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Developing a Comprehensive Safety Performance Evaluation Framework for Saudi Schools

Abstract

Purpose – The objective of this study was to empirically develop a safety performance framework for evaluating the various leading and lagging indicators of safety performance in Saudi public schools.

Design/methodology/approach – A comprehensive review of the safety and performance evaluation literature enabled the formulation of the constructs, factors and items that underpinned a conceptual safety performance evaluation framework. The research method involved a conceptual framework review and refinement process with eighteen experts, followed by a questionnaire survey of 200 respondents from Saudi public schools. The final form of the safety performance evaluation framework was determined through a rigorous statistical analysis process, including exploratory factor analysis to uncover the underlying framework architecture from a relatively large set of items, and then the application of the partial least squares method to confirm framework adequacy and to assign loading coefficients.

Findings – The developed safety performance evaluation framework for Saudi schools included five constructs, namely, safety management and leadership, safety learning and training, safety policy, procedures, and processes, workforce safety culture and safety performance.

Practical implications – The developed safety performance evaluation framework is proposed for implementation by the Saudi Ministry of Education to better monitor and manage school safety in the future.

Originality/value – This safety performance evaluation framework is one of the first to holistically evaluate safety performance in Schools, particularly in the Saudi Arabian context.

Keywords: Saudi Arabia, safety, school, exploratory factor analysis, partial least squares method, safety performance

Article classification: Research paper

1. Background

1.1 Safety in Saudi school environments

A number of countries have applied comprehensive safety management systems (SMS) to better manage their school environments. In the 1970s, the United States became one of the first countries to use these safety systems in its schools, resulting in a subsequent reduction in the number of injured students in each school (Small and Tetrick, 2001). Moreover, studies conducted by UNESCO in Saudi schools in 2005 proved conclusively that the collective influence of the SMS, the safety behaviours of students and teachers and the wisdom of the schools' administration, significantly reduced the number of injuries that occurred during the movement of students within school buildings (Saudi Ministry of Education, 2007).

Although the majority of public educational institutions are government-funded and free for Saudi students, there is a marked preference for private schools and colleges, and a large proportion of Saudi students choose to study at foreign universities rather than at public institutions. One of the major reasons may be the public schools' safety problems. Several such issues have been identified, including student violence, health issues, and the safety of school premises, playgrounds, and other equipment.

Greater consideration for a SMS in Saudi school environments surfaced after 15 girls died from smoke inhalation in a fire at a girls' school in 2002 (Prokop, 2003). This accident and a number of others that have occurred frequently in different Saudi schools for decades have heightened government efforts to search for appropriate methods to develop and apply SMS and other safety strategies to reduce high incident and accident rates.

School accident data are usually obtained at regional levels from schools, hospitals, community health offices, ambulance services, and education authorities. Some previous studies have shown considerable differences in accident reporting activities between schools in the primary and secondary sectors (Latif *et al.*, 2002; Williams *et al.*, 2002). There are often complex philosophies behind accident recording and reporting procedures that may relate to the school environment in the primary sector and to the presence of onsite nurses in secondary schools. Some schools under-report accidents (Stark *et al.*, 1997), whereas others over-report them in anticipation of complaints and litigation (Macgregor and Hiscox, 1998).

The potential for using accident data to reduce the school-accident problem is complicated and remains unrealised by the agencies involved. In schools, teaching staff are usually asked for their views on accident activities, accident reporting and prevention strategies. Staff members from school offices and ambulance services commonly provide a health service perspective on the school accident problem. Eichel and Goldman (2001) describe the following three key areas of focus to ensure the health and safety of a child at school: educational, regulatory and environmental.

Environmental factors other than host and agent-related factors should be studied when analysing accidents and their consequential injuries. Although negligence and over-confidence are often reported as the causes of injuries, environmental factors have an impact before, during, and after an accident occurs (Jha *et al.*, 2004). Accidents and the resulting injuries are known to be one of the most notable causes of disabilities and death in both developed (Majori *et al.*, 2002) and developing (Watters and Dyke, 1996) countries and affect people of all ages.

School accidents that result in injuries are not as widely investigated as other causes of injury among young people (Sheps and Evans, 1987). This factor may have an effect on the common idea that children are fairly well protected in schools because of the safe environment and supervision

that schools are believed to provide. A study by Maitra & Sweeney (1996) has shown that fractures and dislocations in school accidents are as common as those occurring in public places.

Saudi Arabia has implemented stringent measures to ensure that safety regulations are observed in all walks of life. Several studies concentrating on population growth in Saudi Arabia have identified a prolific population growth rate among young people. This exponential growth of the youth population is likely to highlight the need for a safer living environment, particularly in schools. With evidence suggesting that a large proportion of accidents and fatalities have occurred in older Saudi Arabian schools (Saudi Ministry of Education, 2013), the government has embarked on a fast-track program to build more new schools in the country through the Ministry of Education (MOE). However, some of these recently constructed school facilities still fail to meet safety standards because of poor quality design or construction.

1.2 Evaluating safety performance in Saudi schools

The ability to compare, contrast, and make quantifiable statements about safety performance is extremely valuable. This ability means that the Saudi MOE has a basis for determining where to allocate limited resources, where to pay extra safety attention, and how to best achieve long-term safety outcomes. As Lord Kelvin stated in 1883, *“When you can measure what you are speaking about and express it in numbers, you know something about it”* (Kelvin, 1889). On the other hand, he warned, *“But when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind”* (Kelvin, 1889).

Although Saudi Arabia has recently regulated safety standards in its schools, the actual level of compliance and overarching safety performance remains unsatisfactory because of the lack of an appropriate safety performance evaluation framework that can incorporate all the necessary

elements of safety across 33,000 schools (Saudi Ministry of Education, 2013). Poor communication and inadequate reporting make the management of safety environments even more difficult. One way to overcome these obstacles is to develop a comprehensive safety performance evaluation framework that incorporates all salient aspects of safety.

A key feature of the proposed safety performance evaluation framework is that it must include factors and operational variables that cover the various linked elements of the school safety environment and its effective management. Moreover, these factors and variables must take into account not only actual performance in terms of provisions that have been instituted to preserve safety, but also statistical measures of how many accidents have occurred at the respective schools, so that subjective assessments of performance can also be supplemented by performance items. For example, principals can effectively report the safety performance of their school to the safety department of the MOE, leading to improved compliance with safety regulations and ultimately reducing the number of accidents at schools.

On the other hand, several researchers have found that the implementation of any new performance management system is prone to challenges. For instance, in their 2002 and 2003 studies, Bourne, Neely, Mills and Platts sought to determine the reasons why the implementation of these systems may fail. These authors explored the following two main reasons for such failure: poor design and the difficulty of implementation. The factor of poor design is related to inappropriate procedures in setting measurements of performance. Poor design occurs because evaluations often begin with the question, “What *can* we measure?” instead of “What *should* we measure?” and thus lead merely to the repackaging of existing measurements. Thus, it is important to redraw the school safety strategy map, depicting cause-and-effect relationships in graphic representations to explain the school’s strategy and to incorporate the views of the school staff related to the school environment (i.e. teachers, school executives and Ministry of Education officers) (Bourne *et al.*, 2002). Furthermore,

difficulties in implementing performance management systems are related to the organisational environment.

The problem, therefore, is how to evaluate safety issues at Saudi schools through the development of a safety performance evaluation framework, which could effectively provide a measure of the level of safety at the schools. Because performance outcomes are always an integral part of any evaluation framework, this system would help ensure that appropriate measures are identified to not only measure safety aspects but also to improve future performance. In response to the significant demands for research that explores school safety issues in Saudi Arabia, this paper develops a holistic safety performance evaluation framework for Saudi schools through following three main methods: expert review, exploratory factor analysis (EFA), and partial least squares (PLS). The literature underpinning the design of the conceptual safety performance evaluation framework for Saudi schools is described in the next section.

2. Conceptual framework for evaluating safety performance for Saudi schools

Designing a comprehensive safety performance evaluation framework for Saudi schools requires a thorough understanding of the structure of the organisation, its processes, and the hierarchy of its people. Our extensive review of reported safety performance evaluation literature yielded the following five constructs that encapsulate the leading and lagging indicators of safety performance:

- Safety management and leadership (SML);
- Safety learning and training (SLT);
- Safety policy, procedures, and processes (SPPP);
- Workforce safety culture (WSC); and
- Safety performance (SP).

Each of these constructs must be understood, and the factors underlying them should be defined and elaborated upon. Each construct has a number of factors, and each factor has a number of measurement items. A discussion of the key factors of each construct is described in the following sections and a summary of derived framework constructs, factors and items is detailed in Table 1.

