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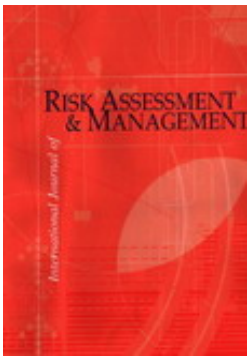

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Investigating the influential key safety climate factors on safety behaviour in the construction industry: a systematic review of the literature

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Investigating the influential key safety climate factors on safety behaviour in the construction industry: a systematic review of the literature

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Abstract: The impact of safety climate factors on safety performance has been seldom inspected in the construction industry, despite that the significance of safety climate factors in human mistakes has been recognised. Basically, distinguishing the significant contributing factors influencing on the safety behaviour should be examined at the workplace. Therefore, this study is aiming to investigate all safety climate factors that affect the safety behaviour and from that the key influential safety climate factors are deduced accordingly. The implications of these findings will significantly reduce at-risk work behaviours and increase the safety performance. The outcome concluded the critical features of key safety climate factors which can be implemented in particular applications in order to handle work behaviours. The critical factors which were identified from the systematic analysis can influence within any organisation towards the safety behaviour and can empower the assurance of influence disparity of all safety climate factors' dimensions.

Keywords: safety climate factors; work safety behaviour; construction industry; key influential factors; systematic analysis.

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1 Introduction

The construction industry has long been notorious for the inherent high risks, with fatality and injury rates substantially higher than average numbers across all industrial sectors in so many jurisdictions (Rowlinson, 2003). Various explanations are proposed to account for this phenomenon. For example, poor housekeeping and compact space (Khanzode et al., 2012), extraordinarily high level of sub-contracting (Chiang, 2009; Salminen, 1995; Tam and Fung IV, 1998), extremely low level of unionisation in some jurisdictions (Litwin, 2000), the decentralising and mobile nature of industry (Fang et al., 2006). On the other hand, some authors found different reasons that lead to the accidents as follows: short-term employment arrangement (Lingard and Rowlinson, 2004), inherently dangerous nature of construction work (Hinze, 1997), a lack of consistent safety competency framework for those who hold critical safety responsibility (Biggs et al., 2006), the lack of motivation in fostering safety culture (Ng et al., 2005). Fabiano et al. (2008) managed to demonstrate that the temporary nature of construction activities was

the critical cause of accidents. For example, Newaz et al. (2019) used a psychological contract of safety to predict safety climate on construction sites. The results showed a positive and strong safety climate where safety obligations between supervisor and workers should be fulfilled.

All in all, many authors found that unsafe acts are the main factors of accidents in construction industry (Blackmon and Gramopadhye, 1995; Heinrich and Granniss, 1959; Gould and Joyce, 2009; Choudhry, 2014). At the same vein, Blackmon and Gramopadhye (1995) found that unsafe acts caused 98% of accidents after conducting a comprehensive study. In fact, most of the investigations have basically concentrated on the risky behaviour of frontline workers, whilst less consideration might have been paid to the fundamental causes behind that behaviour, for example organisational variables (Fung et al., 2010; Zou and Sunindijo, 2013). Safety climate is almost unanimously accepted as one form of organisational climate and thought to develop in the context of organisational climate (Silva et al., 2004). Schneider and Reichers (1983) even opine that organisational climate is so general that it is meaningless without indicating what it is referring to. Hence, it is imperative to examine the key safety climate factors to promote the safety behaviour in construction industry. The big attention and interest recently about safety climate is resulted from the awareness of the significance of organisational factors in safety assessment in the construction industry. Many studies carried out in the construction industry to discover the aspect of safety climate structure (Dedobbeleer and Béland, 1991; Hon et al., 2012; Lingard et al., 2012). Lingard et al. (2012) managed to demonstrate in their study the enormous facts and evidence of a positive link between safety performance and safety climate. On the other hand, only few concepts and no clear mechanism show the relationship between safety climate and worker's safety behaviour and there is no clear mechanism in this regard (Clarke, 2006; Griffin and Neal, 2000; Neal et al., 2000). This is due to various reasons highlighted by many authors since the concept of safety climate is ambiguous (Zohar, 2010).

