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Quality tools in a process of technical project management

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ABSTRACT

Purpose: The aim of this paper is to show how it could utilize the tools of quality management for the process of project management. Also it could be presented a modification of the Ishikawa diagram.
Design/methodology/approach: In presented work has been applied the research methodology that bases on the theoretical analysis and on the empirical researches. It is also presented a practical solution that proved the validity of proposed method.
Findings: The base finding of the presented work is the new concept of the Ishikawa diagram. The second finding is the stratification method. This new management tools let change the process of technical solution preparation.
Research limitations/implications: In presented work it has been used only one improved quality tool. It is consider with the fact that the aim of the paper is to present the possibility of the improved management tool.
Practical implications: The article, and particularly the presented method allow to develop the researches consider with quality tools. Secondly, this paper shows the importance of integration the management and technical procedure. And thirdly in this article is presented a technical solution that is also a result of improved work technique.
Originality/value: The presented improve Ishikawa diagram and stratification analysis is the original author proposition. Also presented technical solutions are original.
Keywords: Project management

1. Introduction

The traditional Ishikawa diagram is a qualitative tool of management [1]. Using this tool one can show the relations between causes and the analyzed effect. The most often used is the Ishikawa diagram in a form called the model 6M+E [2]. The symbol 6M+E describes next general causes: man, machine, material, method, management, measurement and environment. This diagram is presented in the Fig. 1.

The model of the classical Ishikawa diagram is not complete. There is no quantitative information to obtain from this diagram [3], [4], [5]. This need was the origin of the weighted Ishikawa diagram. The change of the diagram is considered with the character of the connections (bones) of the diagram [6], [7]. In this paper there is proposed a completing of the diagram with connections weights. Below is presented the method of preparing the weighted Ishikawa diagram [8]:

- determination of a set of main causes
- determination of subcauses
- determination of weights of main causes
- preparing the weighted Ishikawa diagram
- conducting the stratification analysis
- determination the set of important causes and subcauses

Applying presented above levels makes possible to construct a complete management tool: the weighted Ishikawa diagram. To determine the weights of connections (causes) it is proposed to use a form of the Saaty matrix [9]. In this paper this matrix is called the comparison matrix (Fig. 2).

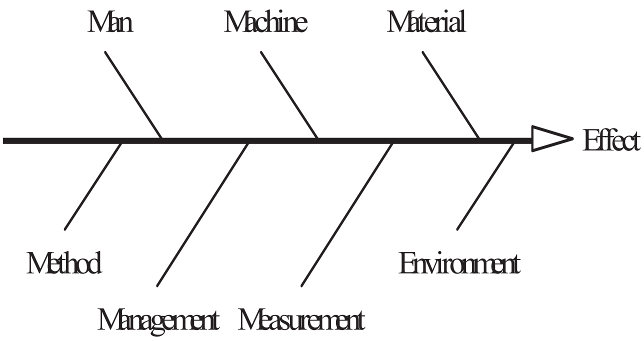

Fig. 1. The 6M+E Ishikawa diagram [2]

	Man	Machine	Material	Method	Management	Measurement	Environment	Σ	Σ_n
Man	X	0,5	1	0,5	1	1	0,5	4,5	0,214
Machine	0,5	X	1	0,5	0,5	1	0	3,5	0,167
Material	0	0	X	0	0,5	0,5	0	1	0,048
Method	0,5	0,5	1	X	0,5	1	0,5	4	0,19
Management	0	0,5	0,5	0,5	X	1	0	2,5	0,119
Measurement	0	0	0,5	0	0	X	0	0,5	0,024
Environment	0,5	1	1	0,5	1	1	X	5	0,238