2.1 Safety management and leadership

Safety management relates to the actual practices, management roles, and functions associated with safe practices in the workplace (Mearns *et al.*, 2003). Indeed, management plays a key role in promoting a positive safety culture (Choudhry *et al.*, 2007). This role is demonstrated through the allocation of resources and time, the participation in risk assessments and consultative committee meetings, and the completion of actions. However, management is concerned with the extent to which employees perceive that the organisation provides an effective information exchange regarding safety matters (Håvold and Nasset, 2009). Furthermore, promoting management's commitment and employees' participation in safety can enhance the organisation's safety culture and climate. When employees become more aware of their responsibilities with regard to incident and injury prevention, they will exhibit more interest in maintaining a safe and healthy work site (Choudhry *et al.*, 2007). Additionally, management is concerned with the level of employees' trust in their supervisor, the competence of the supervisor to support safety practices, and the willingness of the supervisor to accept responsibility for mistakes (Mearns *et al.*, 2003). These concerns lead management to introduce incentives to improve safety practices (Teo *et al.*, 2005).

2.2 Safety learning and training

Management's attitude and actions are devoted to providing the necessary job-related training and promoting the importance of safety training to all employees (Cooper and Phillips, 2004). This role includes the development of safety training and the allocation of resources to implement safety

training and education (Ng *et al.*, 2005). To enhance safety awareness amongst employees, promotional strategies such as mission statements, published materials, and media are implemented (Choudhry *et al.*, 2007). Furthermore, these strategies are concerned with whether lessons were learned from accidents and near accidents, whether incident/accident reports were used to improve safety, and whether feedback was used to improve safety (Håvold and Nasset, 2009). In fact, this construct is concerned with employees' perceptions and knowledge of safety practices as well as their competence with regard to those practices (Håvold and Nasset, 2009).

2.3 Safety policy, procedures, and processes

Management complies with government policies, procedures and processes to effectively evaluate safety environments and work practices and to improve the effectiveness of safety management systems (Teo and Ling, 2006). Safety audits and reviews are a structured process of collecting independent information on the efficiency, effectiveness, and reliability of the total SMS and of drawing up plans for correction and prevention action (Teo and Ling, 2006). This construct is concerned with an employee's feedback in an audit/accident investigation report, his/her satisfaction with regard to follow-up actions, and the supervisor's interest and ability to take necessary action (Clarke, 2010; Grabowski *et al.*, 2007; Huang *et al.*, 2004; Kines *et al.*, 2010; Lawrie *et al.*, 2006). In fact, safety policies and procedures are considered one of the most influential factors driving safety performance because organisational policies regarding safety have a significant influence on cultivating a positive, healthy safety culture (Clarke, 2010; Kines *et al.*, 2010; Ng *et al.*, 2005; Teo *et al.*, 2005). Furthermore, safety processes take responsibility for safety equipment, tools, and other accessories (Glendon and Litherland, 2001; Kines *et al.*, 2010; Teo and Ling, 2006; Teo *et al.*, 2005). This construct also is concerned with regular maintenance and with reinforcing positive achievement (Kines *et al.*, 2010; Teo and Ling, 2006).

2.4 Workforce safety culture

Safety culture has been defined as “*that assembly of characteristics and attitudes in organisations and individuals, which establishes that, as an overriding priority, safety issues receive the attention warranted by their significance*” (Mearns *et al.*, 2003). Safety culture is important because it forms the context within which individual safety attitudes develop and persist and safety behaviours are promoted. This construct is concerned with the openness and effectiveness of the organisation’s reporting system and employees’ propensity to report accidents (Grabowski *et al.*, 2007; Mayze and Bradley, 2008; Wadsworth and Smith, 2009). Furthermore, it is concerned with employees’ perception of the safety of the work environment, including feedback, responsibility, empowerment, and reporting (Clarke, 2010; Mayze and Bradley, 2008; Wadsworth and Smith, 2009). Moreover, this construct relates to the work situation and the effect of pressure on individuals’ behaviours, attitudes, and safety practices (Glendon and Litherland, 2001; Håvold and Nasset, 2009). In addition, this construct notes the causes of accidents/incidents and the efforts of managers and other individuals regarding safety prevention (Håvold and Nasset, 2009).

2.5 Safety performance

Safety performance is sometimes measured using employees’ perceptions of safety in their work environment (Grabowski *et al.*, 2007). Researchers have considered employees’ perceptions of workplace safety as a safety performance variable, along with a range of other variables such as historical data on accidents and other incidents, the development of a safety system, individual behaviours and attitudes towards safety practices, the monitoring of safety compliance, the establishment of safety committees, the communication of safety policies, and employees’ participation (Glendon and Litherland, 2001; Mayze and Bradley, 2008). In fact, this construct underscores individual safety behaviours and the willingness of participation and implements a checklist before performing safety practices (Clarke, 2010; Glendon and Litherland, 2001).

Furthermore, this construct is concerned with the frequency of accidents and incidents in the workplace (Grabowski *et al.*, 2007). Moreover, it addresses key aspects that are of particular importance in Saudi schools, including the emergency plan, the response time to an accident/incident, and emergency training (Cooper and Phillips, 2004; Teo and Ling, 2006). Finally, this construct is concerned with safety feedback and reporting in the workplace and the assessment of corresponding corrective and preventive actions (Clarke, 2010; Cooper and Phillips, 2004; Glendon and Litherland, 2001; Mayze and Bradley, 2008; Teo *et al.*, 2005).

<INSERT TABLE 1 HERE>

3. Research method

3.1 Expert review

The above described conceptual development of the safety performance evaluation framework for Saudi schools was an essential first stage in this research process. An expert review research technique was used to clarify the factors and items that emerged from the developed conceptual framework. This research stage was considered very important since it provided expert confirmation on the identified factors and items and also explored whether other factors or items are potentially needed. Expert review was selected as the first research stage for this study because it provided the researcher with an opportunity to explore the complex attitudes, beliefs, feelings, motivations, experiences, reactions, and behaviours of Saudi school users (Christensen, 2010) in a way that is not viable with other methods such as observation or surveys (Acuff *et al.*, 1999; Morton, 1982). In addition, expert review provided a friendly atmosphere that stimulated participants to openly discuss their ideas and to actively interact with the researcher (Acuff *et al.*, 1999; Morton, 1982). Moreover, because of the complex nature of the school safety phenomenon, an expert review stage was considered an appropriate method for this study (Kantor, 2011). The expert review panel for this study consisted of eighteen experts (i.e., 4 teachers, 8 school executives,

and 6 MOE officers) with at least ten years of experience in the education sector and/or the Saudi education environment.

3.2 Main study – questionnaire survey

The objective of the main study was to empirically refine and confirm the architecture of the safety performance evaluation framework for Saudi schools. This objective would be achieved using a number of below described statistical analyses techniques on the collected respondent survey dataset. The assessment process adopted a framework testing approach (i.e. EFA and then PLS) to extract the final framework architecture. The safety performance evaluation framework was refined by the removal of any non-significant items and reassessed to ensure that it best represented the survey data. A description of the research sample for the main study, questionnaire survey development process, and applied statistical methods to ensure the final safety performance evaluation framework architecture was valid, is discussed in the below sub-sections.

3.2.1 Research sample

Sample selection for any empirical study is critical, and sufficient variability should be ensured in the sample selection so that statistical analyses will produce justified predictable values. The reliability of the results and theory formation depend heavily on sample selection criteria. Moreover, sample selection should be based on a theoretical paradigm rather than statistical specifications (Yin, 2003). The unit of analysis examined in this study was Saudi teachers, school executives, and MOE officers. The study was conducted in five cities in Saudi Arabia that represent the five main Saudi Arabian regions. Survey responses was sought and collected from respondents from the following five Saudi cities: (1) Riyadh, the capital and the largest city in Saudi Arabia; (2) Jeddah, the second largest city in Saudi Arabia and the capital city of the western region; (3) Dammam, the most populous city in the eastern region; (4) Hail, the most populous city in the northern region; and (5) Abha, one of the most populous cities in the southern region.

3.2.2 Questionnaire development and survey

Creswell (2003) stated that the careful design of questionnaires is an important requirement for an effective and justified quantitative study. The survey questions are categorised to ensure that responses are based on past experiences and accurately reflect the participants' perceptions, thus increasing measurement reliability. Therefore, several aspects were considered in the development of the questionnaire. First, the questionnaire was separated into two main sections as follows: (1) gathered demographic information about the respondents and their experiences in the Saudi education environment; and (2) elicited respondents' opinions on the importance of each construct in the proposed research framework. The respondents' opinions are based on their safety performance experience. Second, five-point scales were used to measure the operationally defined elements of the constructs within the proposed research framework. Items for each construct were generated and tested using a quantitative methodology technique. Five-point Likert scales were applied to measure the developed safety performance items in the Saudi schools using two columns. Column A was concerned with the importance of each item, while Column B requested respondents to provide their perceptions on the performance or rating of each item in their current context. The scale comprises a set of statements that express the importance and the performance of each item as either favourable or unfavourable attitudes toward the object of interest.

3.2.3 Statistical techniques

The statistical analysis techniques employed for this research are briefly outlined as follows. The analysis begins with descriptive statistics such as frequencies, percentages, and means related to the sample profile (Sekaran, 2003). Subsequently, in addition to a visual inspection of frequencies for all construct items, the analysis includes the measurement of central tendency and dispersion. The preliminary analysis also includes a factor analysis to examine the factor structures of the constructs

and to reduce redundant items (Neuman, 2006). By computing the construct reliability, the internal consistency of the items was examined.

