CAUSE – EFFECT ANALYSIS WITHIN THE MAINTENANCE ACTIVITY USING THE 5M METHOD

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Abstract. A special importance in the management of the maintenance activity is represented by the study of the cause-effect report. The paper presents the 5M method whose objective is the identification of the elements which participate to the good development of the maintenance activity, with the following components: manpower, work means, environment, methods and materials.

1. INTRODUCTION

Industrial maintenance represents a group of measures and actions allowing the prevention, the good maintenance or the reestablishment of an equipment in a foreseen state or capable to ensure a certain service in the conditions of minimizing the maintenance costs [1].

The cause and the effect are terms which denote a certain type of determination relation. The causes always produce the same effects only if they act in the same conditions, the changeability of the conditions facilitates the variability of the effects.

The assurance of a performance management of the equipment maintenance cannot be conceived without its integration next to the equipment reliability and the availability within the system. Considering that the maintenance process in itself is conditioned by a multitude of factors, in order to perform a complete cause-effect analysis the use of the „5M" method is recommended, frequently used in the quality management.

The objectives of the method aim [4]:

- The construction of the equipment maintenance, meaning the identification of the ensemble of physical components and activities which participate at the achievement of the objectives of the maintenance process;
- The assurance of the maintenance process, which includes the assembly of information through which the construction of the maintenance in guaranteed.

The cause-effect analysis, shaped according to the principles of the „5M method" has as a purpose the increase of the quality level of the maintenance activity, having as components the elements in fig. 1, respectively: manpower, work means, environment, methods and materials.

In the specialized works there are other versions of the „5M" method as well, such as [4]:

- The „6M" variant", which refers to: Materials, Methods, Machine, Manpower, Environment (Mediu), Measurement;
- The „7M" variant, which includes: Materials, Methods, Machine, Manpower, Messages, Management, Financial Means;
- The „4M + I" variant, which includes: Manpower, Materials, Machine, Methods, Information.

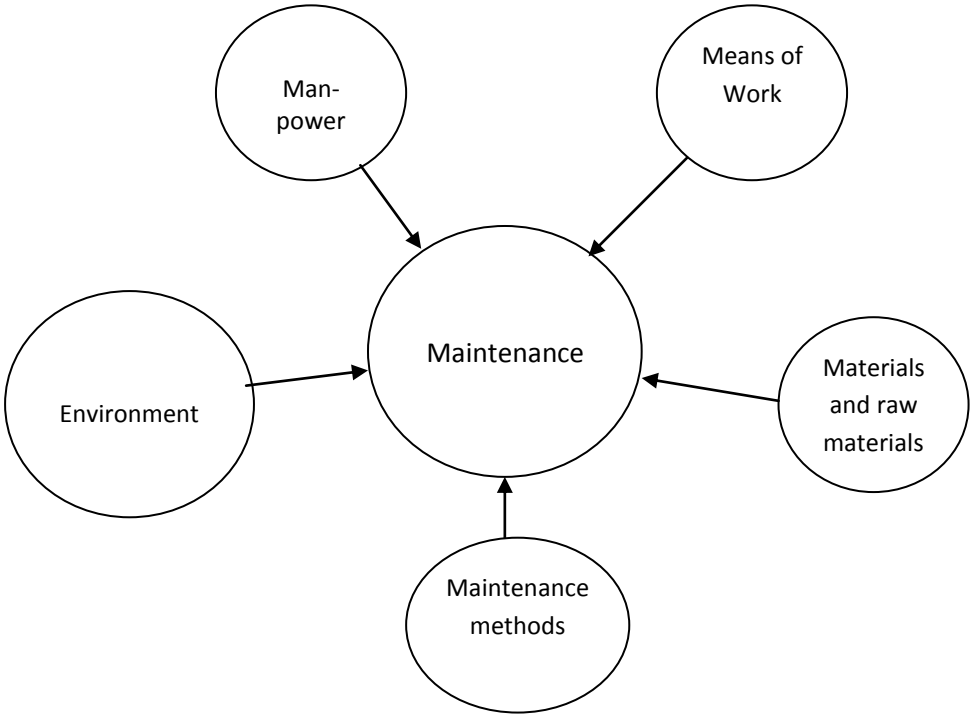

Fig. 1. Component elements of the „5M" method

A complete analysis shows the fact that all the variants have common elements, but the punctual approach can be different (table 1).

