

## SURVEY OF THE MAINTENANCE MANAGEMENT LEVEL IN INDUSTRIAL ENTERPRISES IN CZECH REPUBLIC

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### ABSTRACT

*This article deals with the research, which focuses on characterization of maintenance management level, maintenance cost control and allocation level and range of modern maintenance management tools (Computerized Maintenance Management Systems=CMMS) utilization in industrial enterprises in Czech Republic. This research is realized within student grant competition of CTU in Prague, Faculty of Mechanical Engineering and is carried out through electronic questionnaires. This paper summarizes main goals of the survey, methodology and data collection tools. Article characterizes individual parts of the questionnaire and introduces current survey results.*

**Keywords:** survey, maintenance management, maintenance strategy, Computerized Maintenance Management Systems, maintenance costs

### 1. INTRODUCTION AND SURVEY OBJECTIVES

Maintenance is an integral part of any production system, plays an important role in ensuring the operability of the company and significantly influences its productivity. Appropriately chosen maintenance strategy contributes to the fact that customers receive their products in the required time and required quality, which is involved in maintaining business competitiveness. It is therefore obvious that the level of maintenance management can significantly influence the success of business.

Determining the level of maintenance management in Czech engineering enterprises is the main objective of the survey. It was chosen an electronic questionnaire to meet this objective. The questionnaire consists of five main parts which represent key characterization areas of maintenance management level.

#### A. Definition of the role of maintenance in the enterprise

Respondent defines the scope of maintenance and characterizes the importance of maintenance to ensure the operability of the company.

#### B. Maintenance strategy

Respondent defines which approaches and strategies are applied in the management and maintenance planning in the company.

#### C. Causes of failure

Respondent characterizes the typical causes of failure (if they are monitored and set by the company).

#### **D. Use of IT tools in the management and maintenance planning**

Respondent defines what tools and IT support uses for planning and managing maintenance. When the company uses Computerized Maintenance Management Systems, in which way this system is used, which are the main benefits of the implemented systems.

#### **E. Costs associated with maintenance**

Respondent characterizes the amount of the cost of maintenance and explains what kinds of cost are monitored in the company and to what level they are allocated. This part of questionnaire should be answered by maintenance manager or in consultation with controlling manager.

## **2. DATA COLLECTION**

A questionnaire created in Adobe Acrobat Professional was chosen for data collection. Questionnaires are sent to selected respondents via e-mail. Respondents can directly fill in the answers in the electronic form or use the printed version. This method of data collection was chosen in favor of the online questionnaire tools such as Google Docs or Lime Survey mainly for the following reasons:

- Questionnaire is easy to print and allows to fill in the printed version of the form;
- Possibility to fill in questionnaire offline, to save questionnaire form and redistribute to more people. This characteristic is necessary due to wide complexity of the questionnaire and the need of being filled by more than one target person;
- General knowledge and use of PDF file format;
- Easy processing of the collected data.

The main disadvantage is the considerable amount of work involved in the preparation of the forms and the rigidity regarding the editing of the form.

In the questionnaire were used all the basic types of questions - one choice, multiple choice, scale, text answer, etc.

## **3. THE TARGET RESPONDENT**

The survey is primarily focused on mid-sized and larger engineering enterprises with mostly small-lot production. These companies already have such a number of machines, which requires a systematic approach to maintenance management. On the other hand, sophisticated maintenance management systems are often not implemented and maintenance processes are not precisely defined as it could be seen in automated mass production.

Twenty selected respondents were asked to fill in questionnaire in the first round of the survey. Respondents were mainly representatives of manufacturers of production machines and equipment that meet perfectly above mentioned characteristics but the return of completed forms within the first round was insufficient. It was necessary to organize second round and address a broader range of respondents. Together for the first and part of the second round ten questionnaires were collected. Target number is twenty completed questionnaires and we assume reaching this target within the following two months.

