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K. Coperich, E. Cudney, H. Nembhard, eds.

What are the antecedents of safety performance in the workplace? A critical review of literature

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Given the progressive growth of interest in both academic and practitioners about safety performance in the workplace, the aim of this study is to provide a review of the literature on workplace safety from the perspective of the antecedent of safety performance. By conducting a systematic literature review, a list of relevant contributions on workplace safety is provided. The contributions were analyzed and classified regarding the arguments about the antecedents of safety performance. The study integrated different domains of the antecedent of safety performance to provide a clear and consistent definition for the concept of "antecedent" when applied to safety performance. Moreover, a list of common antecedents of safety performance was extracted from the literature and categorized. Finally, a unified and classified framework for antecedents of safety performance is proposed. From an academic perspective, this paper enables future research in developing research streams on the antecedents of safety performance. Equally important, practitioners can employ the proposed framework to select leading KPIs for safety performance evaluation and monitoring in the workplace.

Keywords
Safety performance, Antecedent, Framework, Literature review

1. Introduction
Evidence shows that determining the antecedents of safety performance can help to develop a stronger plan to reduce the number of workplace accidents [1]. Considerable research has been devoted to the safety outcome in the workplace [2]; however, less attention has been paid to the antecedents of safety performance [3]. Further, the existing safety literature lacks clear and consistent definitions and conceptualizations [4]. There is not a clear and widely accepted definition for the concept of "antecedent of safety performance" [5]. For example, individual factors, such as human errors, were traditionally mentioned in the safety literature as the influencing factors of safety and health problems, but after two catastrophic accidents (Chernobyl and Bhopal) researchers warned of other influencing factors for accidents such as management practices and work conditions [5]. Therefore, recently researchers are faced with a wide variety of heterogeneous antecedents of safety performance (individual characteristics, management practices, and work conditions), which are difficult to be placed in an integrated framework. Similarly, as described by Danna and Griffin [6] a unified model or theory is still necessary to develop the main constructs of health and safety in the workplace in order to better understand the boundary of these factors and clearly define the independency and interdependency among these factors.

Hence, in the present study, there are three research goals. First, since a clear definition of the antecedents of safety performance is lacking in the literature, a comprehensive definition, grounded in the existing literature, is presented. Second, the relationships between the antecedents and safety performance are investigated based on contemporary theories. Finally, since different categories of antecedents have been introduced in the scientific literature, a unified framework for the antecedents of safety performance is proposed.

The remainder of the paper is organized as follows. The next section provides the methodology adopted within this review. The third section presents and discusses the review results in three key aspects: (1) illustrating the definition of the antecedents of safety performance, (2) investigating the relationships between antecedents and safety performance, and (3) proposing a unified framework of antecedents of safety performance. In the final section, concluding remarks and directions for future research are presented.

2. Methodology
The literature review methodology was selected for the present study for several reasons. First, since there is no clear agreement in literature on the conceptualization of the antecedent of safety performance, different relevant meanings were extracted in order to propose a unified definition for the antecedent of safety performance. Next,

relevant studies were reviewed to investigate the relationships between the antecedents and safety performance. Finally, different domains of the antecedents were extracted from the scientific literature in order to propose a unified framework for the antecedents of safety performance.

A systematic search of the literature was conducted to identify relevant studies regarding the research objectives. To meet the first objective, a list of keywords was selected. According to the Oxford English dictionary “antecedent” refers to “A statement upon which a consequence logically depends.” Therefore, in addition to the term "antecedent” other similar keywords were selected. The final list of keywords for the first objective included accident cause(s), accident source, antecedent(s), influencing factors, factors affecting, job stressor AND safety performance, accident, injury, safety behavior, and safety outcome. In order to address the second objective, the following keywords were searched: antecedents, accident cause(s), influencing factors, factors affecting, job stressor AND relationship AND safety performance, safety outcome, safety behavior, accident, and injury. Finally, for the third objective, the literature that was searched based on the two prior steps was used to determine the different domains of the antecedents of safety performance.

Following the keywords selection, the academic databases of Google Scholar, Web of Knowledge, Science Direct, Springer, and PsycINFO were searched. In addition, several peer-reviewed journals, such as Safety Science, Accident Analysis and Prevention, and Safety Research were specifically reviewed. After combining the results from the journals and databases, the initial search provided more than 600 articles. In the next step, formal filters including subject area and journal title were applied. Then, by excluding duplicates, merging results, and reviewing abstracts, the relevance of literature was ensured. The abstracts and introductions were reviewed. According to the objectives of the present study, if the literature was relevant, it was retained; otherwise, it was excluded. Finally, in order to check for additional relevant studies, the references of the selected studies from previous steps were checked for relevance (i.e., snowballing). By conducting these steps 21 contributions were identified.