This study employed an exploratory factor analysis (EFA) to identify the underlying structure of data for each construct. According to Hair, Anderson, Tatham, and Black (2010), the exploratory analysis procedure is a powerful tool that can address a wide range of theoretical questions. Additionally, this procedure defines potential relationships in general form, which then will allow the multivariate techniques to estimate relationships (Hair *et al.*, 2010). In other words, by allowing the method and the data to define the nature of the relationships, exploratory analyses specify relationships (Hair *et al.*, 2010).

Two prevalent techniques are commonly utilised for Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM): (1) Maximum Likelihood (ML) covariance analysis (via LISERL or AMOS software); and (2) a component variance analysis technique referred to as Partial Least Squares (PLS). PLS, which was developed by Wold (1980b), is a second-generation multivariate analysis technique (Barclay *et al.*, 1995) used to analyse statistical frameworks that involve a set of constructs and multiple items (Chin, 1998; Fornell and Bookstein, 1982). Selecting the appropriate CFA technique depends upon several considerations, such as the theoretical foundation, robustness of measures, and sample size requirements (Gefen, et al., 2000). Although ML is considered to be theory oriented and more useful for confirmatory analysis, PLS is considered more appropriate in situations of limited theoretical information and when large sample sizes are not available. Fornell and Bookstein (1982) stated that, in contrast to ML technique, PLS avoids the problems of improper solutions and factor indeterminacy. In addition, instead of using the framework for explaining the co-variation of all of the items PLS has an advantage over other ML approaches because it minimises the variance of all dependent variables (Chin, 1998b). This nature of this study supports the use of the PLS technique to conduct the CFA process and test the

overall structure of the safety performance evaluation framework. The EFA and PLS assessments and their criteria that has been utilised in this study are summarised in Table 2.

<INSERT TABLE 2 HERE>

4. Data analysis and results

4.1 Expert review of conceptual safety performance evaluation framework

To pre-test the suitability of the conceptually developed safety performance evaluation framework architecture and its components to the Saudi school education context, a questionnaire was developed. In May 2011, the questionnaire was distributed to 18 experts, including 4 teachers (3 male and 1 female), 8 school executives (6 male and 2 female), and 6 male MOE officers (the Saudi Ministry of Education employs only male officers). The participants' years of experience ranged from 11 to 26. First, to measure the importance of each construct relative to others, the experts were asked to weight each proposed construct. Second, the experts were asked to consider whether the proposed factors and items were representative of each construct. Although many of the experts confirmed that the proposed factors and items were justified, some experts deleted or added some items and other experts linked items to other factors. Large numbers of experts commented on some factors, which helped to redefine these factors.

Construct 1 (safety management and leadership) had an average weighting of 21.94%. When considering this construct, one female teacher suggested a new factor termed 'training courses for students'. In addition, one male school executive suggested a new item termed 'safety strategic plan' and one MOE officer suggested a new item termed 'students and their contribution and roles'. Several of these factors were considered for inclusion in the conceptual framework, and the 'strategic safety plan' item was added to the framework. The mean weighting for construct 2 (safety learning and training) was 25.27%. In this construct, one male teacher suggested a new item termed

‘safety application’ that was added. The average weighting for construct 3 (safety policy, procedures, and processes), 4 (workforce safety culture) and 5 (safety performance) was 25.27%, 14.75% and 12.77%, respectively. All items that received a mean ‘importance’ rating of less than 3 from the expert panel were removed. In summary, the expert review process resulted in five items being added (two items in construct 2, two items in construct 3, and one item in construct 4) and two items being removed (two items in construct 5). Overall, the expert panel were in agreement that the conceptual safety performance evaluation framework comprehensively covered all facets of evaluation of safety performance in Saudi schools and was sufficiently operationalised.

4.2 Main study descriptive statistics

In December 2011, the main study questionnaire survey was distributed in the Saudi Arabian educational environment. The questionnaire was distributed to both male and female teachers and school executives in Saudi schools and to the MOE officers to measure the respondents’ perceptions of the importance and rating level for the various measurement items. At completion of the survey period, exactly two-hundred (200) complete and valid questionnaires were received. The respondents included 110 teachers (55%), 42 school executives (21%), and 48 MOE officers (24%). Of the 200 questionnaire respondents, 140 were male (70%) and 60 were female (30%). It should be noted that all MOE respondents were male as there is presently no female officers in the Saudi Arabia MOE. The schools involved in this study were five primary schools (three male and two female), five elementary schools (three male and two female), and six secondary schools (three male and three female).

The majority of the participants were between 30 and 50 years old (169 participants), with only 31 being younger than 30 years old. In total, 78% of them had more than five years of education

related experience which provided confidence that survey responses were valid. The respondents were also requested to indicate their years of experience in their current work role to better understand to what degree they can rate their school safety. Of the respondents, 47.5% had 6-20 years' experience in their current role with the remainder having five years or less. Finally, most respondents came from the densely populated central region (69%) followed by the northern (11%), eastern (7%), western (7%), and northern (6%) region of Saudi Arabia.

4.3 Internal reliability analysis

The two-hundred surveys were firstly collated and analysed to ensure that collected data was sufficiently valid and reliable. Correlation coefficients of the items with the total items were deemed to be statistically significant at a 0.01 level (Table 3). This result indicates a high degree of internal consistency among the items and confirms the internal correlation between all items in the scale, thus confirming the internal validity of the items and the scale used in this study. Moreover, the data was deemed to be sufficiently reliable due to the high overall Cronbach's alpha (0.967) for the dataset (Pellegrini and Long, 2002).

<INSERT TABLE 3 HERE>

Furthermore, the data were free from extreme outliers and upheld the assumptions of normality and linearity. Also, the assessment of standard deviation and standard error of the mean value indicated that a mean value could be used as a representative score for each variable (item), and therefore, the sample used in this study sufficiently represented the contributors. The mean values for all 79 items for both column A and B helped to assess unusual response patterns. Importantly, differences in opinion between the three respondent groups was explored (i.e., teachers, school executives, and MOE officers) using ANOVA. This analysis did not show any statistically significant differences in responses between the three groups for all items. Therefore, the data could be treated as a single sample for subsequent analysis (i.e. EFA).

Five independent scales were used in the questionnaire to measure the five constructs proposed in the conceptual framework. Those scales consistently and accurately captured the meaning of the framework constructs, and additionally, a scale reliability analysis was performed to assess internal consistency and item-total correlations. Table 4 presents the Cronbach's alphas for the measurement scales of the constructs in Column A. The five values of the alpha coefficient ranged from 0.863 to 0.929, which is much higher than the threshold acceptance limit of 0.7, indicating very strong consistency between the scales.

<INSERT TABLE 4 HERE>

As discussed previously, the survey requested that respondents provide a rating (1-5 scale) for both the importance level (Column A) and performance level (Column B) of each item. Column A data (i.e. item importance) was utilised for EFA analysis in order to explore and organise the structure of the factors for each individual construct. For the subsequently conducted PLS analysis that was utilised to confirm EFA findings, Column B data (i.e. item performance) was utilised as this data was concerned with relationships among items, which is more appropriate for this type of analysis.

4.4 Safety evaluation framework development: exploratory factor analysis

After assessing scale reliability to determine whether any items should be removed and to accurately capture the meaning of the framework constructs, EFA was conducted (Gerbing and Anderson, 1988; Hair *et al.*, 2010; Koufteros, 1999). Moreover, because the main objective of this stage was to group the items into a set of latent dimensions, rather than condensing individual respondents into distinct groups (factors), an *R factor analysis*, which is used to examine the relationships among variables to identify groups of variables that form latent dimensions or factors (Hair *et al.*, 2010), was employed. Each construct was processed to determine whether the items of

each construct could be represented by their factors. Additionally, to ensure that the items in each factor had practical significance, a cut-off loading of 0.50 was used (Hair *et al.*, 2010). Based on the above procedures and criteria, EFA was performed separately for each of the five constructs by using the SPSS program. EFA with Varimax rotation was performed using a principle axis extraction method (Table 2), on items measuring the five conceptualised constructs of the safety performance evaluation framework (Tables 5 to 9). Finally, Harman's one-factor test was conducted to determine whether the majority of the variance can be accounted for by one general factor (Yang *et al.*, 2006) and evidently showed that this was not the case.

4.4.1 SML construct

The conceptualised SML construct was perceived to have five key factors represented by several items that were derived from prior empirical studies. Confirming SML construct operationalisation, five factors were identified by the EFA process (Table 5). The five factors explained 70.9% of the total variance for this construct. Item A3.1 was removed because the factor loading for this item was < 0.50 . All other factor loadings were greater than 0.5 (0.560-0.900) and there were no significant cross loadings. The Cronbach's alpha of 0.854 indicated a good reliability of scale. Finally, to confirm the significance of the factor loading, an evaluation of the correlation matrix through the KMO and Bartlett's test was conducted. The results show that the KMO was 0.736, which is acceptable, and the Bartlett's test was significant at $p < 0.001$. To test the factorability of the data, all remaining items fell within the acceptable range for a factor analysis of 0.319 to 0.686 (> 0.3). Finally, five factors were derived from the 16 retained items:

- SML1: Management commitment to safety (5 items);
- SML2: Management's active participation in safety (3 items);
- SML3: Safety communication and relations (4 items);
- SML4: Safety practice incentives (2 items); and
- SML5: perceived supervisor competence (2 items).