There are no agreed safety climate scales for the industry, besides, a wide range of factors and conceptual topics are covered by the matter of concept (Flin et al., 2000; Guldenmund, 2000; Hon et al., 2012). Dejoy (2005) and Neal et al. (2000) explained that, the safety climate concept is frequently utilised interchangeably with safety culture, which may lead to become capture-all term regarding the human belief relating the contextual and organisational factors. Although the strong fact is that the safety climate has a solid and direct positive impact on safety performance, there is a risk that this relationship idea can weaken its analytical power in this regard, especially when defining the influence mechanisms between safety results and safety behaviour. Hence, it is quite necessary and important to go through better understanding for these mechanisms, as long as the principal objective of calculating safety climate is to improve the safety performance in the industries (Cooper and Phillips, 2004). Many researchers as well managed to address the necessity to explore the specific dimensions of the relationship impact between safety behaviour and safety climate (Pousette et al., 2008; Prussia et al., 2003; Wirth and Sigurdsson, 2008).

Basically, in view of the knowledge gap of no satisfying comprehensive model of safety climate containing the cause, the content and the consequence of safety climate and depicting how safety climate is supposed to be embedded in the organisation noted by Guldenmund (2000) and other writers, such as Zohar (2010), Lingard et al. (2010), DeJoy et al. (2004), Ostroff et al. (2003), and Griffin and Neal (2000), this paper investigates the working mechanism underlying safety climate toward the safety

behaviour at workplace in the construction industry. Therefore, the key influential safety factors should be identified to promote the safety behaviour at workplace in construction industry.

2 Research background

The construction industry is globally recognised as one of the largest employers with important contributions to economic and social objectives of the countries. It is also recognised as one of the most hazardous industries in both developed and developing countries (Zid et al., 2020). The fatal and non-fatal work-related injury rates in this sector are considerably higher than in many other industries. Causes of this disproportion have been very often attributed to the nature of the construction industry which exhibits particular characteristics in terms of the construction process and project organisation (Zid et al., 2020). Given the dynamic nature of the construction process, having accurate and opportune information about safety gaps in the work area can contribute to the design and implementation of more effective safety interventions. Safety climate, a component of the organisational culture which some studies have found related with safe behaviour and injury occurrence in the workplace (Christian et al., 2009; Clarke, 2006; Zohar, 2003), has been proposed as a leading indicator of the workplace safety (Beus et al., 2010; Payne et al., 2010). Safety climate is conceptualised as a measure of workers' shared perceptions regarding the priority given to safety at the work place, and has been considered as a relevant element in the study of injury occurrence because some studies have reported an association between safety behaviours and injury rates, suggesting that there is a link in the causal pathway.

Safety climate is a summary of perceptions that employees share about their work environment (Zohar, 1980). Different researchers have different definitions of safety climate (Zohar, 1980; Dedobbeleer and Béland, 1991; Williamson et al., 1997; Zhang et al., 2002). It seems, however, that most of them concern employees' perceptions about objects related with safety, probably due to the original definition given by Zohar in 1980, the initiator of safety climate research. After 23 years, Zohar (2003) refines the definition and describes safety climate as shared perceptions with regard to safety policies, procedures, and practices. This definition is in line with the broader organisational climate literature, and excludes any identified contaminant (Beus et al., 2010). A safety climate is the sum of employees' shared perceptions of the policies, procedures, and practices relating to safety in their work environment (Zohar, 1980; Huang and Hinze, 2006). In general terms, safety climate describes shared perceptions held by employees about the value, importance and priority given to safety in each organisation (Cooper and Phillips, 2004; Hahn and Murphy, 2008; Mark et al., 2007; Mohamed, 2002; Zohar, 2010) and denotes attitudes to safety within an organisation (Guldenmund, 2000).

Several reasons have been proposed to account for the popularity of safety climate. According to Guldenmund (2000), through research and study of the safety climate, people can find desired behaviours to reduce and eliminate hazards, reveal strengths and weaknesses of safety programs, find solutions to the unearthed problems, establish benchmarks for future safety programs, develop survey instruments to appraise safety climate. Also, Marin et al. (2019) illustrated that perceptions of safety climate across construction personnel are associated with injury rates. Gyekye and Salminen (2009)

report the benefits brought by safety perception surveys including (i) proactively identifying precursors to accident and thus effectively reducing safety climate and related constructs accident occurrence, (ii) providing guidance to management in developing safety programs, (iii) relatively inexpensive compared with other proactive accident prevention methods, and (iv) providing insight about safety management from the perspective of employees. The introduction of safety initiatives to the rail industry can not only reduce the likelihood of accident occurrence, but also bring real business and financial benefits, in terms of the reduction in sick leave, litigation costs, healthcare costs, worker compensation, property damages, and training and development costs, as reported by the Health and Safety Executive of the UK government (HSEUG, 2005). From a macro perspective, these initiatives can improve performance/productivity, well-being and morale of employees, employee loyalty and company image. Apparently, the common theme is that the result of safety climate surveycanprovidecost-effective methods to reduce accident occurrence, on the assumption that employees' perceptions have significant impact on both individual and organisational outcomes (Zahoor et al., 2015; Saunders et al., 2017).

