THE MEASUREMENT OF THE EFFICACY OF MAINTENANCE FUNCTION AS AN INSTRUMENT OF MANAGEMENT AT THE DS CM "ABID LOLIC" BILA-TRAVNIK

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SUMMARY
Today's business conditions on the world market require continuous monitoring indicators of the efficacy to achieve the goals set in every business system and also the maintanance indicators of the efficacy of as a subsystem in the business system. The application of scientific and professional approach provides quality information on a performance indicators that enable high-quality and responsible management system of maintenance functions. In selecting the method of determining the efficacy of maintenance it is important to take into account the width of the scope of reality maintenance functions and the necessary information provided by this method on the efficacy of maintenance functions. Those information must fulfill all levels of management in order to maintain the business system. In this paper we used a complex method that satisfies these requirements.
Keywords: maintanance operation**,** eficiency**,** indicators

1. INTRODUCTION
With the advent of complex technical systems the tasks of maintenance function as an instrument for achieving the goal of maintenance functions began to complicate also. The central place of successfully managing occupies the achievement of these objectives of business systems. From these goals come concrete actions on the management and maintenance of technical systems. The purpose of management in business systems is constantly improving the performance of these systems, in particular the efficiency and effectiveness for the survival, growth and development of business systems. To achieve these goals it is necessary to achieve the goals of the system maintenance function as a subsystem of the business system. The goal of maintenance is to ensure the functionality of funds for the work according to the requirements of the production function, in the given conditions, at minimum cost and commitment of funds. Successful accomplishment of the goal of the maintenance function, as well as the successful tracking of the development goals of the business system, assumes an access to much relevant informations about the system maintenance function. These informations can be reached through the scientific and technical approach and the use of best practices of others. This approach to obtain the indicators of performance of maintenance function, provides a good overview of the current situation, the possibility of reducing the influence of negative and unforeseen events in the future, initiating, planning, directing, institutionalization and successful implementation of changes with positive effects.

2. MAIN CHARACTERISTICS OF THE COMPLEX METHOD
It is assumed that the performance of maintenance becomes the object of a study in a time when maintaining the economics of the business systems becomes the limiting factor of capacity utilization and a significant cost factor. The first and simplest methods that were used to account for the performance of maintenance function are indicator method with the highest application today in expressing the performance of maintenance. In this paper, to determine the maintanace function of

efficacy we used complex method. Complex method covers more than other methods and approaches to determine the success of maintenance. This method takes into account all activities of maintenance function in a lifetime maintained funds and all funds maintained. Complex method gives a performance information about maintanace function for all levels of management in the function of maintaining and operating system as well as for other users of direct operatives in maintaining, the organizers at all levels to analysts with technical, organizational and economic approach. The complex method is based on the characteristics of behavior of maintained resources and in that is based on the likelihood of these conditions. The method is based on the characteristics and behavior as a function of maintaining economic and organizational system. Those characteristics are stochastic. By this method the overall, complex performance of maintenance function consist of technical (ET), organizational (EO) and economic (EE) components: E (t) = f (ET, EO, EE). The goal of any system is the transformation of inputs into output through the structure and changes of the system. The measurment of the eficiency of achieving this goal can be set as the ratio of input and output components. The components of efficacy of maintenance function can be expressed as the ratio of specific sets of elements of outputs with certain characteristics (technical, organizational or economic) and elements of the inputs with certain characteristics:

$$Ei = fi \left(\frac{output\ elements\ with\ characteristics\ i}{input\ elements\ with\ characteristics\ i} \right)$$

Each system should be technically achivable, organizationaly rational and economically acceptable which means it needs to be successful and technically and organizationally and economically. In the logical algebra this statement is translated into the structure of a serial connection:
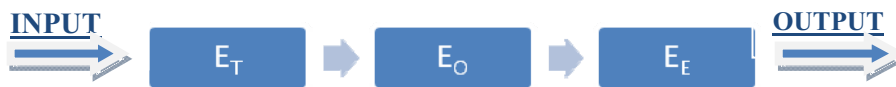
Picture 1. The structure of the efficacy of the maintance function

3. THE DS CM „ Abid Lolic " BILA-TRAVNIK
The mine Bila was founded 19.10.1947. By the decision of the Government of the Federation of Bosnia and Herzegovina 14.01.2009, the share ownership of the FBiH Government in the coal mines was transferred to PC EP Inc. Sarajevo. On the basis of the contract on the transfer of shares between the FBiH Government and JP EP Inc. Sarajevo signed 24.07.2009., the mine Bila was registered as DS CM "Abid Lolic" Travnik as a part of the Group of PC EP Sarajevo. The company has its statuts, control authorities and management:the assembly, the supervisory board and management.

3.1. Experiment
The collection of data for determining the performance of maintenance function in the mine was carried out for the period 2011-2014. year. The complex method is defined on existing structure maintenance during this period. The production process takes place through four-shift system (24 hours) in three shifts, in very specific conditions, characteristic mining of mining exploatation and chamber dug coal. The goal of maintenance function at the mine must be in accordance with business objectives and planned mines, priority achievement of planned production and realization of planned financial results, and that means functional funds provided for the work, plant and equipment for 24 hours (365 days), in very difficult conditions of exploitation with frequent changes of conditions, with planned costs and the reasors that are available. The research was performed at the level of the mine, with particular attention to the production process. Territorially, the research included the entire area of the mine, underground coal mining, open pit, outdoor drive and outbuildings.

3.2. The results of efficacy of maintanance

Mathematical equations used to determine the efficacy of maintenance function using a complex method are given in table number 1 and table number 2 presents the results of obtained efficacy of maintenance [8].