<INSERT TABLE 5 HERE>

4.4.2 SLT construct

A total of 14 items were selected to operationally define the SLT construct (Table 6). The results revealed three factors for the SLT construct explaining 65% of the total variance. After the third component had been selected, an inspection of the scree plot revealed a very clear break. Items B2.3 and B4.1 were removed because the factor loading for these items was less than 0.50. For the 14 significant items their factor loadings ranged from 0.542-0.891 and were not cross loaded across factors. Cronbach's alpha was 0.872, which indicates a good reliability of scale. The KMO (0.812) and Bartlett's test ($p < 0.001$) showed a significant probability level. In reference to the factorability of the data, all remaining items fell within the acceptable range for a factor analysis of 0.301 to 0.785 (> 0.3). In summary, three factors were derived from the 14 items as follows:

- SLT1: Safety training, seminar, and promotional strategies (6 items);
- SLT2: Safety learning openness (4 items); and
- SLT3: Safety knowledge and competence (4 items).

<INSERT TABLE 6 HERE>

4.4.3 SPPP construct

A total of 15 items were selected to operationally define the SPPP construct. The results revealed three factors that explained 69.4% of the variance (Table 7). After the third component had been selected, an inspection of the scree plot revealed a very clear break. Items C1.4, C2.1, C3.3, and C3.4 were removed since the factor loading for these items was less than 0.50. Other factor loadings ranged between 0.675 and 0.866 (i.e. > 0.50) without being loading equally highly on more than one factor (i.e., cross loading). The Cronbach's alpha (0.917), KMO (0.870) and Bartlett's test ($p < 0.001$) all exceeded threshold levels. To test the factorability of the data, all remaining items fell within the acceptable range for a factor analysis of 0.384 to 0.804 (> 0.3). In summary, the following three factors were derived from the 15 items:

- SPPP1: Safety procedures, audits, and reviews (8 items);
- SPPP2: Safety accountability and feedback (5 items); and
- SPPP3: Built environment safety (2 items).

<INSERT TABLE 7 HERE>

4.4.4 WSC construct

A total of 13 items were selected to operationally define the WSC construct. The results revealed three factors that explained 66% of the variance (Table 8). Items D1.4, D2.3, and D4.3 were removed because the factor loading for these items was less than 0.50. Retained items had loadings ranging from between 0.572 and 0.848, and were not cross loaded. Cronbach's alpha (0.886) indicated good reliability of scale. To confirm the significance of the factor loading, an evaluation of the correlation matrix through the KMO and Bartlett's test was conducted. The results show that the KMO was 0.823, which is acceptable, and the Bartlett's test was significant ($p < 0.001$). To test the factorability of the data, all remaining items fell within the acceptable range for a factor analysis of 0.324 to 0.706 (> 0.3). The following three WSC factors were derived from the 13 items:

- WSC1: Individual responsibility to safety (5 items);
- WSC2: Perceptions of work situation and pressure (5 items); and
- WSC3: Propensity to report incidents and accidents (3 items).

<INSERT TABLE 8 HERE>

4.4.5 SP construct

A total of eight items were selected to operationally define the SP construct. The results revealed three factors that explained 78.9% of the variance (Table 9). After the third component had been selected, an inspection of the scree plot revealed a very clear break. Items E1.3, E2.3, and E4.1 were removed because the factor loading for these items was < 0.50 . The eight retained items had high

factor loadings (i.e. 0.711 to 0.858) and were not cross loaded across factors. Cronbach's alpha (0.854), KMO (0.835) and the Bartlett's test ($p < 0.001$), all provided confidence that the construct structure was correct. The SP construct had 13 items spread across three constructs:

- SP1: Safety accident and incident rates and appropriate responses (3 items, component);
- SP2: General safety behaviours of staff (3 items); and
- SP3: Emergency response (2 items).

<INSERT TABLE 9 HERE>

4.5 Safety evaluation framework architecture validation: partial least squares analysis

Urbach and Ahlemann (2010) suggest that after the data quality has been evaluated, the PLS method can be run to calculate the framework parameters' estimates. Wold has developed PLS as a general method for the estimation of path frameworks involving latent constructs indirectly measured by multiple items (Wold, 1966, 1979, 1980a, 2006). Overall, the safety performance evaluation framework validation is an attempt to determine whether the measurement frameworks and the structural framework fulfil the quality criteria for empirical work (Urbach and Ahlemann, 2010). Although the PLS method does not have rigid and globally accepted goodness-of-fit criterion, there are several reported acceptance criteria for assessing framework structures (Urbach and Ahlemann, 2010). The assessment of the measurement frameworks considered a systematic application of the reflective criteria.

Following the validation guidelines of Straub, Boudreau and Gefen (2004) and Lewis, Templeton and Byrd (2005), the assessment of reflective measurement frameworks can be accomplished by testing the reflective measurement frameworks for at least unidimensionality, internal consistency reliability, item reliability, convergent validity, and discriminant validity by applying standard decision rules (Urbach and Ahlemann, 2010). Unidimensionality refers to a construct having each of its measurement items relate to it better than to any others (Gerbing and Anderson, 1988). By

using SmartPLS 2.0 (beta), the first measure of which is cross-loadings; this measure is obtained by correlating each item score with all of the other factors (Chin, 1998). If each item's loading is higher for its proposed factor than for any of the other factors, it can be inferred that the different factors' items are not interchangeable. In this study, cross-loading values were higher than 0.5 (Chin, 1998) for all items except for two, which have been omitted (Table 10).

The significance of the item loadings has been tested using the bootstrapping method (Efron, 1979; Efron and Tibshirani, 1994). The second measure is the Fornell-Larcker criterion (Pepler *et al.*, 2006), which requires that the average explained variance (AVE) in the correlation of each factor must be higher than the correlation between the other factors (Table 11). Furthermore, the composite reliability (CR) is an alternative measure to Cronbach's Alpha (Ando *et al.*, 2005). Because CR overcomes some of Cronbach's Alpha deficiencies, Chin (1998) recommends CR as a measure in PLS. In this study, CR values for all constructs were above 0.80 indicating an acceptable range (Nunnally and Bernstein, 1994). The last measure is convergent validity, which involves the degree to which individual items reflecting a construct converge in comparison to items measuring different constructs. AVE proposed by Fornell and Larcker (2006), is considered a commonly applied criterion of convergent validity. Urbach and Ahlemann (2010) suggest that to demonstrate sufficient convergent validity, an AVE value of at least 0.50 indicates that the construct is on average able to explain more than half of the variance of its items. The AVE value for all constructs in this study that are greater than 0.50 (Table 12).

<INSERT TABLE 10 HERE>

<INSERT TABLE 11 HERE>

<INSERT TABLE 12 HERE>

4.6 Final safety performance evaluation framework for Saudi schools

Expert review, EFA and PLS findings led to the development of a robust safety performance evaluation framework for Saudi schools (Table 13). Traditional safety performance measurement approaches that often just focus on the number of accidents or incidents are insufficient as they fail to capture all the lead and lag indicators of safety performance. Applying the proposed safety performance evaluation framework will help align key safety performance measures with strategy at all levels of a school system, providing management with a comprehensive picture of safety performance operations. In addition, the methodology facilitates communication and the understanding of safety goals and strategies at all levels of a school, thereby maximising cooperation and communication. Team members are focused on helping one another succeed and usable results transform safety strategy into action and desired behaviours. Safety performance initiatives can be continually measured and evaluated against the factors/items in the framework, creating a culture of performance measurement and management. Finally, schools and other organisations that have difficulty establishing mechanisms to translate their strategic safety vision into concrete goals and actions will benefit from the power of the safety performance framework.

<INSERT TABLE 13 HERE>

5. Conclusions, industry implications and future research

After an extensive review of the previous literature pertinent to the issue of safety performance measurement and school safety, the architecture of a safety performance evaluation framework for Saudi schools was developed. This conceptual framework has been examined through the input of 18 experts, EFA and PLS. This process led to a final robust safety performance evaluation framework for Saudi schools consisting of five core constructs: (1) safety management and

leadership; (2) safety learning and training; (3) safety policy, procedures, and processes; (4) workforce safety culture; and (5) safety performance.

This framework is of benefit not only to the Saudi schooling system, but other education systems seeking innovative approaches to improve their present level of safety performance over the long-term. Ultimately, the implementation and widespread utilisation of this fully operationalized safety performance evaluation framework in the Saudi schooling system will enable the longitudinal monitoring and management of the various lagging and leading indicators of safety and provide a holistically formed strategic roadmap for MOE and school executives, as well as teachers and school administration personnel. Over time, the leading safety indicators of incident and accident rates should reduce significantly from their current levels, thereby ensuring a safer learning environment for Saudi school aged children across the entire public school sector.