Table 1[4]

Components / Variant	Manpower	Mieans of work	Environment	Methods	Materials	Measurement	Messages	Management	Information
5M	●	●	●	●	●				
6M	●	●	●	●	●	●			
7M	●	●		●	●	●	●	●	
4M+I	●	●		●	●				●

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2. METHOD APPLICATION

In order to apply the „5M" method in the maintenance field it is necessary to group the activities in the five different categories:

- **M_1 – man power** necessary to the maintenance process, which refers to: the operators who perform the maintenance, the planners of the process and third parties who have activities within this process;
- **M_2 – means of work** used for the achievement of the maintenance, represented by equipments, computer systems, S.D.V.s, sample stands;
- **M_3 – materials** necessary for the maintenance process; they include: spare parts, maintenance materials, subassemblies, components;

➢ **M_4 - maintenance method** which refers to the adopted maintenance system, as well as the pertaining infrastructure specific procedures;

➢ **M_5 – environment** where the maintenance activity takes place, made of the pertaining spaces and infrastructure, which contributes to the maintenance process, the external environment which used the products of the equipments, the assembly of the ergonomical conditions;

This method can be approached in the context of the Ishikawa diagram shown in fig. 2.

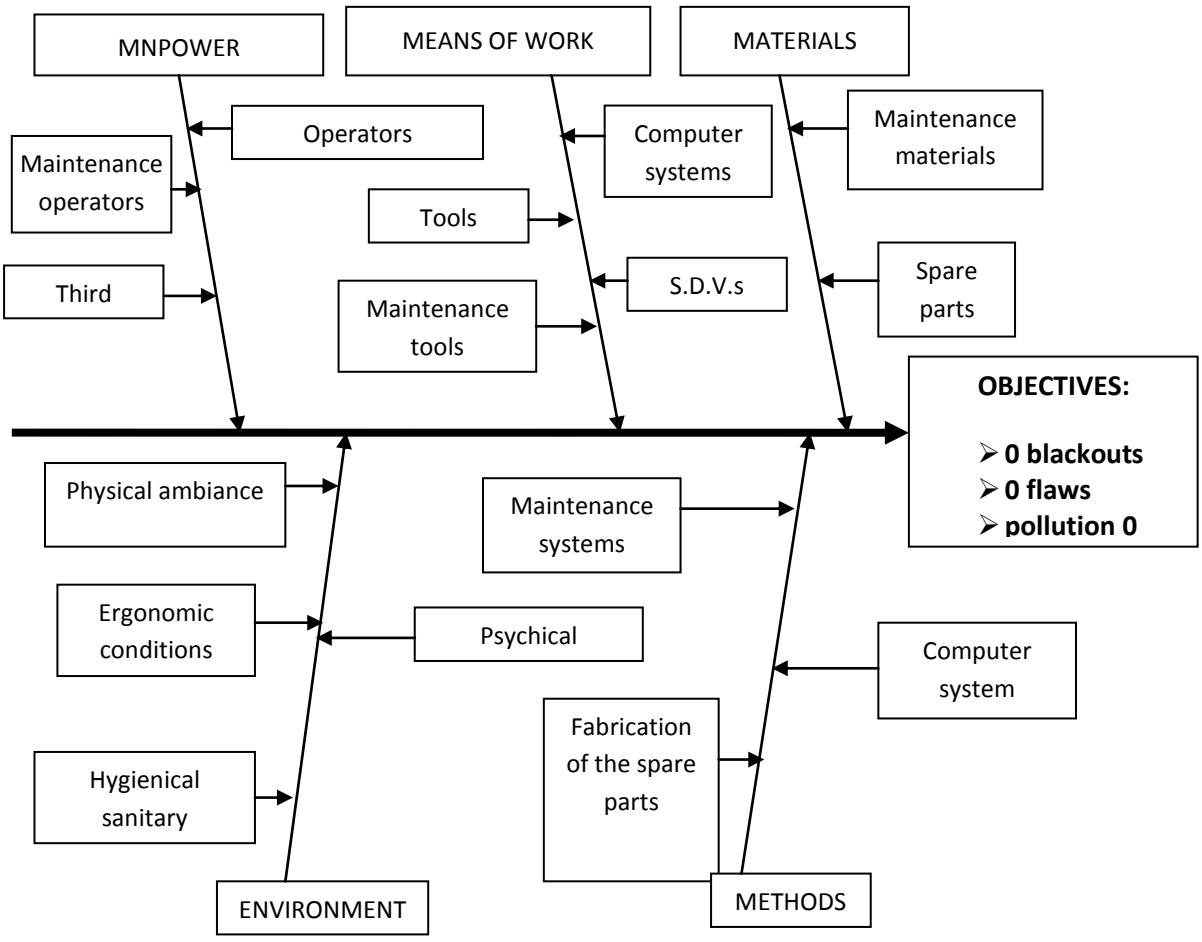

Fig.2 Maintenance assurance [4]

