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Evidence-based safety (EBS) management: A new approach to teaching the practice of safety management (SM)

Bing Wang, * Chao Wu, Bo Shi, Lang Huang

School of Resources and Safety Engineering, Central South University, Changsha, Hunan 410083, PR China

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ABSTRACT

Introduction: In safety management (SM), it is important to make an effective safety decision based on the reliable and sufficient safety-related information. However, many SM failures in organizations occur for a lack of the necessary safety-related information for safety decision-making. Since facts are the important basis and foundation for decision-making, more efforts to seek the best evidence relevant to a particular SM problem would lead to a more effective SM solution. Therefore, the new paradigm for decision-making named "evidence-based practice (EBP)" can hold important implications for SM, because it uses the current best evidence for effective decision-making. *Methods*: Based on a systematic review of existing SM approaches and an analysis of reasons why we need new SM approaches, we created a new SM approach called evidence-based safety (EBS) management by introducing evidence-based practice into SM. *Results*: It was necessary to create new SM approaches. A new SM approach called EBS was put forward, and the basic questions of EBS such as its definition and core were analyzed in detail. Moreover, the determinants of EBS included manager's attitudes towards EBS; evidence-based consciousness in SM; evidence sources; technical support; EBS human resources; organizational culture; and individual attributes. *Conclusions*: EBS is a new and effective approach to teaching the practice of SM. Of course, further research on EBS should be carried out to make EBS a reality. *Practical applications*: Our work can provide a new and effective idea and method to teach the practice of SM. Specifically, EBS proposed in our study can help safety professionals make an effective safety decision based on a firm foundation of high-grade evidence.

1. Introduction

Numerous accidents happen each day in many organizations all over the world, which result in injury to people, environment pollution, and consequential reputation damage, so safety management (SM) is a very important element of effective organizational management. In recent years, because of the essential role of SM in maintaining the safety of work systems in the workplace and improving safety performance, SM has drawn much attention of both practitioners and academia. Though the term SM frequently appears in the literature on safety science and receives daily attention, unfortunately, an in-depth discussion or reflection of SM bases or approaches is missing. Moreover, most organizations are facing the bottleneck of the improvement of safety performance due to their good past safety performance (Mcsween, 2003, p. 23). Consequently, a new and more effective SM approach is urgently needed in the current SM.

For many years, people have been seriously debating the use or improvement of traditional SM bases or approaches (Akkerman, Farahani, & Grunow, 2010; Hale, Heming, Carthey, & Kirwan, 1997; Mooren, Newton, Grzebieta, & Williamson, 2011). Obviously, because management bases or approaches are the basis for carrying out management activities (Wagner, 1975, p. 13), mainstream in current SM research not only hinders the improvement of SM research quality but the discovery of the effective solutions for the new SM problems. Therefore, the value of most existing research on SM is questionable, which is forcing us to re-examine traditional bases or approaches of SM. In other words, practitioners and researchers need to further explore new bases or approaches of SM to improve the safety performance more effectively in the future.

Because a management basis is a basis for a management method, changes of a management paradigm usually begin with the doubt to its foundation and finally find a new management approach (Rousseau, 2006; Pfeffer & Sutton, 2006, p. 33). For example, some management scholars (Pfeffer & Sutton, 2006; Rousseau, 2006) put forward an effective management approach, named evidence-based management, based on the doubt of bases of the traditional management methods such as personal experience, professional skills, exaggerated advertisings, a few successful cases, and so on. Similarly, the doubt of bases of the existing SM methods should be the starting point for finding a new SM approach. In SM, it is most important to make an effective safety decision according to the accessible and reliable safety-related information (Yang, 2012). In fact, because people usually only have extremely limited information (e.g., the self-safety experience of SM,

* Corresponding author.
E-mail address: wangbing187717@163.com (B. Wang).

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safety standards, safety norms, the case of accidents, and advanced practices of SM) for making a safety decision, and there may be some inaccuracy or errors in these information, the effectiveness of safety decision is often not very good (Yang, 2012). In a word, the need for safety decision-making bases and skills increases dramatically in SM. Although it is generally accepted wisdom that the defect in organizational SM is the root cause of many organizational accidents (Abdelhamid & Everett, 2000; Howell, 2005; Hudson, 2014; Lehto & Salvendy, 1991), however, currently very few researches focus on thinking and resolving the defect in SM from the basis for SM. Therefore, unless the best basis for SM is well addressed, a convincing and effective path to improve safety performance is difficult to reach. For this reason, more and more practitioners and researchers are beginning to seek a more reliable and effective basis for SM.