The authors plan to conduct further research and implementation activities to ensure that the developed safety performance evaluation framework can be comprehensively applied. Firstly, the causal relationships between framework constructs will be examined through structural equation modelling. Secondly, a benchmarking methodology will be developed and trialled in a number of Saudi schools to demonstrate the practical utilisation of the safety evaluation framework. Finally, a number of detailed longitudinal case studies will be completed over a five year period where the developed framework is utilised in Saudi schools to evaluate safety performance. Results from these case studies will serve to refine measurement items, verify construct causal relationships and demonstrate the frameworks' fitness for purpose for continuous safety improvement in Saudi schools.

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Table 1: Synthesis of literature supporting safety performance evaluation framework constructs

Constructs	Factors	Items	Authors
Safety Management & Leadership	Management commitment to safety	Management actions safety issues Management promotes a safety culture Management provides adequate resources to safety Management participation in risk assessments, consultative committee meetings, and inspections Management encourages employees to voice concerns and safety improvement proposals	Choudhry et al., (2007); Mearns et al., (2003); Rundmo & Hale, (2003); Wadsworth & Smith, (2009)
	Safety communication	Management and supervisors have an open door policy Safety information is brought to employees' attention by their supervisors Safety information is provided (e.g. media, mission statements, accident statistics, etc.) Safety information (i.e. procedures) is visibly present in the workplace	Choudhry et al., (2007); Håvold & Nasset, (2009)
	Employee involvement in safety	All levels of employees are empowered to be involved in safety management Employees are involved in setting safety objectives, decision making, and improvement plans	Choudhry et al., (2007); Mearns et al., (2003)
	Perceived supervisor competence	Supervisor is more attentive to safety issues than the average employee Supervisor is trusted and can relate safety-related information to employees Supervisor has the adequate skills and authority to tackle safety issues	Choudhry et al., (2007); Mearns et al., (2003); Wadsworth & Smith, (2009)
	Safety practice incentives	Monetary incentives (e.g. bonuses) for employees for good safety practices Recognition incentives (e.g. safe employee of the month) for employees for good safety practices Punitive measures for continued poor safety practices (e.g. fines, demotions, etc.)	Teo et al., (2005)
Safety Learning & Training	Safety training and seminars	Development of safety training (e.g. short talks, group meetings, and workplace safety responsibilities) Provision of safety training to all employees Resource allocation for safety training Adequate and up-to-date safety training	Choudhry et al., (2007); Cooper & Phillips, (2004); Håvold & Nasset, (2009); Ng et al., (2005)
	Safety promotional strategies	Enhance safety awareness through clear mission statements (e.g. slogans and logos) Provision of published materials (e.g. books, statistics, and newsletters) Provision of media promotion (i.e. posters, displays, audio-visual media, e-mail, and Internet)	Choudhry et al., (2007); Sawacha et al., (1999)
	Safety learning openness	Employees give tips to each other on how to work safely Accident/incident reports are used to improve safety. Employees learn lessons from near misses and incident reports Feedback is used to improve safety	Håvold & Nasset, (2009)
	Safety knowledge and competence	Employees are familiar with the organisation's safety policy Employees understand the purpose of the Quality Management System Employees know when to report near accidents	Håvold & Nasset, (2009)
Safety Policy, Procedures and Processes	Safety audits and reviews	Conducting safety inspections and supervision Employment of safety office and supervisor Familiar with the organisation's safety policies and procedures Audit program is conducted regularly	Håvold & Nasset, (2009); Lawrie et al., (2006); Ng et al., (2005); Teo & Ling, (2006)

Constructs	Factors	Items	Authors
	Safety accountability and feedback	Publication of safety issues to staff members and parents The results of accident investigation are fed back to the supervisory level Employees are satisfied with the feedback given on accidents/incidents Employees are satisfied with follow-up measures taken after accidents/incidents	Clarke, (2010); Grabowski et al., (2007); Huang et al., (2004); Kines et al., (2010); Lawrie et al., (2006); Mcdonald et al., (2000)
	Safety policies and procedures	Development of emergency plans and procedures Implementation of safety audits to the safety management system Supervisor monitors progress towards safety improvement goals based on the feedback and weekly meetings Safety policies/procedures can be followed without conflicting with work practices	Clarke, (2010); Glendon & Litherland, (2001); Kines et al., (2010); Ng et al., (2005); Teo & Ling, (2006)
	Safety operations and governance	Equipment, tools, and other accessories are maintained regularly Conducting training on the use of safety equipment Safety officer's attitude has great influence on others' safety attitudes	Glendon & Litherland, (2001); Kines et al., (2010); Ng et al., (2005); Sawacha et al., (1999); Teo & Ling, (2006)
	Built environment maintenance	Development of a safety checklist to actively maintain facilities before accidents occur Identification of any safety area problems and respond in a timely manner	Kines et al., (2010); Teo & Ling, (2006)
	Propensity to report accidents and incidents	Employee perceptions of the effectiveness of the reporting system Employee willingness to report a co-worker's failure Employee perceptions of the organisation's ability to correct mistakes	Grabowski et al., (2007); Mayze & Bradley, (2008); Mearns & Håvold, (2003); Wadsworth & Smith, (2009)
Workforce Safety Culture	Individual responsibility to safety	The influence of personality on safety practices Value placed on personal safety responsibility High-quality work environment leads to better personal safety responsibility Employee involvement in informing management of safety issues Employee ability to consider safety as a top priority	Clarke, (2010); Grabowski et al., (2007); Mayze & Bradley, (2008); Wadsworth & Smith, (2009)
	Perceptions of work situation and pressure	There are enough employees to carry out the required work Employees have enough time to carry out their tasks Realistic times are scheduled for completing assigned tasks Work procedures are presented clearly	Glendon & Litherland, (2001); Håvold & Nessel, (2009); Nansel et al., (2001)
	Fatalism	Accidents are unavoidable The use of machines and technical equipment makes accidents unavoidable Accidents seem inevitable despite the school's efforts to avoid them	Håvold & Nessel, (2009)
Safety Performance	General safety behaviours of staff	The influence of safety attitudes and behaviours Behaviour checklist towards safety practice The willingness to comply with procedures and policies, and to participate in safety practices Usage of personal protection equipment	Clarke, (2010); Glendon & Litherland, (2001); Mayze & Bradley, (2008)
	Accidents and Incident	Measurement of accidents and incident rates	Glendon & Litherland,

Constructs	Factors	Items	Authors
	rates	Recordable accidents/incident frequency	(2001); Grabowski et al., (2007); Mayze & Bradley, (2008)
		Total injury frequency	
	Emergency response	Emergency response education and training	Cooper & Phillips, (2004); Glendon & Litherland , (2001); Håvold & Nettet, (2009); Teo & Ling, (2006)
		Staffers are trained to identify the cause of an incident in a timely manner	
		Training includes skills practice for emergencies	
	Safety reporting, response and corrective actions	There are clear and well-documented procedures for developing remedial actions based on the incidents' causes	Clarke, (2010); Cooper & Phillips, (2004); Glendon & Litherland , (2001); Mayze & Bradley, (2008)
		An effective documentation management system ensures the availability of procedures	
		Auditors' reports can provide valuable feedback and a basis for corrective and preventive actions	

Table 2: Assessment of the EFA and PLS analysis, adapted from (Urbach and Ahlemann, 2010)

Validity Type	Criterion	Description	Authors
Exploratory factor analysis (EFA)	Bartlett's Test	Bartlett's (1954) test of sphericity can be used to determine the factorability of data ($p < 0.001$).	Field, (2009); Hair et al., (2010); Tabachnick & Fidell, (2007)
	KMO	Kaiser-Mayer-Olkin measure of sample adequacy (KMO) can be used to determine the factorability of data, presenting the minimum acceptable sample (0.60).	Hair et al., (2010); Tabachnick & Fidell, (2007)
	Anti-image correlation matrix	Can be used to test the factorability of data. Each matrix should be inspected for correlations above (0.30).	Hair et al., (2010); Pellegrini & Long, (2002); Tabachnick & Fidell, (2007)
	Cut-off factor loading	Each loading should be above (0.50).	Hair et al., (2010)
	Cronbach's Alpha	The scales for the reliability coefficients (0.70).	Pellegrini & Long, (2002)
	Cumulative variance	The total variance extracted by successive items of its perspective (60%).	Hair et al., (2010)
Partial Least Squares (PLS)	Item loadings	Measures how much of the items are explained by the corresponding factor. Values should be significant at (0.50).	Chin, (1998b)
	Cross-loadings	Cross-loadings are obtained by correlating the component scores of each item with all other factors. If the loading of each item is higher for its designated factor than for any of the other factors, it can be inferred that the frameworks of BSC perspectives differ sufficiently from one another.	Chin, (1998b)
	Fornell-Larcker criterion	The average explained variance (AVE) of the correlate of each factor must be higher than the correlation between the other factors.	Pepler et al., (2006)
	Cronbach's alpha (CA)	Alpha values ranges from 0 (completely unreliable) to 1 (perfectly reliable). Proposed threshold value for confirmative (explorative) research: CA > (0.80) .	Cronbach, (1951); Nunnally & Bernstein, (1994)
	Composite reliability (CR)	CR values between 0 (completely unreliable) and 1 (perfectly reliable). As an alternative to Cronbach's Alpha, it allows items to not be equally weighted. Proposed threshold value for confirmative (explorative) research: CA > (0.80) .	Ando, Asakura, & Simons-Morton, (2005); Nunnally & Bernstein, (1994)
	Average variance extracted (AVE)	Attempts to measure the amount of variance that BSC perspective captures from its items relative to the amount due to measurement error. Proposed threshold value: AVE > (0.50) .	Pepler et al., (2006)