Fig. 2. The matrix of comparison

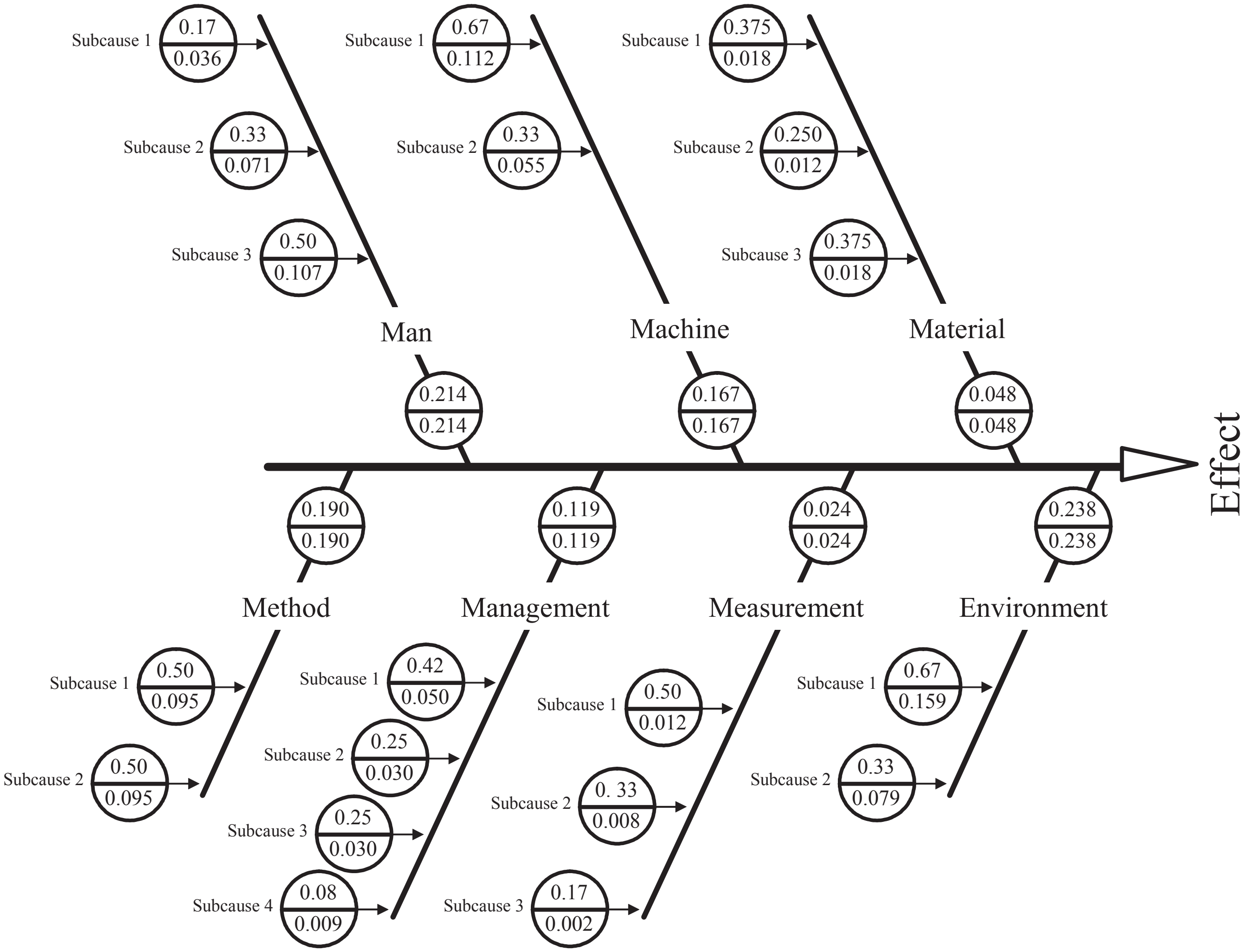

Fig. 3. The weighted Ishikawa diagram

Using this matrix one can compare in pairs every cause on the same level of analysis. The scale of notes is as presented: 0, 0.25, 0.5, 0.75, 1. "O" means that analyzed cause is of no importance. The note 0.25 is for causes of small importance. If the importance of causes is equal one gives them the note 0.5. The notes 0.75 and 1 are for cause that are more important and very important. Next, in the column Σ there is calculated the sum of all component notes. This sum is the weight of each cause. In the next column the normalized weight is computed. The normalized weights are inscribed to the Ishikawa diagram.

In the same manner the weights of subcauses, for each main cause separately, are determined. Next are computed the absolute weights by comparising the weights of subcauses with the weight of the main cause. In the result one can prepare the weighted Ishikawa diagram as presented in the Fig.3.

The next step is the stratification analysis [9]. This analysis bases on the Pareto rule. The first step in this analysis is to prepare a histogram of weights. Next is determined the reference field, a special factor which is used instead of the classical Pareto rule (80:20). In the point, where the reference field is the largest the limit for two sets is determined. In the presented case the firs 7 subcauses constitute the group of important causes (as it is presented in the Fig. 4).

No	Subcause	Weight	Cumulate weight	Reference index
1	environment 1	0.159	0.159	2.862
2	machine 1	0.112	0.271	4.607
3	man 3	0.107	0.378	6.048
4	method 1	0.095	0.473	7.095
5	method 2	0.095	0.568	7.952
6	environment 2	0.079	0.647	8.411
7	man 2	0.071	0.718	**8.616**
8	machine 2	0.055	0.773	8.503
9	management 1	0.050	0.823	8.230
10	man 1	0.036	0.859	7.731
11	management 2	0.030	0.889	7.112
12	management 3	0.030	0.919	6.433
13	material 1	0.018	0.937	5.622
14	material 3	0.018	0.955	4.775
15	material 2	0.012	0.967	3.868
16	measurement 1	0.012	0.979	2.937
17	management 4	0.009	0.988	1.976
18	measurement 2	0.008	0.996	0.996
19	measurement 3	0.002	0.998	0

Fig. 4. The matrix of stratification analysis

This process let us prepare the weighted Ishikawa diagram and to obtain the quantitative information from this diagram. As one can see the more important causes are: environment 1, machine 1 and man 3. These three causes generate over 30 % of defects of a mining support.