Another way of approaching the method is the quality spiral of J.M. Juran considering the following arguments (fig. 3):

➢ The construction of the maintenance and its assurance are processes which take place and change in time;

➢ Maintenance is a component of the equipment availability;

➢ Maintenance must assure an increasing qualitative level of the products.

The evolution of the quality level of the maintenance process is conditioned by the way the manager gets to develop the 5M method components. If these components have optimal conditions than the level of the quality of the maintenance process will have a constant positive evolution; if the issues related to quality assurance will decrease, the quality level will have a less positive evolution;

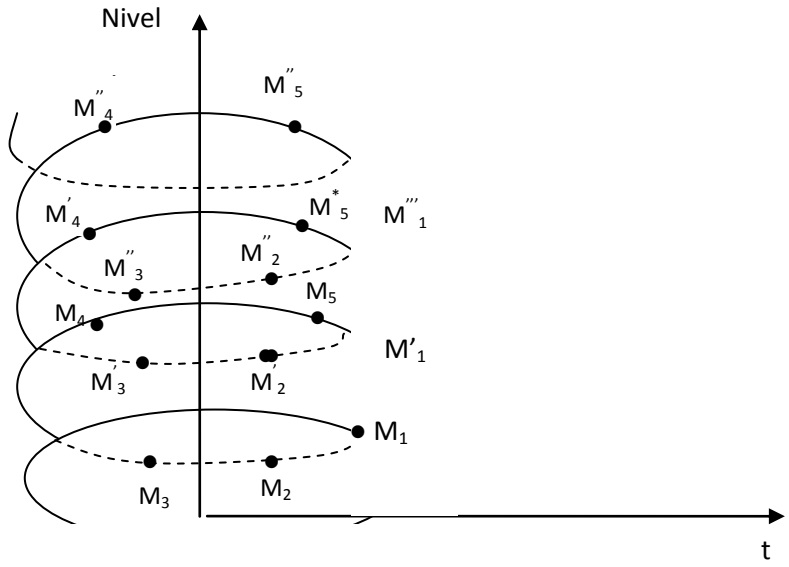

Fig. 3 Quality spiral.

Following the evolution of the J.M. Juran quality spiral, we can conclude the fact that the cause-effect analysis can use variants of the method „5M" according to the structure of the maintenance process.

3. MAINTENANCE MATRIX

In order to assure and construct the maintenance, the information regarding the maintenance can be synthesized in a centralizing matrix shaped like the one in table 2, with the purpose to perform an evaluation of the development in the development state of each component.

Table 2

ENSURING THE MAINTENANCE						
REFERENCE		EXISTENCE			RESPECTED	
		Necessary	Existing	Adapted	Respected	With consequences
		1	2	3	4	5
MAINTENANCE CONSTRUCTION	**Environment**					
	1. Physical ambiance					
	Illumination level					
	Microclimate					
	Air purity					
	Noise level					
	Vibration level					
	2 Psychical ambiance					
	Colors					
	Functional music					

	Motivation					
	Collaboration					
	Interest					
	Variation of activity					
	3. Ergonomic conditions					
	Ergonomic chairs					
	Stands					
	Work posts with adjustable dimensions					
	4. Hygienical – sanitary conditions					
	Assuring the space for meals and rest					
	Assuring drinkable water					
	Organizing the lockers					

The matrix offers certain advantages in comparison with the representation through the quality spiral or the Ischikawa diagram, in the sense of detailing the information related to each component.

4. CONCLUSIONS

The increase of the economic efficiency of the repairs system imposes a change of the management conception of the repairs activity which must not be seen as an auxiliary activity. Among these changes, the method presented in the paper, represents an adaptation in the field of the maintenance activity of the 5M method specific to the quality management.

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