Table 3: Data validity and reliability testing

Construct	Column A		Column B	
	Pearson correlation coefficients of each item with item-total for the scale	Total correlation of Cronbach's alpha if item deleted	Pearson correlation coefficients of each item with item-total for the scale	Total Correlation Cronbach's alpha if item deleted
Safety Management and Leadership	0.636**	0.860	0.627**	0.859
Safety Learning and Training	0.753**	0.885	0.651**	0.866
Safety Policy, Procedures and Processes	0.760**	0.929	0.536**	0.913
Workforce Safety Culture	0.755**	0.898	0.722**	0.894
Safety Performance	0.579**	0.834	0.553**	0.821

**Correlation is significant at the 0.01 level (2-tailed).

Cronbach's alpha: 0.967

Table 4: Cronbach's alphas for the construct measurement scales

Perspective	Number of items	Cronbach's Alpha (α)
		Column A
Safety Management and Leadership (SML)	17	0.863
Safety Learning and Training (SLT)	16	0.885
Safety Policy, Procedures, and Processes (SPPP)	19	0.929
Workforce Safety Culture (WSC)	16	0.898
Safety Performance (SP)	11	0.894

Table 5: EFA of the SML construct

Items	Rotated Component Matrix*				
	1-SML1**	2-SML2**	3-SML3**	4-SML4**	5-SML5**
A1.1	.811	.009	-.234	.026	.254
A1.3	.764	.293	.064	.104	.159
A1.5	.632	.496	.068	-.060	-.111
A2.3	.700	.104	.416	.194	.145
A3.2	.659	-.079	.303	.123	-.208
A1.2	.324	.616	-.139	-.021	.219
A1.4	.170	.842	.203	.121	-.103
A2.4	-.077	.772	.147	.186	.144
A2.1	.507	-.008	.585	.118	.166
A2.2	.049	.457	.560	.107	.275
A4.1	.143	.023	.836	.090	-.026
A4.2	-.092	.223	.670	.328	.197
A5.1	.124	.104	.257	.838	.125
A5.2	.120	.122	.098	.900	.066
A4.3	.263	-.160	.318	.152	.750
A4.4	.004	.343	.041	.092	.790

(A3.1_CA) Deleted

Notes: * Extraction methods: Principal axis analysis; Rotation methods: Varimax; ** Component number – factor: Number 1-5: component 1-5; Cumulative variance explained = 70.9%; Cronbach's alpha - 0.854; KMO - 0.736; Bartlett's test ($p < 0.001$); Total correlations of SML between 0.319 to 0.686; number of items: 16

Table 6: EFA of the SLT construct

Items	Rotated Component Matrix*		
	1-SLT1**	2-SLT2**	3-SLT3**
B1.1	.777	.200	.192
B1.2	.891	.118	.140
B1.3	.871	.135	.157
B1.4	.582	.498	.195
B2.1	.690	.137	.097
B2.2	.595	.320	.056
B3.1	.198	.704	.028
B3.2	.491	.649	.140
B3.3	.228	.788	.173
B3.4	.075	.891	-.028
B4.3	.150	-.070	.851
B4.4	-.059	.356	.770
B4.5	.156	.057	.766
B4.2	.308	.023	.542

(B2.3 and B4.1) Deleted

Notes: * Extraction methods: Principal axis analysis; Rotation methods: Varimax; ** Component number – factor: Number 1-3: component 1-3; Cumulative variance explained = 65%; Cronbach's alpha - 0.872; KMO - 0.812; Bartlett's test ($p < 0.001$); Total correlations of SLT between 0.301 to 0.785; number of items: 14

Table 7: EFA of the SPPP construct

Items	Rotated Component Matrix [*]		
	1-SPPP1 ^{**}	2-SPPP2 ^{**}	3-SPPP3 ^{**}
C1.1	.691	.290	.027
C1.2	.686	.335	-.217
C2.2	.682	.191	.228
C3.1	.866	.162	.140
C3.2	.808	.249	.090
C4.1	.714	.029	.427
C4.2	.818	.235	.170
C5.1	.675	.127	.362
C1.3	.377	.765	-.018
C2.3	.074	.751	.042
C2.4	.123	.804	.143
C2.5	.236	.833	.150
C4.3	.273	.728	.163
C5.2	.579	.010	.707
C5.3	.094	.486	.793

(C1.4, C2.1, C3.3, and C3.4) Deleted

Notes: * Extraction methods: Principal axis analysis; Rotation methods: Varimax; ** Component number – factor: Number 1-3: component 1-3; Cumulative variance explained = 69.4%; Cronbach's alpha - 0.917; KMO - 0.870; Bartlett's test ($p < 0.001$); Total correlations of SPPP between 0.384 to 0.804; number of items: 15

Table 8: EFA of the WSC construct

Items	Rotated Component Matrix [*]		
	1-WSC1 ^{**}	2-WSC2 ^{**}	3-WSC3 ^{**}
D2.1	.623	.349	.427
D2.2	.769	.226	.216
D2.5	.572	.409	.181
D4.1	.753	.175	.272
D4.2	.829	-.142	.015
D2.4	.059	.750	.217
D3.1	.499	.639	.181
D3.2	.447	.650	.270
D3.3	-.106	.810	.152
D3.4	.300	.634	.101
D1.1	.203	.063	.861
D1.2	.262	.122	.848
D1.3	.078	.374	.632

(D1.4, D2.3, and D4.3) Deleted

Notes: * Extraction methods: Principal axis analysis; Rotation methods: Varimax; ** Component number – factor: Number 1-3: component 1-3; Cumulative variance explained = 66.037%; Cronbach's alpha - 0.886; KMO - 0.823; Bartlett's test ($p < 0.001$); Total correlations of WSC between 0.324 to 0.706; number of items: 13

Table 9: EFA of the SP construct

Items	Rotated Component Matrix [*]		
	1-SP1 ^{**}	2-SP2 ^{**}	3-SP3 ^{**}
E2.1	.758	.075	.447
E2.2	.858	.104	.329
E4.2	.777	.228	.244
E1.1	.545	.711	-.223
E1.2	.154	.846	.105
E3.3	-.014	.800	.379
E3.1	.295	.085	.796
E3.2	.415	.223	.791

(**E1.3, E2.3, and E4.1**) Deleted

Notes: * Extraction methods: Principal axis analysis; Rotation methods: Varimax; ** Component number – factor: Number 1-3: component 1-3; Cumulative variance explained = 78.906%; Cronbach's alpha - 0.854; KMO - 0.835; Bartlett's test ($p < 0.001$); Total correlations of SP between 0.445 to 0.817; number of items: 8