3. Summary of Review and Discussion

Safety performance is a concept that describes the status of safety activities in an organization [7]. Therefore, a set of tools and techniques is utilized within this concept. Historically, a set of lagging indicators has been used for safety performance measurement. However, recently a new group of leading indicators were introduced in the safety literature as a complementary method for measuring safety performance. As such, the meaning of “safety performance” also changed. For example, Christian et al. [4] concluded that the term safety performance could be used with two different meanings: safety outcomes and safety behaviors. Safety outcomes refer to organizational metrics, such as the number of accidents and injuries, and safety behaviors refer to individual safe behaviors, including safety compliance and safety participation. Therefore, lagging indicators are employed for measuring safety outcomes, and leading indicators are used for measuring safety-related behaviors. To address the objectives of the present study, the model of workplace safety proposed by Christian et al. [4], which is provided in Figure 1, was adopted.

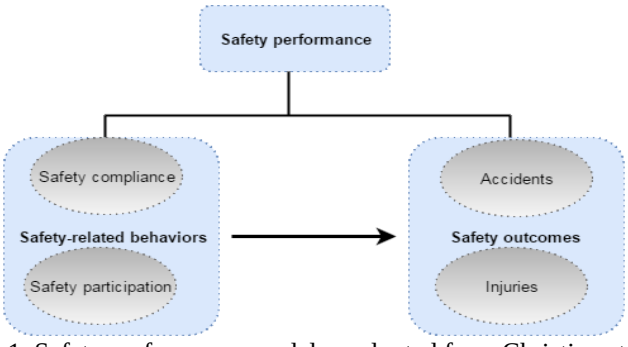

Figure 1. Safety performance model as adopted from Christian et al. [4]

3.1 Definition of Antecedent of Safety Performance

According to the definition of antecedent in the Oxford English dictionary, the literature was searched to reach the antecedents of safety performance. For instance, Griffin and Neal [5] showed that antecedents of performance include individual-level factors, such as ability, experience, and personality, as well as group and organizational factors, such as leadership, group norms, and climate. In another study, Christian et al. [4] introduced antecedents of safety performance in two different categories: distal factors and proximal factors. Distal factors refer to situational

and personal factors. Proximal factors refer to safety motivation and safety knowledge. Moreover, we can see in studies that some similar keywords (different terminologies) to the antecedents' meaning are employed to describe the influencing factors of safety performance. Given these definitions, it could be concluded that direct and indirect items, which influence safety performance, could be defined as an antecedent of safety performance. Hence, in this study, the items that are consistent with the antecedent definition from the selected literature were extracted and listed in Table 1.

Table 1. Antecedents of safety performance extracted from selected papers

Reference	Antecedents of Safety Performance
El-nagar et al. (2015)	Worker factors, environmental factors, organizational factors
Clark (2013)	Leadership styles, organizational climate
Card (2013)	Person, organization, technologies and tools, process, environment, tasks
Muniz et al. (2012)	Management's commitment, incentives, work pressure, communication
Hansez and Chmiel (2010)	Job demands, job resources, management commitment
Clarke (2010)	Job characteristics, work group, leader, organizational structure
Wu et al. (2010)	Workplace, work team, equipment, material
Christian et al. (2009)	Safety climate, leadership, personality characteristics, job attitudes
Nahrgang et al. (2007)	Job demands, job resources
Gibb et al. (2006)	Work team, workplace, equipment, material
Neal and Griffin (2006)	Organization factors, individual factors
Teo et al. (2005)	Policy, process, personnel, incentive
Haslam et al. (2005)	Worker (work team), workplace, materials, equipments, originating influences (safety culture, management)
Goldenhar et al. (2003)	Job-task demands, organizational factors, physical/chemical stressors
Parker et al. (2001)	Work design, role demands, supportive work context
Griffin and Neal (2000)	Individual-level factor, group and organizational factors
Sawacha et al. (1999)	Historical factors, economical factors, psychological factors, technical factors, procedural factors, organizational factors, environmental factors
Manuele (1997)	Culture, management system, task performance practices
Krause (1997)	Culture, management system, exposure
Hofmann et al. (1995)	Individual factors, micro, and macro organizational factors
Embrey (1992)	Operating environment, task characteristics, operator characteristics, organizational and social factors

3.2 Classifying Antecedents of Safety Performance

As shown in Table 1, a wide variety of antecedents of safety performance exists in literature and some authors has already provided some interpretative and classification frameworks [4, 19, 21]. However, it appears that a comprehensive and unified framework for classifying the antecedents of safety performance is still lacking, though useful. In the present study, prior frameworks and the items provided in Table 1 were employed to propose a unified and comprehensive framework for the antecedents of safety performance as shown in Figure 2.