The level of analysis of some organisational constructs, such as climate, safety climate and related constructs such as participation, leadership affect, and technology, is open to debate (Klein et al., 1994). Safety climate can be conceived as either a psychosocial, or a socio-cultural concept, and perceptions can be aggregated at group, organisational or other higher possible levels (Glendon, 2008; Shen et al., 2015; He et al., 2016) and also toward safety performance (Chen et al., 2018; Alruqi et al., 2018). Zohar (2003) reports three validation criteria for aggregated perceptions, namely, within-unit homogeneity, between-unit variability, and correspondence of units of analysis with natural social units. Zohar and Luria (2005) investigated safety climate at both organisational and subunits levels, and find that the group-level safety climate mediates the relationship between organisational safety climate and individual safety behaviour in construction industry. In the Idris et al. (2012) study, the psychosocial safety climate on an Australian sample consisting of 126 workers in 16 teams and a Malaysian sample composing 180 workers in 31 teams, found that psychosocial safety climate impacts individual psychological health through the mediation of job demands. The research, however, focuses on psychological safety climate, not only to follow the tradition of safety climate research in the construction industry, but also to fulfil the stated research objectives, i.e., to explore the working mechanism of safety climate. In addition, it can serve as an avenue to look into the issue at a higher level, due to the assertion that relationships at the individual level can be indicative of similar relationships at the higher levels (Parker et al., 2003).

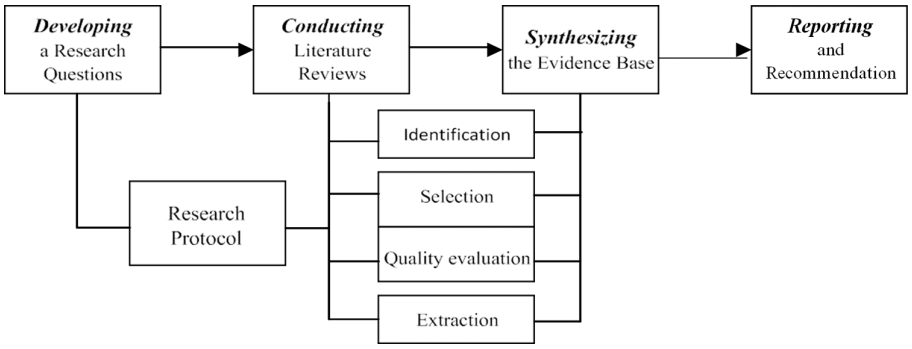
After showing the importance of the safety climate to promote the safety behaviour, an extensive literature review systematic analysis was applied to identify the key important climate factors that have a significant influence on safety behaviour in construction industry. Methodology includes a detailed description related to the mechanisms that should be applied in this study.

3 Research methodology

The research methodology mainly relied on the aggregation of data and combining results from different studies with the objective of identifying patterns among study findings

(fink, 2013). A literature search was conducted on electronic sources in multiple data bases. The review followed the guidelines of Fink (2009, 2013) for literature reviews by including the four phases of the Fink approach: developing, conducting, synthesising and reporting as shown in Figure 1.

Figure 1 Research literature review steps



Source: Fink (2009)

Nowadays, most fatal accidents are mainly accrued in construction industry. Furthermore, through the previous studies, we concluded that despite the latest high tech and the advanced risk assessment applied in construction industry, the constructions till records very scary escalator pattern of fatal accidents. In order to tackle this issue, an extensive literature review was conducted about climate safety factors that influence on safety behaviour in construction industry.

Basically, identifying the key climate safety factors is focused on the latest bibliographic databases. To obtain multiple perspectives, the search included also somehow other industries apart from construction. The key search terms used to find relevant literature were summarised as follow: 'Safety behaviour methods', 'safety behaviour factors in construction industry', 'safety climate variables of safety behaviour', ...etc., using SPIDER approach which developed by Cooke et al. (2012). The keywords, titles, and abstracts have been highlighted by using End Note in the main databases published work until now as shown in Figure 2.