Table 10: Cross-loading framework at the item level

Item	SML1	SML2	SML3	SML4	SML5	SLT1	SLT2	SLT3	SPPP1	SPPP2	SPPP3	WSC1	WSC2	WSC3	SP1	SP2	SP3
SML11	0.74	0.64	0.20	0.25	0.13	0.54	0.34	0.22	0.07	0.13	-0.03	0.16	0.16	0.09	0.12	0.13	0.30
SML12	0.79	0.73	0.21	0.20	0.20	0.37	0.12	0.14	0.08	0.16	0.06	0.10	0.11	0.10	0.17	0.07	0.16
SML13	0.71	0.62	0.19	0.25	0.22	0.41	0.15	0.17	0.00	0.15	0.01	0.11	0.09	0.09	0.12	0.09	0.19
SML14	0.74	0.53	0.59	0.30	0.31	0.45	0.39	0.25	0.17	0.39	0.06	0.25	0.35	0.30	0.10	0.09	0.01
SML15	0.49	0.29	0.37	0.37	0.22	0.32	0.39	0.15	0.24	0.36	0.16	0.33	0.42	0.24	0.10	0.21	0.17
SML21	0.65	0.78	0.14	0.15	0.00	0.48	0.29	0.18	0.20	0.05	-0.04	0.12	0.02	0.13	0.04	0.10	0.22
SML22	0.59	0.78	0.23	0.11	0.06	0.37	0.25	0.06	-0.01	0.12	-0.11	0.17	0.10	0.00	0.06	0.09	0.19
SML23	0.64	0.77	0.31	0.19	0.28	0.49	0.25	0.16	0.08	0.15	0.08	0.16	0.13	0.15	0.14	0.21	0.25
SNL31	0.38	0.28	0.72	0.32	0.19	0.07	0.04	0.03	0.19	0.25	0.01	0.16	0.20	0.27	0.02	0.04	0.01
SML32	0.51	0.36	0.78	0.35	0.18	0.38	0.28	0.12	0.14	0.12	0.01	0.11	0.20	0.28	0.08	-0.01	-0.05
SML33	-0.05	-0.06	0.51	0.32	0.33	0.11	0.12	0.10	0.44	0.26	0.27	0.20	0.30	0.32	0.25	0.27	0.09
SML34	0.23	0.11	0.72	0.37	0.64	0.30	0.25	0.24	0.28	0.40	0.29	0.23	0.41	0.28	0.13	0.16	0.10
SML41	0.35	0.16	0.39	0.86	0.47	0.41	0.30	0.08	0.21	0.38	0.29	0.19	0.43	0.20	0.13	0.24	0.08
SML42	0.30	0.17	0.42	0.82	0.29	0.45	0.32	0.22	0.34	0.30	0.21	0.19	0.35	0.26	0.22	0.24	0.17
SML51	0.11	-0.07	0.42	0.42	0.84	0.27	0.23	0.13	0.21	0.39	0.33	0.05	0.39	0.22	0.16	0.18	0.06
SML52	0.39	0.29	0.41	0.41	0.93	0.41	0.30	0.13	0.15	0.39	0.20	0.14	0.36	0.23	0.22	0.29	0.20
SLT11	0.52	0.49	0.34	0.40	0.29	0.85	0.59	0.26	0.29	0.25	0.12	0.32	0.33	0.32	0.16	0.32	0.27
SLT12	0.56	0.56	0.36	0.44	0.28	0.81	0.53	0.23	0.29	0.20	0.18	0.33	0.29	0.32	0.14	0.33	0.27
SLT13	0.52	0.51	0.19	0.34	0.30	0.80	0.52	0.21	0.16	0.28	0.18	0.29	0.33	0.18	0.10	0.31	0.26
SLT14	0.52	0.53	0.17	0.43	0.44	0.80	0.40	0.18	0.11	0.20	0.13	0.25	0.28	0.16	0.07	0.23	0.28
SLT15	0.34	0.29	0.26	0.40	0.30	0.70	0.55	0.27	0.26	0.32	0.18	0.41	0.50	0.40	0.25	0.36	0.26
SLT16	0.37	0.33	0.23	0.40	0.29	0.74	0.49	0.16	0.15	0.24	0.14	0.31	0.41	0.22	0.18	0.25	0.33
SLT21	0.24	0.19	0.20	0.27	0.20	0.52	0.76	0.19	0.14	0.26	0.00	0.30	0.34	0.13	0.22	0.31	0.11
SLT22	0.20	0.22	0.22	0.22	0.16	0.43	0.64	0.27	0.19	0.31	0.10	0.22	0.27	0.15	0.05	0.18	0.06
SLT23	0.43	0.39	0.21	0.25	0.28	0.54	0.80	0.25	0.01	0.24	0.02	0.31	0.30	0.18	0.17	0.22	0.17
SLT24	0.27	0.17	0.12	0.32	0.22	0.37	0.66	0.66	-0.02	0.17	-0.05	0.27	0.31	0.17	0.31	0.21	0.16
SLT31	0.25	0.18	0.13	0.14	0.17	0.27	0.44	0.97	0.03	0.25	-0.01	0.20	0.30	0.08	0.24	0.17	0.28
SLT32	0.27	0.16	0.21	0.20	0.11	0.28	0.47	0.97	0.18	0.31	0.02	0.23	0.33	0.15	0.19	0.14	0.15
SPPP11	0.17	0.12	0.25	0.24	0.12	0.15	0.10	0.14	0.90	0.54	0.50	0.41	0.37	0.55	0.23	0.45	0.16
SPPP12	0.13	0.08	0.24	0.16	0.00	0.10	0.17	0.20	0.75	0.50	0.43	0.40	0.27	0.52	0.13	0.32	0.01
SPPP13	0.12	0.10	0.30	0.29	0.13	0.24	0.02	0.06	0.74	0.31	0.40	0.37	0.36	0.55	0.36	0.53	0.37
SPPP14	0.02	0.01	0.20	0.16	0.09	0.13	-0.01	0.10	0.74	0.33	0.43	0.28	0.19	0.44	0.12	0.26	0.10
SPPP15	0.29	0.20	0.40	0.24	0.25	0.27	0.10	0.00	0.54	0.46	0.24	0.26	0.31	0.36	0.08	0.23	0.06

Item	SML1	SML2	SML3	SML4	SML5	SLT1	SLT2	SLT3	SPPP1	SPPP2	SPPP3	WSC1	WSC2	WSC3	SP1	SP2	SP3
SPPP16	0.11	0.09	0.23	0.21	0.19	0.25	0.16	-0.02	0.81	0.33	0.43	0.38	0.29	0.52	0.18	0.41	0.19
SPPP17	0.00	-0.02	0.14	0.35	0.25	0.23	-0.04	-0.05	0.71	0.29	0.47	0.33	0.31	0.45	0.19	0.42	0.23
SPPP18	0.10	0.09	0.22	0.30	0.15	0.30	0.12	0.20	0.72	0.31	0.50	0.37	0.33	0.40	0.14	0.36	0.19
SPPP21	0.20	0.10	0.22	0.17	0.26	0.19	0.11	0.03	0.46	0.69	0.30	0.15	0.32	0.29	0.11	0.26	0.02
SPPP22	0.25	0.10	0.16	0.28	0.33	0.21	0.26	0.22	0.24	0.74	0.26	0.24	0.38	0.18	0.27	0.38	0.21
SPPP23	0.38	0.18	0.38	0.43	0.42	0.28	0.31	0.32	0.44	0.84	0.33	0.30	0.49	0.31	0.19	0.36	0.12
SPPP24	0.29	0.13	0.32	0.39	0.38	0.27	0.32	0.32	0.37	0.83	0.45	0.31	0.58	0.27	0.28	0.37	0.18
SPPP25	0.14	-0.01	0.21	0.22	0.23	0.22	0.27	0.17	0.41	0.64	0.33	0.21	0.36	0.42	0.14	0.25	0.05
SPPP31	-0.01	-0.03	0.17	0.17	0.12	0.12	0.03	-0.05	0.60	0.33	0.89	0.33	0.28	0.43	0.01	0.25	0.06
SPPP32	0.18	0.01	0.07	0.35	0.39	0.21	-0.01	0.10	0.19	0.39	0.59	0.20	0.39	0.28	0.19	0.29	0.26
WSC11	0.23	0.10	0.27	0.25	0.15	0.32	0.25	0.19	0.46	0.31	0.39	0.82	0.59	0.42	0.25	0.52	0.33
WSC12	0.25	0.20	0.25	0.21	0.15	0.34	0.34	0.16	0.40	0.27	0.30	0.86	0.49	0.41	0.30	0.57	0.37
WSC13	0.26	0.22	0.19	0.15	0.16	0.42	0.47	0.32	0.17	0.31	0.10	0.54	0.48	0.30	0.05	0.33	0.25
WSC14	0.06	0.08	-0.05	0.00	-0.13	0.15	0.10	0.01	0.25	0.01	0.19	0.55	0.16	0.26	0.17	0.35	0.37
WSC15	0.00	0.04	-0.02	0.02	-0.07	0.01	0.05	-0.02	0.25	0.08	0.16	0.54	0.15	0.22	0.37	0.39	0.28
WSC21	0.19	0.11	0.27	0.36	0.19	0.39	0.39	0.28	0.37	0.26	0.26	0.65	0.67	0.44	0.29	0.52	0.35
WSC22	0.27	0.02	0.43	0.42	0.37	0.34	0.25	0.30	0.40	0.48	0.36	0.41	0.79	0.41	0.31	0.39	0.39
WSC23	0.35	0.19	0.21	0.42	0.36	0.40	0.30	0.14	0.21	0.40	0.35	0.54	0.78	0.28	0.33	0.39	0.43
WSC24	0.15	-0.01	0.24	0.25	0.28	0.24	0.32	0.30	0.25	0.53	0.37	0.25	0.73	0.31	0.21	0.31	0.11
WSC25	0.24	0.10	0.27	0.28	0.37	0.31	0.34	0.24	0.30	0.52	0.24	0.41	0.80	0.41	0.30	0.47	0.20
WSC31	0.12	0.11	0.24	0.03	0.08	0.15	0.12	0.01	0.50	0.16	0.29	0.38	0.21	0.75	0.19	0.30	0.16
WSC32	0.16	0.12	0.30	0.26	0.12	0.28	0.15	-0.01	0.59	0.21	0.31	0.47	0.35	0.80	0.26	0.45	0.33
WSC33	0.24	0.05	0.33	0.28	0.35	0.30	0.21	0.27	0.32	0.49	0.44	0.23	0.50	0.64	0.19	0.33	0.16
SP11	0.11	0.01	0.13	0.23	0.22	0.16	0.24	0.24	0.19	0.25	-0.01	0.17	0.34	0.22	0.82	0.48	0.34
SP12	0.20	0.13	0.19	0.16	0.20	0.17	0.29	0.23	0.21	0.24	0.00	0.27	0.37	0.28	0.79	0.39	0.36
SP13	0.10	0.11	0.01	0.08	0.09	0.11	0.08	0.05	0.15	0.11	0.23	0.30	0.18	0.16	0.68	0.50	0.56
SP21	0.28	0.16	0.26	0.41	0.42	0.39	0.32	0.12	0.35	0.44	0.22	0.47	0.60	0.40	0.58	0.79	0.46
SP22	0.14	0.25	-0.02	0.12	0.06	0.35	0.25	0.07	0.41	0.17	0.24	0.57	0.29	0.37	0.32	0.78	0.57
SP23	-0.13	-0.07	-0.01	0.03	0.07	0.03	0.09	0.17	0.34	0.31	0.28	0.34	0.28	0.30	0.39	0.58	0.37
SP31	0.34	0.32	0.10	0.18	0.26	0.47	0.32	0.34	0.12	0.26	0.14	0.36	0.42	0.29	0.37	0.47	0.79
SP32	0.06	0.17	-0.03	0.07	0.03	0.15	0.00	0.05	0.23	0.02	0.14	0.40	0.26	0.22	0.54	0.60	0.86