The lack of necessary information for decision-making is a general problem in many fields. To solve this difficulty, evidence-based practice (EBP) was proposed, which provides a new and suitable approach to effective decision-making for better results (Chwalisz, 2003; Evidence-based Medicine Working Group, 1992; Young, 2002). In fact, EBP is not a new idea. Medicine is a success story as the first domain to institutionalize EBP (Estabrooks, 1998; Metzdorff, 2013; Sackett, Straus, Richardson, Rosenberg, & Haynes, 2000, p. 35). Meanwhile, EBP is gradually introduced to many other fields (e.g., evidence-based policy, evidence-based management, and evidence-based education) for effective decision-making in recent years (Briner & Rousseau, 2009; Dounavi & Dillenburger, 2013; Head, 2010; Klimoski & Amos, 2012; Pawson, 2002; Rousseau, 2006). In other words, the phrase "evidence-based" is a buzzword in many fields. And distinct effects have been gained by EBP. Since so far no paper has discussed how to implement EBP in SM, the authors, inspired by EBP, propose a new and rigorous approach for SM that is evidence-based safety (EBS) management. Specifically, this paper proposes EBS by reviewing of existing SM approaches and analyzing reasons why we need new SM approaches, and presents the basic questions and the determinants of EBS.

2. A review of existing safety management approaches

2.1. Categories of existing SM approaches

Existing SM approaches could be divided into seven types based on their management bases, which are experience-based safety (ExBS) management, theory-based safety (TBS) management, behavior-based safety (BBS) management, standards-based safety (SBS) management, risk-based safety (RBS) management, accident-based safety (ABS) management, and countermeasures-based safety (CBS) management. Table 1 lists them according to some literatures (Lindberg, Hansson, & Rollenhagen, 2010; Sousa, Almeida, & Dias, 2015; Sulzer-Azaroff & Austin, 2000).

In addition, the following two issues need to be explained in Table 1: (1) the examples of ExBS management is a blank because SM activities would require some experience, and (2) in the actual SM operation, people likely use a combination of these SM approaches in Table 1.

2.2. Shortcomings of existing SM approaches

Shortcomings of existing SM approaches are shown in Table 1. In a nutshell, using them to carry out SM may fail for their erroneousness. An example is the Yifeng bus accident where the bus caught fire and resulted in 35 fatalities and 13 injuries, on Jun. 26, 2016, Hunan Province, China (SAWS, 2017): although the bus involved in this accident with only one door meets the standards of the 'Safety Specifications for Motor Vehicles Operating on Roads' (GB 7258—2004) (Ministry of Public Security of PRC, 2004) and the 'Provisions on the Standards for Compulsory Retirement of Motor Vehicles' (Ministry of Commerce of PRC, National Development, & Reform Commission of PRC, Ministry of Public Security of PRC, 2012), inadequate number of doors is still one of the main reasons for high numbers of fatalities and injuries (SAWS, 2017). This example shows that using SBS to carry out SM may fail. Unfortunately, the current SM approaches in Table 1 are regarded as the very effective SM methods in the current SM.

Firstly, the erroneousness of ExBS, BBS, SBS, and ABS is determined by their decision logic (inductive reasoning). Specifically, the essence of their decision logic is to turn limited SM experience, safety behaviors, accident cases, and safety requirements into the universal SM principles. Obviously, according to the law of large numbers, the universal SM principles could be derived only by considering all possible SM experiences, safety behaviors, accident cases, and safety requirements.

Secondly, the erroneousness of TBS and CBS also is determined by their decision logic (deductive reasoning). Specifically, the essence of their decision logic is applying the universal safety science principles, management science principles, and SM strategies to a specific SM practice. Though they have a good exterior validity, unfortunately, since they are drawn from assumptions or limitations, which may not be available in practical application, they may not achieve their desired application effect in a specific organization. Furthermore, because the concern of a SM theory or strategy is not the SM bottleneck in an organization, its application result also is not ideal.

Thirdly, the basis of RBS actually is identified risk, which may have some errors. And there are some human errors in the specific implementation process of seven SM approaches in Table 1.

3. Why is it necessary to create new safety management approaches?

In sum, there are three main reasons why we need new SM approaches:

1. Based on the analysis in Section 2, it is easy to know that existing SM approaches need to be improved. There is a particular need to improve the correctness and efficiency of existing SM approaches.
2. Though existing SM approaches to the simple traditional safety problems are very suitable for past organizational SM, unfortunately, they have a number of restrictions and disadvantages in organizational SM at present, because the organization's structure and external environment have dramatically changed (see Table 2) (Leveson, 2011, pp. 2–4).
3. A major problem in SM has not been overcome, which is how to really apply the scientific laws and principles in SM research to the SM practice to make the SM practice more scientific and effective. In fact, the research-practice gap is a long-standing and common problem. For SM, researchers and practitioners seem to be living in two isolated worlds. Though the SM rules and methods having a positive effect on safety performance have been proved by many studies, the SM practices of many organizations are not in accordance with them.

4. The definition of evidence-based practice

Needless to say, EBP is not a new idea. In recent years, there has been a great deal of interest in EBP around the world, and the concept of "evidence-based practice" has also developed a considerable literature. EBP stems from evidence-based medicine (EBM), which came to prominence in the 1990s (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). EBM has developed into a basic discipline of its own in clinical medicine, and is regarded as 21st-century clinical medicine (Metzdorff, 2013).

EBM stresses that medicine decisions should be based, as much as possible, on a firm foundation of high-grade scientific evidence, rather than on intuition, unsystematic clinical experience, and pathophysiologic rationale (Sackett et al., 1996). In other words, physicians diagnose the patients' illness and determine the most appropriate treatment and best care methods for their patients by using the most accurate information. In short, because EBM is a practice of clinical medicine

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