Tabela 1.The results of obtained efficacy of maintenance in period 2011-2014 [8]

Method	Mathemathical equations	No. of variables
Complex method	$E = E_T \cdot E_O \cdot E_E$ $E_T = P(t) \cdot R(t) = \frac{1}{n(nk)} \sum_i^{n(nk)} P1(ksl) \cdot R1(ksl)$ $E_O = Gr \cdot Grd \cdot Gsr$ $E_O = \frac{\int g(r)dt}{nr \cdot FRVh} \cdot \frac{ZZrd}{UZrd} \cdot \frac{ZZsr}{UZsr}$ $E_E = A \cdot B \cdot C = \frac{F}{L} \cdot \frac{Kup \cdot UI}{CKfod} \cdot \frac{Kd \cdot D}{S}$ $E_E = \frac{\sum_i^{n(nk)} Rt(ksl)}{Lop + Lpp + Lort} \cdot \frac{\frac{CKfod \cdot UP}{CK}}{CKfod} \cdot \frac{npr \cdot D}{Sob + Sos}$	24

Tabela 2.The results of obtained efficacy of maintenance in period 2011-2014 [8]

	2011.	2012.	2013.	2014.
Availability R	0,9569	0,9532	0,9179	0,9009
Reliability P	0,7915	0,7594	0,7714	0,6669
Tehnical eficiency E_T	0,7573	0,7288	0,7081	0,6008
Availability of spare parts G_{rd}	0,239	0,153	0,217	0,223
Availability of resorces for work G_{sr}	0,247 (1)$_U$	0,35 (1)$_U$	0,282 (1)$_U$	0,308 (1)$_U$
Availability of workers G_r	0,8721	0,9006	0,8519	0,705
Organizacional eficiency E_o	0,0515	0,0482	0,0521	0,049
Stipulation org. eficiency E_{ousl}	0,208	0,137	0,185	0,157
Inner eficiency E_u	0,039	0,035	0,036	0,029
Inner stipulation eficiency E_{uusl}	0,197	0,187	0,19	0,094
Productivity A	0,0928	0,0913	0,0895	0,0907
Economy B	0,95	0,9142	1,0052	0,92
RentabilityC	1,688	1,443	1,295	1,4
Economical eficiency E_E	0,149	0,121	0,117	0,117
Total eficiency E_U	**0,024**	**0,012**	**0,015**	**0,011**

3.3. Result analysis

From the results of efficacy of maintenance function can be concluded: the efficacy of maintenance function is changed during this period; the efficacy of maintenance function is associated with the efficacy of the company; the technical performance results indicate greater eficiency to eliminate breakdowns in relation to the prevention of failures; there is no well defined approach to managing spare parts and materials for the purposes of maintenance services; increased tasks maintenance function, due to the investment cycle, which lasts during this period continuously it leads to the fall of readiness of workers due to the number of injuries and sick leaves; existing resources of maintenance function can not meet the requirements set by the services of maintenance which leads to the continuous growth of the cost of external services for maintenance; there is no concept designed politics and system maintenance functions, the overall performance of maintenance function during

this period has continued a downward trend; existing resources service of maintenance mines can not keep track of the overall development process and future dynamics of investment and overall development of the mine.
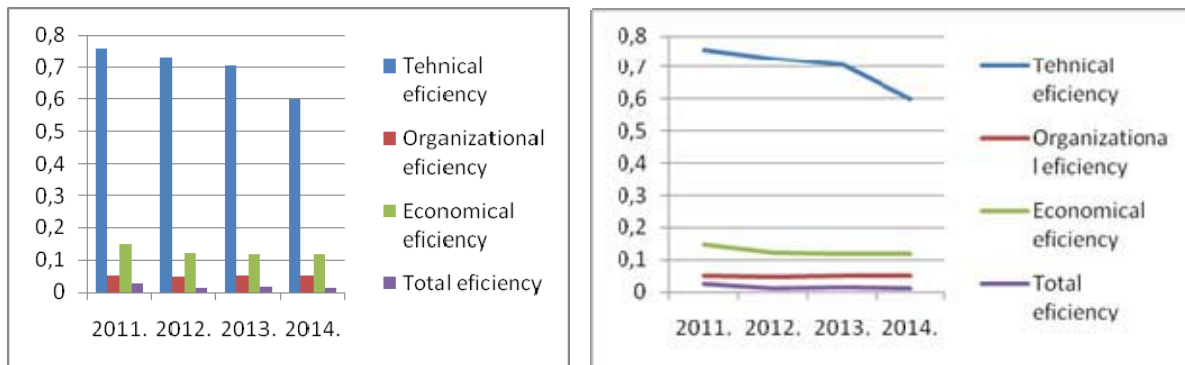
Picture 2.i 3. The motion of the components and total eficiency throughout 2011-2014. Year

4. CONLUCION

Maintenance management system is a series of tasks that needs to harmonize a large number of interdependent influencing factors in time and space, in quantity and quality in the function of achieving the goals of maintenance, with respect to prescribed procedures of quality management. The data obtained in the process of collecting the necessary data to determine the efficacy of maintenance function by using complex methods and results of performance of maintenance function that have been reached, give a clear picture of the structure and state-maintained assets, conditions of exploitation of the system organization and the condition of maintenance function. All this provides the necessary parameters for the necessary measures and activities that management of the mines should take so the system of maintenance function could realize their objectives in accordance with the planning and development goals of mine. The optimization of choice and dimensioning resources of maintenance should performe by the basis of the criteria for necessary readiness funds for work on the basis of the law and requires production while keeping costs at the current level (range 8-10% of the total cost of production). Needed, selected and defined resources provided through planned investment cycles in the future.

5. REFERENCE

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