The main factors forming the concept of working environments are related to the four factors including physical factors (e.g., noise, heat, lighting), chemical factors (e.g., dust, chemical, smoke), ergonomic factors (e.g., workstation design, chairs), and biological factors (e.g., virus, bacteria) [27]. The effect of each these factors on OHS performance has been widely reported in the literature. For instance, Shikdar and Sawaqed [28] show the importance of working environments' factors on the rate of occupational accidents and injuries in the workplace. In another study, Dann and Griffin [6] highlight the role of working environments such as biological factors and chemical factors that influence health and safety performance. In the same vein, the significance of physical factors on preventing occupational accidents at construction sites is shown by Wu et al. [14]. Also, numerous studies were carried out to investigate how ergonomic factors affect OHS performance. As an illustration, Marek Dźwiarek [29] analyzes the accidents caused by improper functioning of control systems, which consist of the errors made by designers. In summary, these four elements are kept together in one unit noted as working environment in the present study.

Figure 2. Classification of safety performance's antecedents and their relationship to safety performance

According to Reason's theory [30], humans are the key reason behind accidents. Although within this theory organizational factors have critical effects, the person's role is discussed as the main cause of accidents. Several researchers also mention the importance of people's role as an antecedent of safety performance [4, 6]. Alternatively, by referring to the theory of Individual Differences in Task and Contextual Performance, Motowidlo et al. [31] states "individual differences in personality and cognitive ability variables, in combination with learning experiences, lead to variability in knowledge, skills, and work habits that mediate effects of personality and cognitive ability on job performance". For example, people with type A behavior patterns are "hard-driving, competitive, job involved and hostile". Complementary to this, several studies have been conducted on the relationship between personality differences and safety issues [32-34]. The items extracted from literature, which are related to the workforce characteristics, include motivation, risk-taking, locus of control, and knowledge (also shown in Table 2).

Parker et al. [20] suggests that work characteristics are an important antecedent for safety performance in the workplace. The result of this study is consistent with Clarke [13] who concludes that job characteristics, such as job control, autonomy, and challenge, have a strong influence on perceived safety climate and safety outcomes. Additionally, Barling and Zacharatos' model [36] proposes ten practices for enhancing safety performance, which include several that are related to the work characteristics, such as job autonomy and high-quality jobs. Similarly, work characteristics have been reported by Betcherman et al. [37] as a critical factor to lower accident rates in organizations. In addition, work characteristics as an antecedent for safety performance have also been addressed in the literature [18].

In order to address the importance of organizational factors' role in safety performance, Hofman et al. [25] state "Although individual safety-related attitudes and behaviors are certainly important and no doubt to be addressed by organizations, there are clearly larger organizational variables that impact safety performance". Therefore, the interest in knowing the effects of management and organizational factors on safety performance is rising. For example, in the model developed by Embrey [26], organizational factors were introduced as latent factors that induce unsafe systems and human errors. Further, Paté-Cornell [38] argues that organizational factors are the root of failures in a critical engineering system. Likewise, for demonstrating the significant role of leadership, as an organizational factor, Zohar, and Luria [39] argue that the leadership of organizations, through their support for safety, can be the major source of employee climate. Organizational factors, which are proposed as the antecedents of safety performance, were also found to be important. Management issues, culture, and communication are the most common organizational factors extracted from the literature.

4. Conclusion

Occupational accidents cause an increase in the cost to society through productivity loss and additional costs for medical care. Therefore, scholars are working on the safety related issues in the workplace. However, while considerable research has been devoted to the relationship between safety performance and other key performance indicators within organizations, less attention has been paid to the antecedents of safety performance itself. In line with this premise, the aim of this study was to shine new light on the antecedent of safety performance. Clear and consistent definition of the antecedent of safety performance, interconnectivity among antecedents and safety

performance, and unified framework for presenting the antecedent of safety performance are the challenges existing in the current literature. Therefore, this literature review was specifically developed to overcome those challenges.

According to the objective of the study, 18 publications were selected from databases. In order to obtain the relevant contributions, different search methods were employed. The contributions that address the antecedents of safety performance and describe the relationships' model between antecedents and safety performance were provided. By searching the literature, a wide range of antecedents of safety performance were provided in Table 1. Then, they were classified into four certain categories including working environment, workforce characteristics, task characteristics, and organizational factors. In conclusion, these four categories can be treated as antecedents of safety performance (shown in Figure 2). Moreover, because of the challenges around safety performance definition, a model was developed for distinguishing the safety performance conceptualization (Figure 1).

Although interesting results and findings came out from this study, limitations do exist. In particular, the main limitation lies in the potential omission of relevant contributions from the review. While the keyword structure was designed through a number of trials to ensure the most effective and feasible research space, it cannot be guaranteed that other papers dealing with this subject do exist, but under different labels. Nevertheless, it is believed that this analysis provides an adequate classification for antecedents of safety performance. This study has important implications for both academics and practitioners. From an academic perspective, the paper provides a unified framework for antecedents of safety performance, which helps future research to develop research streams regarding the antecedents of safety performance. From a practical viewpoint, the result and finding of this study, specifically the proposed framework for antecedents of safety performance, can be useful for organizations to employ this framework while the assessment of safety performance is being conducted in their systems. Future research in this field may involve the following areas; (i) verification of the proposed framework and (ii) conducting experimental studies regarding the findings of this study.

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