Table 11: Correlation among safety performance evaluation framework factor scores (square root of AVE in diagonal)

Factor	SML1	SML2	SML3	SML4	SML5	SLT1	SLT2	SLT3	SPPP1	SPPP2	SPPP3	WSC1	WSC2	WSC3	SP1	SP2	SP3
SML1	0.70																
SML2	0.81	0.77															
SML3	0.46	0.30	0.69														
SML4	0.39	0.20	0.48	0.84													
SML5	0.31	0.16	0.47	0.46	0.89												
SLT1	0.60	0.58	0.33	0.51	0.40	0.79											
SLT2	0.40	0.34	0.26	0.37	0.30	0.66	0.72										
SLT3	0.27	0.17	0.18	0.18	0.14	0.28	0.47	0.97									
SPPP1	0.16	0.11	0.33	0.32	0.19	0.27	0.11	0.11	0.74								
SPPP2	0.34	0.14	0.35	0.40	0.44	0.32	0.34	0.29	0.52	0.75							
SPPP3	0.07	-0.02	0.17	0.30	0.28	0.20	0.02	0.01	0.58	0.45	0.76						
WSC1	0.27	0.20	0.24	0.23	0.12	0.40	0.39	0.22	0.47	0.33	0.36	0.68					
WSC2	0.32	0.11	0.38	0.46	0.42	0.45	0.43	0.33	0.41	0.58	0.42	0.61	0.75				
WSC3	0.24	0.13	0.40	0.27	0.25	0.34	0.22	0.12	0.64	0.40	0.48	0.49	0.49	0.73			
SP1	0.18	0.11	0.14	0.21	0.22	0.19	0.26	0.22	0.24	0.26	0.10	0.32	0.39	0.29	0.76		
SP2	0.17	0.18	0.12	0.28	0.28	0.38	0.33	0.16	0.50	0.43	0.34	0.64	0.56	0.50	0.61	0.72	
SP3	0.23	0.29	0.04	0.15	0.16	0.35	0.17	0.22	0.22	0.15	0.17	0.46	0.40	0.30	0.55	0.65	0.83

Table 12: AVE, CR and CA values

Construct	AVE	Composite Reliability (CR)	Cronbach's Alpha (CA)
SML	0.51	0.84	0.85
SLT	0.65	0.84	0.88
SPPP	0.67	0.86	0.89
WSC	0.66	0.85	0.85
SP	0.73	0.89	0.81

Table 13: Safety performance evaluation framework constructs, factors and items

SML: Safety Management and Leadership (Construct)
<i>SML1: Management Commitment to Safety (Factor)</i>
SML11: Management actions safety issues
SML12: Management provides adequate resources to safety
SML12: Management encourages employees to voice concerns and safety improvement proposals
SML14: Management provides adequate safety information (i.e. media, mission statements, accident statistics, etc.)
SML15: Management involves employees when setting safety objectives, decision making and improvement plans
<i>SML2: Management's Active Participation in Safety (Factor)</i>
SML21: Management promotes a safety culture
SML22: Management actively participates in risk assessments, consultative committee meetings and inspections
SML23: Management ensures that information (i.e. procedures) is visibly present in the workplace
<i>SML3: Safety Communication and Relations (Factor)</i>
SML31: Management and supervisors have an open door policy
SML32: Safety information is regularly brought to my attention by supervisors
SML33: Supervisors are more attentive to safety issues than the average employee
SML34: Supervisors are trusted and can relate with employees about safety
<i>SML4: Safety Practice Incentives (Factor)</i>
SML41: Monetary (e.g. bonuses) or recognition (e.g. safe employee of the month) incentives are provided for employees for good safety practices
SML42: There are punitive measures for the continued poor safety practices of employees (e.g. fines, demotions, etc.)
<i>SML5: Perceived Supervisor Competence (Factor)</i>
SML51: Supervisors have adequate skills and authority to tackle safety issues
SML52: Supervisors are committed to, and convinced of, the benefits of safety
SLT: Safety Learning and Training (Construct)
<i>SLT1: Safety Training, Seminar, and Promotional Strategies (Factor)</i>
SLT11: Regular safety seminars and updates are provided to employees (e.g. short talks, group meetings, etc)
SLT12: Adequate provision of up-to-date safety training to all employees
SLT13: Adequate resources allocated to safety training
SLT14: Safety training adequately covers emergency response and provides first-aid competencies
SLT15: Enhanced safety awareness by clearly visible mission statements in the workplace (i.e. slogans and logos)
SLT16: Readily available published materials on safety in the workplace (i.e. library, statistics, and newsletters)
<i>SLT2: Safety learning openness (Factor)</i>
SLT21: Employees give tips to each other on how to work safely
SLT22: Accident/incident reports are used to improve safety
SLT23: Employees learn lessons from near misses, incident and accident reports
SLT24: Feedback is used to improve safety in the workplace
<i>SLT3: Safety knowledge and competence (Factor)</i>
SLT31: Employees are competent in fulfilling their safety obligations
SLT32: School students are instilled with sufficient knowledge on safety management procedures
Safety Policy, Procedures, and Processes (Construct)
<i>SPPP1: Safety procedures, audits and reviews (Factor)</i>
SPPP11: Safety inspections are regularly conducted
SPPP12: Employment of a safety officer and safety supervisors
SPPP13: The results of accident investigations are fed back to the supervisory level
SPPP14: Adequate emergency planning and procedures

SPPP15: Safety management systems include strong auditing requirements
 SPPP16: Safety equipment, tools and other accessories are maintained and tested regularly
 SPPP17: Sufficient training on the use of safety equipment is available to employees
 SPPP18: Safety is viewed as an important consideration in the design process for new School buildings and facilities
SPPP2: Safety accountability and feedback (Factor)
 SPPP21: Safety auditors are sufficiently familiar with the appropriate safety policy and procedures
 SPPP22: Employee/parent satisfaction with the feedback given on accidents/incidents, near loss and injuries that occurred
 SPPP23: Employee/parent satisfaction with the follow-up actions taken after incidents and accidents have taken place
 SPPP24: Periodic maintenance of safety resources to reflect current best practices
 SPPP25: Safety operations are conducted professionally and adequately governed by senior management
SPPP3: Built environment safety (Factor)
 SPPP31: A safety checklist is regularly completed for School buildings/facilities to ensure that they are safe to use
 SPPP32: Maintenance issues that are viewed as high safety risks are given high priority and addressed quickly

Workforce Safety Culture (Construct)

WSC1: Individual responsibility to safety (Factor)

WSC11: Employee's at all levels generally have a personality that is conducive to good safety practices
 WSC12: Value is placed on strong personal safety responsibility
 WSC13: Employee's place a high priority on safety
 WSC14: Employee's demonstrate 'Duty of Care' towards one another
 WSC15: Employees safely utilise available machines and technical equipment

WSC2: Perceptions of work situation and pressure (Factor)

WSC21: There are enough employees to carry out required work in a safe manner
 WSC22: Employee's have enough time to carry out their tasks in a safe manner
 WSC23: A realistic amount of time is generally scheduled for completing assigned tasks in a safe manner
 WSC24: Work procedures are presented clearly and logically
 WSC25: Employee's feel comfortable to inform management of safety issues

WSC3: Propensity to report incidents and accidents (Factor)

WSC31: Employee perceive that the incident/accident reporting system is effective
 WSC32: Employee's are willing to account for a co-worker's ongoing failure to report incidents/accidents
 WSC33: Employee's have confidence in the ability of executives to correct safety issues and concerns

SP: Safety Performance (Construct)

SP1: Safety accident and incident rates and appropriate responses (Factor)

SP11: There is a low frequency of incidents in our school
 SP12: There is a low frequency of accidents in our school
 SP13: Accident reports always result in a range of appropriate corrective and preventive actions

SP2: General safety behaviours of staff (Factor)

SP21: There are good safety attitudes and behaviours in the school environment
 SP22: There is strong willingness to comply with safety policy, procedures and practices
 SP23: Employees are always willing to assess incidents or accidents that occur and organise appropriate emergency care

SP3: Emergency response (Factor)

SP31: There is a quick emergency response to accidents
 SP32: Emergency planning and response is effective