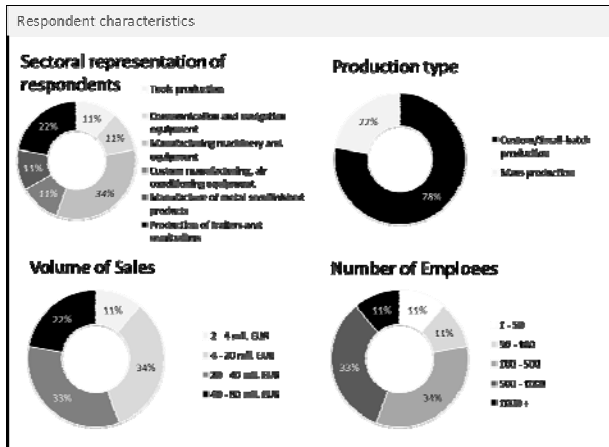


Figure 1. Respondent characteristics

### Target Person:

Most of the questions are directly related to maintenance issues and could be answered by the head of the maintenance department (or other person responsible for this area). The last part (Part E) of the questionnaire focuses on costs and their allocation level. In most companies maintenance personnel isn't able to answer all questions and cooperation of the officer responsible for managing and monitoring costs (the economist or controller) is needed. Therefore is the possibility of redistributing of the questionnaire form so important.

## 4. PARTIAL RESULTS

In this paper are presented only partial results because we are in middle of the second round of data collecting, but they can already provide representative picture about maintenance situation and role in Czech engineering enterprises focused mainly on small-lot production.

### 4.1. Definition of the role of maintenance in the enterprise

In this part of the questionnaire respondents defines the scope of maintenance and characterizes the role and importance of maintenance in the company. The scope of maintenance is characterized by the number of machines on which maintenance is performed and by the average age of machines (see fig. 2).

To characterize the importance of maintenance respondents were asked to rate the role of maintenance on the scale from 1 to 5 where:

- 1= Maintenance isn't important for us. If maintenance isn't performed properly it has no major impacts on reliability of productions process and there are no significant financial losses. Regularly performed preventive maintenance doesn't significantly improve reliability of the production process.
- 5= Maintenance plays a vital role in our company, any failure or unplanned shutdown has a major impact, causes significant damage or reduced quality of production. Our company cannot afford such failures, so there is a big emphasis on quality of maintenance system.

The results show that 50% of respondents perceive the role of maintenance as very important (rate 5 or 4). These respondents are characterized by larger number of machines, older machines or by focusing on mass production. Other respondents rated the importance of maintenance as middle (rate 2 or 3) – small numbers, younger machines, small-lot production.

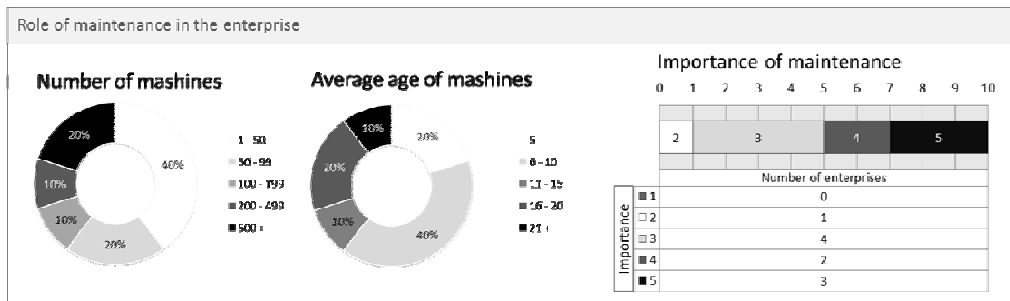


Figure 2. Role of maintenance in the enterprise

### 4.2. Maintenance strategy

To define maintenance strategy in the company respondents select one or more of typical maintenance strategic approaches implemented in their company – reactive, preventive, proactive or TPM. Most of respondents define their maintenance strategy as a combination of reactive and preventive approach. They differ only in the ratio between these parts. Average share of machines on which preventive maintenance is performed is approximately 75%. This share is lower for companies with smaller number of machines and younger machines.

The most important reasons for performing preventive maintenance on the machine are mentioned in the Figure 3. The importance of the factor (reason) is rated on the scale from 1(not important) to 5 (very important).

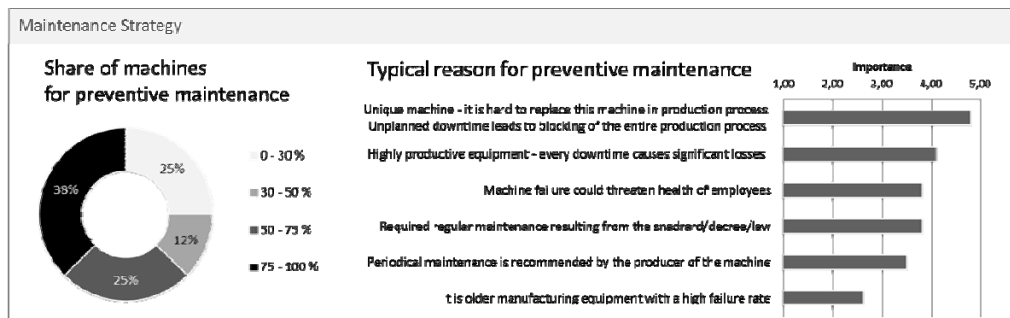


Figure 3. Share of machines for preventive maintenance and reasons for preventive maintenance

### 4.3. Causes of failure

In this part of the questionnaire the respondents characterize if they identify causes of the failures and what are the main causes of the failures. Respondents who identify causes only for significant failures define key factors which are essential for choosing the failure for identification.

