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Method for quantitative assessment of safety culture

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ABSTRACT

Many events with catastrophic consequences occurred over past decades. One of them was the disaster in Bhopal. A weak safety culture is mentioned as a one of the causes of this tragic event. It is a generally accepted fact that the level of safety culture has to be continuously evaluated and improved to avoid the occurrence of such situations in the future. This paper introduces a new method – Assessment Tree Method (ATM) allowing for quantitative estimation of the level of safety culture in an organization.

The ATM enables the determination and quantification of the key aspects of safety culture on the basis of assessment trees. The structure of the trees is analogical to fault tree, a commonly used tool for the analysis of accidents. The assessment process is based on the guided interviews. As a result, a deeper insight is gained and effective identification and elimination of weak points in safety culture enabled. Next, the level of safety culture is calculated taking into account the results obtained for key safety aspects specific for a given organisation as well as their weights of importance.

The ATM was tested for the evaluation of safety culture at the university department. There were twenty students, and three staff members responsible for safety, participating in the study. The six key aspects of safety culture were identified: knowledge & skills; awareness; flow of information; monitoring & control & supervision; management commitment and continuous improvement. On the basis of the obtained results it was concluded that the level of safety culture is high and some recommendations were given to make it even better.

The most important advantages of the proposed method are quantification and simplicity enabling assessment of a broad scope of the specific aspects of safety culture. The proposed method could be used for the standardised benchmarking of the different organisations.

1. Introduction

For the first time, the term “safety culture” was used in the report on the nuclear disaster at Chernobyl in 1986, published by International Atomic Energy Agency (IAEA, 1991). The definition of safety culture presented in this report is given as:

> “Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance”.

In the following years, the analysis of other disasters e.g. the explosion on the Piper Alpha offshore drilling platform (Cullen, 1990) or the Clapham Junction rail crash (Hidden, 1989), confirmed the importance of safety culture. The increasing interest in the concept of safety culture leads to intensive research in this field (Yule, 2003; Pidgeon, 1991; Turner et al., 1989). The conducted research clearly identified the strong relationship between the level of safety culture and the number of accidents. As it was to be expected, the higher level of safety culture had a positive impact on the decrease of the number of accidents (Milczarek, 2000). One of the major subjects of research is identification of the aspects of safety culture (Ejdys, 2010; Pidgeon, 1991). For example, He et al. (2012) recognized 32 elements of safety culture.

Another important aspects of research are attempts to quantify the level of safety culture (Yule, 2003; Cooper, 2008). In the past, the level of safety at work was determined on the basis of few quantitative components, such as: financial loss incurred as a result of accidents, the number of the days of the absence of employees,

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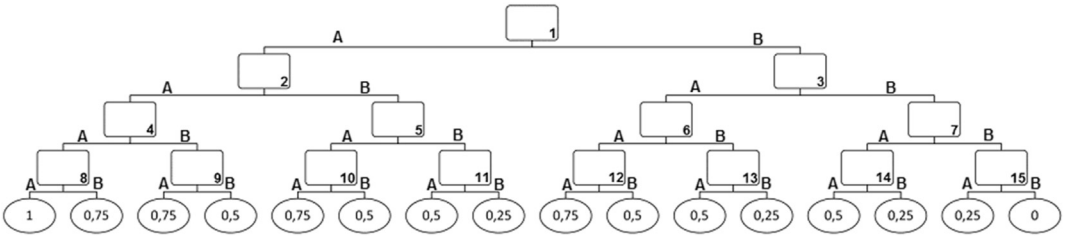

Fig. 1. The structure of assessment tree.

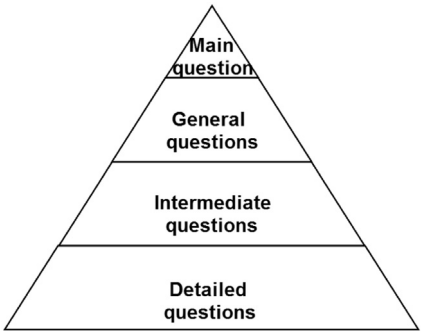

Fig. 2. The hierarchy of the questions.

the days of downtimes in factories etc. (Janicak, 2003). However, such approach was not applicable to the issue of quantification of safety culture.

The existing methods of safety culture assessment are qualitative. They are using inter alia interviews, expert ratings, audits (Yule, 2003). The mentioned approaches allow to obtain a lot of information on the level of awareness of workers or motivation of their actions.

John S. Carroll (1998) proposed use of the survey consisting mainly of questions, each to be answered on a four-category scale (strongly disagree, disagree, agree, strongly agree), and interviews to measure safety culture. He also recognized the problem of a quantitative study of this issue. The suggestion to use the checklist (Score Your Safety Culture Checklist) to assess the level of safety culture was given by Reason (2011). The method consists in assessment of twenty situations related to various aspects of safety culture. The respondent gives "yes/no" answers and the final score is a sum of positive replies. The other method is Safety Culture Grid proposed by G. Kirschstein and E. Werner-Keppner (Ejdys, 2010). Cooper (2008) tried to introduce quantitative method taking into account the risk. The author proposes to conduct audit and to use

Table 1
Questions for the key aspect of safety culture – knowledge and skills.

Number of question	Question	Expected answer
1.	Does the student know how to act in case of emergency or danger?	Yes, he/she does. (Student should: - call the national emergency number 112; - state his/her name; - describe what happened and where; - answer the dispatcher's questions; - do not disconnect the call before you are given permission; - call the university's emergency number (initiate emergency measures)
2.	Does the student know the working hours of the lab?	Yes, he/she does (8 am – 5 pm)
3.	Does the student know who the protector of the lab is?	Yes, he/she does. (The answer depend on the laboratory)
4.	Does the student know that usage of pressure and gas vessels requires the permission of the technician?	Yes, he/she does.
5.	Does the student know what individual protection he/she should use?	Yes, he/she does. (The answer depends on the students type of work)
6.	Does the student know that he/she should take part in safety training before he/she starts work in the lab?	Yes, he/she does.
7.	Did the student acquaint himself/herself with risk assessment?	Yes, he/she did.
8.	Does the student know where he/she can find information about chemical substances?	Yes, he/she does. (The data sheet is available on the website)
9.	Does the student know the meaning of near misses?	Yes, he/she does. (The near misses are "an unplanned events that did not result in injury, illness, or damage – but had the potential to do so")
10.	Does the student know what he/she should do if the individual protection is not available or damaged?	Yes, he/she does. (He/she should stop working and take new ones)
11.	Does the student know how to report an accident and near miss?	Yes, he/she does.
12.	Is the student able to perform first aid after safety training?	Yes, he/she is.
13.	Does the student know how to protect himself/herself against impact with the substance/machine which he/she uses?	Yes, he/she does.
14.	Does the student know that his/her duty is to take care of the workplace?	Yes, he/she does.
15.	Does the student know about hazards existing in the lab?	Yes, he/she does. (the hazards depend on the laboratory in which student works)