2. The example of application

The presented weighted Ishikawa diagram could be applied in many real world problems. Of course it is mainly the tool for quality management but it could be applied in different problems of management. The proposed method is simple so it could be easy used by managers or workers from the quality circles. Moreover it let us to avoid the long discussions about the problem which cause is the most important. In the continuous improvement management systems one need effective tools, which help him to solve his problems.

In presented work the weighted Ishikawa diagram is applied to improve the process of designing a new mining support [10]. The scheme of a traditional support is presented in the Figure 5.

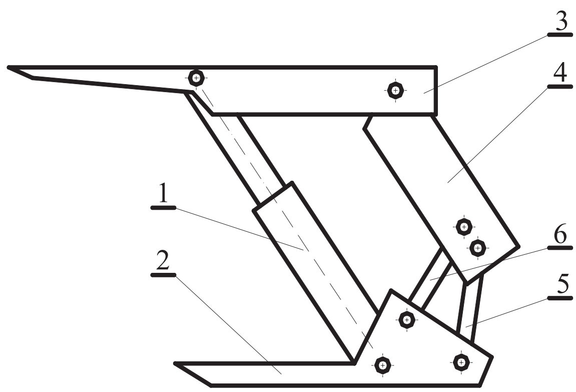

Fig. 5. The scheme of a traditional mining support: 1 – hydraulic cylinders, 2 – foot piece, 3 – roof bar, 4 – shield, 5 – rear lemniscate link, 6 – front lemniscate link

The present support was the subject of analysis. It has been done many interviews with miner (users of the support), maintenance worker and others to determine the main faults of the system of traditional mining support. Results are presented below.

Other interviews have been done with mining supports designers. This data aided the process of elaborating constructional parameters for the new technical mean.

3. Faults of the traditional support

Results of the investigations let show some main causes of the faults of a traditional support. Firstly one should analyze main groups of causes of faults of traditional support. They are presented in the Fig. 6 in a form of the weighted Ishikawa diagram. As one can see the main problems are consider with three groups: machine, environment and man [10]. It could be interpret that the main faults of the traditional support are cause by the human mistakes (designers and operators) or by geological factors.

The mentioned three groups include 64 % of the total number of general faults. So one can easily state that solving problems consider with these groups could radically improve the work of a support.

The group man includes next faults: occasional withdrawing of a support, deterioration of the shield or faulty assembly of units [11]. In the group machine one can list next faults: bad decomposition of forces causes mainly by skew hydraulic cylinders, not safety work space or too long roof bar. Elimination of these faults should allow designing new construction of the mining support. The other problem are material faults [12]. Some of these problems could be solved using modern materials [13].

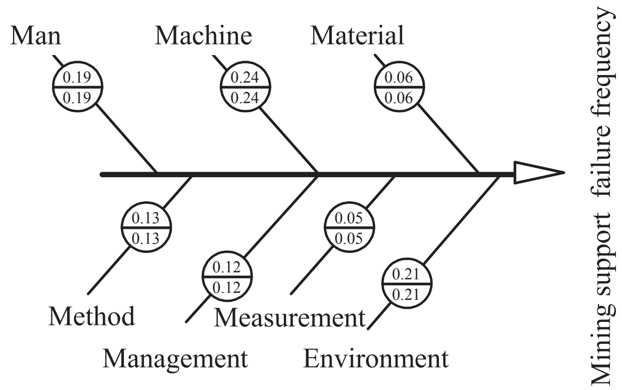

Fig. 6. The Ishikawa diagram for the construction defects of the support

4. Conclusions

Basing on the prepared constructional parameters it has been design the construction of new hydraulic support (Fig.7).

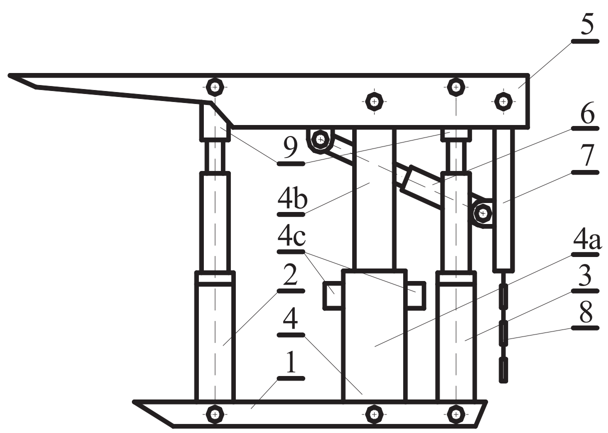

Fig. 7. Proposition of new construction of a support

Main changes are considered with the system of hydraulic cylinders. In this concept it has been used four cylinders. Secondly these cylinders are mounted vertically.

The second group of changes is considered with the human factors. In this construction it has been planed the work space for miners protected by front cylinders 2. Moreover this support is protected by hydraulic shock absorbers. The above presented support has been determined as original construction and is protected by Polish paten [14].

Concluding one should state that the proposed method includes both elements of technical data acquisition [15] and technical project management [16] linking them into one holistic system.

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