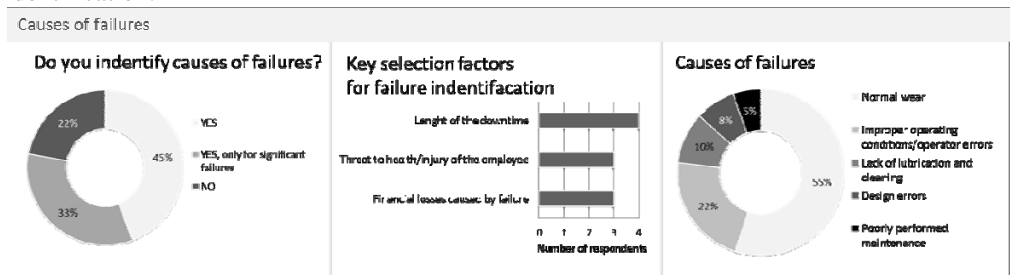


Figure 4. Identification of causes of failures

## Maintenance management and planning tools

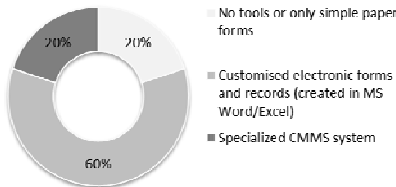


Figure 5. Maintenance management tools

## 4.4. Use of IT tools in the management and maintenance planning

This part of the survey characterizes what IT tools companies use for managing, planning and evaluating of the maintenance. Three levels were defined:

- No tools are used or just simple paper forms
- Use of own forms, tables, reports made in MS Word or MS Excel
- Use of sophisticated and specialized CMMS = Computerized Maintenance Management System

Only two respondents use for planning and maintenance management specialized CMMS system.

Most of the respondents use their own forms and tables made in MS Word or Excel. Enterprises with small number of machines and with small rate of preventive maintenance use only simple paper forms for planning and evidence of the maintenance activities.

Two CMMS users defined main tasks and benefits of implemented systems:

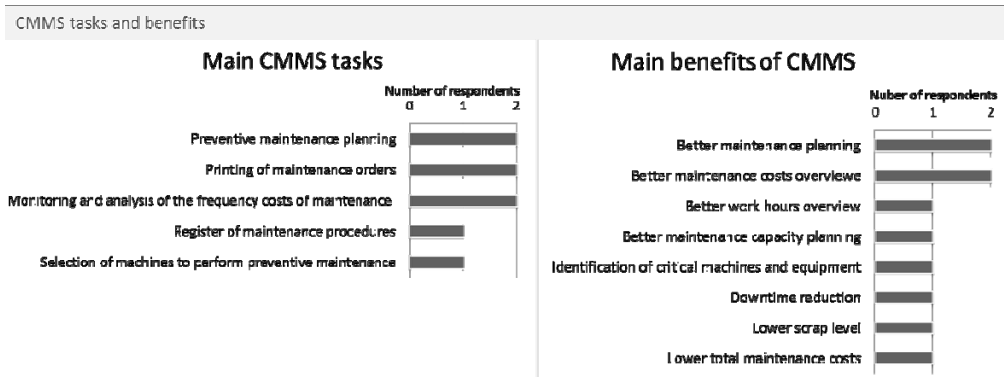


Figure 6. CMMS tasks and benefits

Respondents are also asked whether they are considering the purchase of CMMS. Two respondents mentioned that they are planning to purchase CMMS and they described main reasons:

*“Number of our machines is so high that the current maintenance management system is insufficient, planning and evidence of the maintenance activities is chaotic.”*

*“We would like to use CMMS for maintenance cost analysis and for critical machines and equipment identification.”*

## 4.5. Costs associated with maintenance

In this part of the questionnaire respondents characterize costs associated with maintenance and their allocation level. This section deals with direct maintenance costs (costs of spare parts, personal costs of maintenance employees, costs of outsourced maintenance) but also with indirect costs (downtime cost, penalty charges for late delivery of products caused by unplanned failures, etc.) that arise when maintenance isn't performed properly.

