Planning repair strategies with the application of modified FMEA method

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Abstract: The article presents a proposal to modify the FMEA method, taking into account the importance of the cost of repair. The method has been applied to an approximate assessment of the reliability of the device. The presented case concerns reliability analysis in conditions where full service data is not known. The purpose of the work is to determine the weakest element in the design of the tool, taking into account the costs of replacement of damaged elements. The analysis can be used for optimal planning of service parts inventory or planning maintenance service.

INTRODUCTION

In operational practice, after a certain time of operation, there is a significant decrease in the assumed efficiency of the device, often abruptly, it becomes ineffective. Very often the device becomes completely useless. It is serviced and sometimes repaired. Improvement may consist in performing a set range of maintenance activities assigned to a particular service, e.g. after a specific period of use. The repair, on the other hand, consists in replacing selected elements of the device with new ones without any defects. Depending on the complexity of the device, some methods of conduct are used, the common goal of which is to achieve the desired state of the device (fitness status and full functionality). A very important problem from the point of view of the service is to decide what parts in what quantity should be purchased and kept in stock so that the repair takes place quickly enough, which for obvious reasons, depends on the user to a large extend. From the point of view of the user, the cost-effectiveness of repairs is also very important. [1]
The scientific objective of the article is to modify the generally known method of failure mode and effects analysis (FMEA) so that it takes into account the cost factor associated with the repair.
The practical objective of the article is to develop a simple method, taking into account service costs in carrying out future repairs. The developed method can be used to optimally plan purchases of spare service parts. It can be used to assess the cost-effectiveness of the repair and to optimize the cost of repairs.

SUBJECT OF ANALYSIS

The subject of the analysis is an impact wrench with pneumatic drive, designed for various types of assembly and renovation works. In particular, they are widely used in the automotive industry as well as in mining. They are especially used in hard coal mining, during the assembly and disassembly of, among others, mining casings, thus their operation takes place in very difficult conditions.

In the case of this work, specialist service repairs a damaged impact wrench. The key provided for the service has unknown history of service and operation.

The key is made up of three basic systems. The air motor assembly consists of 9 elements, the control unit consists of 9 elements, the impact unit consists of 8 elements. The total of 26 elements have different price and different operational strength.

FMEA ANANLYSIS

The FMEA (Failure Mode and Effects Analysis) analysis is the standard used in industry at the design stage of construction or technology [2]. The FMEA method does not specify the average time between failures or the reliability function, but it can be used to describe the type, effect, cause and significance of damage to the functional units of the device, which are defined globally by the so-called priority number of risk. High value of this number, related to specific elements of the structure, indicates the legitimacy of using preventive measures to improve the reliability of the device. However, this method does not refers to the cost of parts.
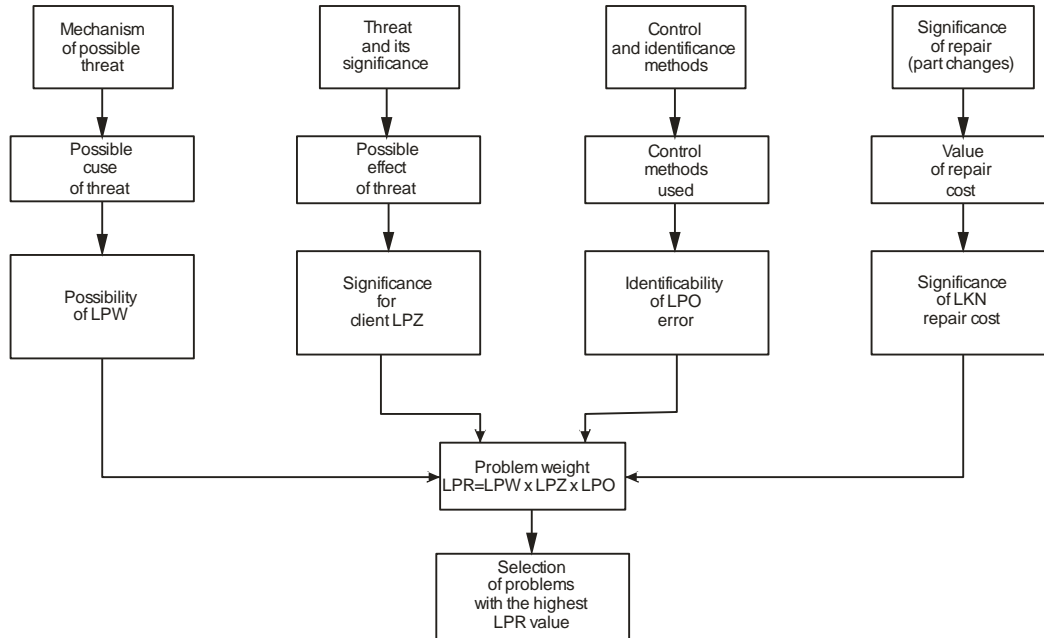
MODIFIED FMEA METHOD

FIGURE 1. Structure of the modified FMEA method

The new element used in the applied FMEA method (Fig. 1) was the use of the cost of parts replacement (including preventive exchange) to assess the priority risk number (LPR) [3]. In this way, the FMEA method was linked to the reliability function and a new modified repair strategy was proposed.

CONCLUSIONS

The proposed method allowed to reduce the frequency of repairs (in the considered case by about 8%) and to optimize the costs of repair (by about 5%). The application of this method allowed for the optimization of planned spare parts stocks by reducing the number of unnecessary parts in stock.

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