The databases involved ProQuest, Social Sciences Full Text, Scopus journal, Web of Science, Health and Safety Science Abstracts, and Science Direct…etc. So far, 375 articles have been managed to summon for this research as preliminary findings, after deleting the duplicate articles, the number decreased to 349 articles. The evaluation of articles has processed by screening method where 182 articles were excluded from this study because they are not relevant to the topic of study or not addressing the aim of the research. This operation reduced the number of articles to 167 as shown in Figure 3. The process filtered out 62 articles and left 96 articles which have been used for the content analysis and synthesising the evidence base as shown in Figure 3. All 96 articles are mentioned in the Table 1.

Figure 2 End note database during the systematic literature review analysis (see online version for colours)

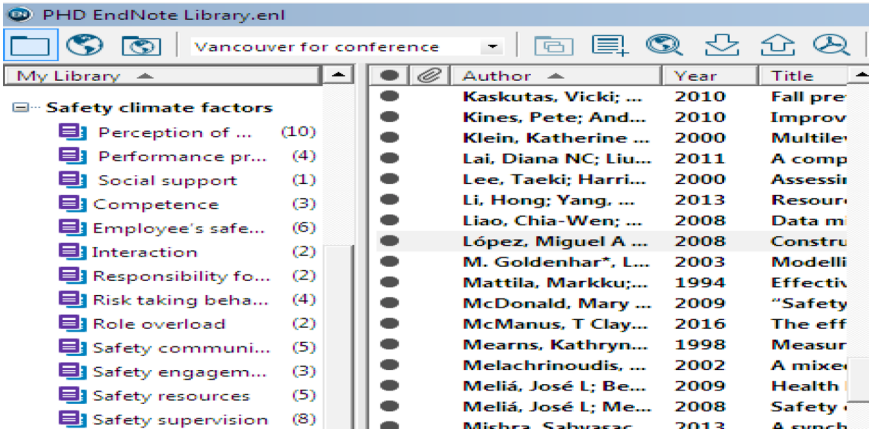


Figure 3 Preliminary literature review process including the articles screening

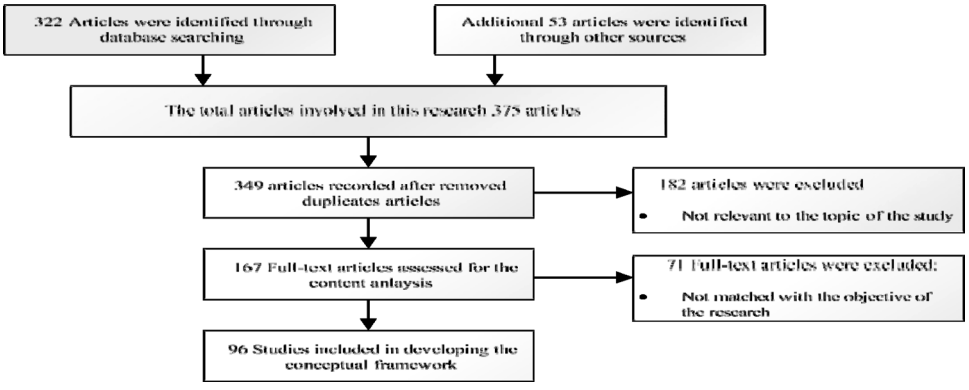
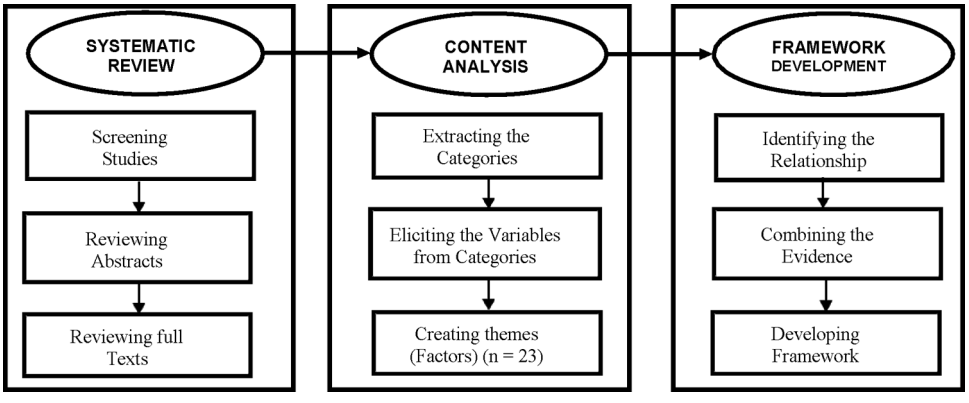


Figure 4 Flow diagram of study design



These studies were then selected based on safety climate factors that affect safety behaviour. The abstracts and the contents were accordingly re-reviewed and analysed in order to determine all variables which have an influence on safety behaviours in

construction industry. All relevant studies were finalised accordingly to develop a comprehensive safety behaviour conceptual framework by following the whole process of Figure 4.