Respondents define, whether they calculate particular type of cost associated with maintenance and on which level is this cost type allocated. Four allocation levels were defined:

- Machine (equipment) where maintenance is performed (indirect maintenance costs are associated with)
- Production Department (Center), where the machine is located

- Maintenance Department (Center), which provides maintenance
- The cost type is monitored for the whole enterprise

Results are shown in Figure 7:

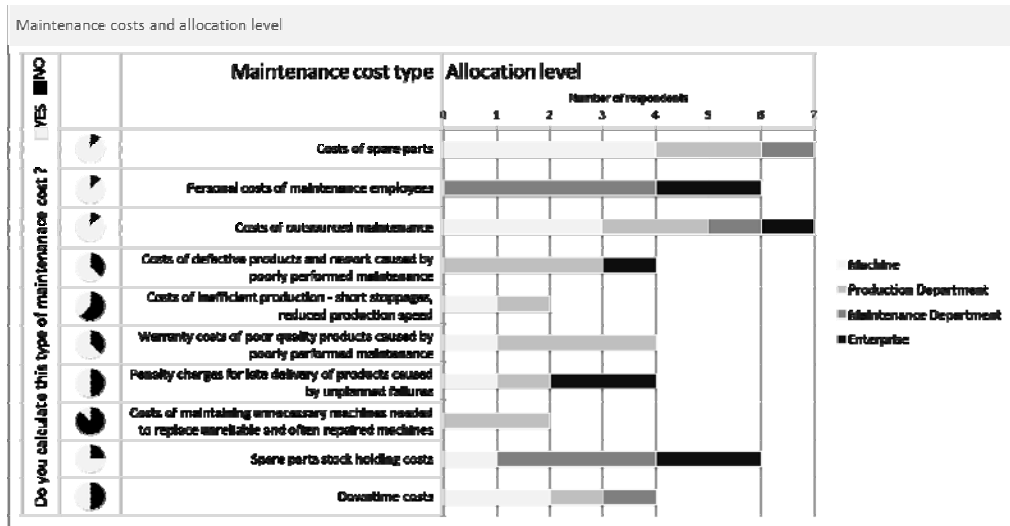


Figure 7. Maintenance costs and allocation level

Respondents are also asked whether they analyze maintenance costs and for what purpose are the analysis results used for.

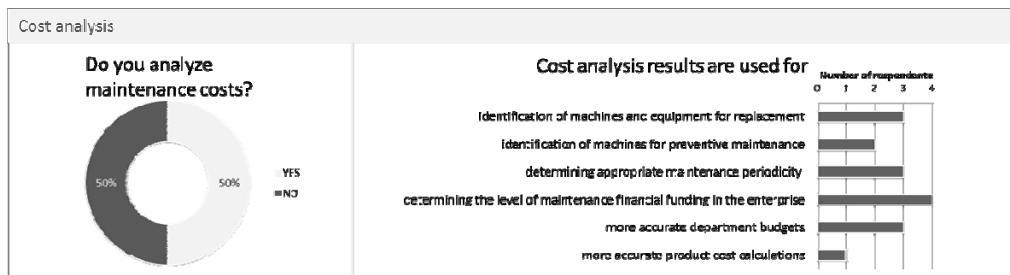


Figure 8. Cost analysis

## 5. CONCLUSIONS

Survey of the maintenance management level is in middle of the second round of data collecting and only partial results were presented in this paper, but they can already provide representative picture about maintenance situation and role in Czech engineering enterprises focused mainly on small-lot production.

The questionnaire was divided into five sections. In first section the role of maintenance in the company was studied. Approximately 50 % of respondents rated the importance of the maintenance as middle and the remaining 50 % as very important. This rating depends on the production character, number and age of the machines.

Second part deals with maintenance strategy. All respondents use combination of reactive and preventive maintenance. They differ in the proportion of these strategies. Key factors for performing preventive maintenance on the machine were identified.

In the third part main failure causes and key factors for failure identification were defined. Results show that a large portion of failures can be directly influenced by maintenance (normal wear, lack of lubrication or cleaning, poorly performed maintenance).

In the fourth section the utilization of maintenance management tools was studied. Only 20 % of respondents have implemented specialized CMMS systems. These respondents also described main tasks and benefits of these systems.

Last part deals with maintenance costs. It was found that mostly only direct costs are properly calculated and the costs are not allocated to the place of origin - to the machine.

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