewers:

Mazgar Nasipovich Isjanbaev, Prof.
Joanna Rosak Szyrocka MSc. PhD.