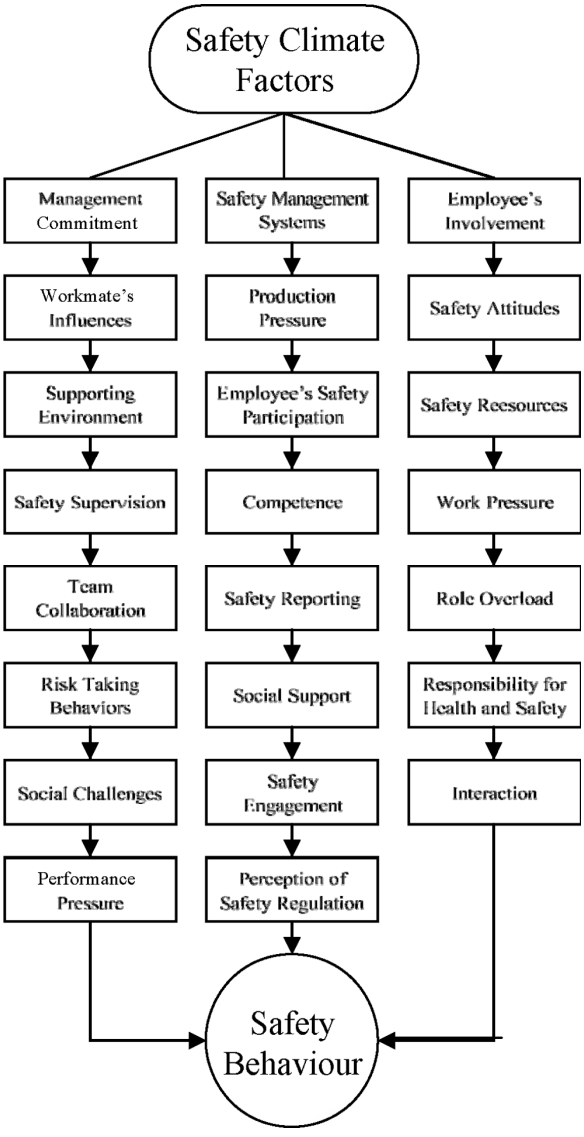
All extracted variables were categorised based on their contribution to the previous studies into four key safety climate factors. Basically, the trustworthiness of the concluded data was retrieved and evaluated based on study context, methods, analysis process, key findings and the contribution.

4 All safety climate factors influencing on the employees' safety behaviour

Safety climate factors are basically defined through various studies as the underlying reasons of unsafe behaviour. Indeed, social scientific constructs are usually multi-dimensional (Guldenmund, 2000), and the construct of safety climate is no exception. In reviewing 16 past safety climate studies, Clarke and Cooper (2004) find that the dimensions of safety climate range from one to sixteen. Variation in the dimensionality of safety climate instruments has been observed and discussed almost since the first empirical research about safety climate. Williamson et al. (1997) attribute such differences partly to the two different approaches to what are assumed to be elements of safety climate, despite that they prefer adopting both approaches in producing their safety climate measurement instrument. One approach assumes that safety climate is produced by the actual features of the workplace and thus can be measured by asking employees about their perceptions of the *status quo* of those features, and the scales employed by Zohar (1980), Dedobbeleer and Béland (1991), and Glendon et al. (1994), can be numbered into this category. The other approach assumes that safety climate is engendered by workers' attitudes towards the general safety and their perceptions of the workplace features, with the scale used by Cox and Cox (1991) as its representative. Using Zohar's (1980) safety climate questionnaire which is intended to assess employee perceptions, and a self-developed safety attitude scale, Díaz and Cabrera (1997) find a positive relationship between them, that is, those companies with higher scores on the climate scale also have a more positive safety attitude.

Clarke (2006) makes a comparison with respect to predictive validity between the perceptual approach and attitudinal approach, and finds that perceptual approach outperforms the attitudes towards safety. Seo et al. (2004) report the following reasons for the variation, including the lack of theoretical under pinning and thus satisfactory construct validity of safety climate, seldom reuse of instruments, the different targeted populations in different industries or cultures, and the fact that the factor labelling is up to the researchers. Likewise, Choudhry et al. (2009) maintain that variety of questionnaire, samples, and methodologies employed by different researchers can account for the inconsistency in factorial structure of safety climate. Flin et al. (2000), Beus et al. (2010) attribute the lack of consensus about the dimensionality of the construct of safety climate to the inductive conceptualisation of safety climate using measures tailored to specific industry or situation by examining safety-related literature and administering interviews and focus groups. Morrow et al. (2010) report that differences in culture, industry, and/or job position may account for the variation about safety climate facets.

Figure 5 Association between safety climate factors and safety behaviours



Many authors have sought to classify and understand reasonable safety climate factors (Chen et al., 2017a; Siu et al., 2004; Larsson et al., 2008; Glendon and Litherland, 2001; Dedobbeleer and Béland, 1991; Guo et al., 2016; Zhou et al., 2008; Mohammadfam et al., 2017). These studies can be presented by analysis method or research process. The preliminary results are presented in Figure 5 after concluded 23 safety climate factors which have an influence on the safety behaviour. These results were obtained after performing systematic analysis approach as mentioned in previous section of methodology. Nevertheless, all factors were gone through a major analysis and review based on the content of findings and their significant influence on safety behaviour in particular. On the same vein, Table 1 was created to combine all facts and the data from

the literature review incorporated with the necessary references. Basically, Table 1 includes all previous studies that embraced any such factor which proved its significant influence on safety behaviour. Many standards were embraced for this study to identify the impact of each factor based on: firstly, the evidence of significant association (low, moderate, strong); secondly, the empirical association which can be found in this regard, but the study did not report a certain influence; thirdly, the nature of the correlation between the safety climate factor and the safety behaviour; lastly, inspection of using a such factor in building a model in order to evaluate the safety behaviour. Table 1 includes all findings of the systematic analysis approach.

Table 1 The description of contributory safety climate factors' influence on safety behaviour

	Studies (citation)	*Volume of papers*	*Associations with safety behaviour*
Safety climate factors	Newaz et al. (2019), Chen et al. (2017a, 2018), Chan et al. (2017), Li et al. (2017), Shen et al. (2015), He et al. (2016), Zahoor et al. (2015), Zou and Sunindijo (2013), Cigularov et al. (2013), Meliá et al. (2008), Siu et al. (2004), Larsson et al. (2008), Glendon and Litherland (2001), Dedobbeleer and Béland (1991), Guo et al. (2016), Zhou et al. (2008), Mohammadfam et al. (2017), Alruqi et al. (2018), Marin et al. (2019)	+++	↑↑↑, P, M
Safety attitude	Schröder et al. (2016), Findley et al. (2007), Jitwasinkul et al. (2016), Siu et al. (2003), Donald and Canter (1994), Zhou et al. (2008), Jitwasinkul et al. (2011), Hadikusumo et al. (2017), Shin et al. (2014), Mohammadfam et al. (2017)	+++	↑↑↑, P, M
Management commitment	Pinion et al. (2017), Ahmad et al. (2016), Jitwasinkul and Hadikusumo (2011), Abudayyeh et al. (2006), Michael et al. (2005), Mohammadfam et al. (2017), Jitwasinkul et al. (2016), Paşaoğlu (2015), Hadikusumo et al. (2017), Amponsah-Tawaih and Adu (2016)	+++	↑↑↑, P, M
Safety management system	Machfudiyanto et al. (2017), Li et al. (2015), Huang et al. (2015), Yoon et al. (2013), Park and Kim (2013), Ismail et al. (2012), Carbonari et al. (2011), Mohammadfam et al. (2017), Jitwasinkul and Hadikusumo (2011), Jitwasinkul et al. (2016), Hadikusumo et al. (2017)	+++	↑↑↑, P, M
Employees' involvement	Hussain et al. (2018), Scharrer (2015), Jitwasinkul et al. (2016), Martin and Hafer (1995), Zhou et al. (2008), Cottini et al. (2011), Mohammadfam et al. (2017), Jitwasinkul and Hadikusumo (2011), Lin (2006), Hadikusumo et al. (2017)	+++	↑↑↑, P, M
Production pressure	Guo et al. (2016), Kitchel and Ball (2014), Dos Santos and Szklo (2016), He et al. (2016), Han et al. (2014), Mohammadfam et al. (2017), Amponsah-Tawaih and Adu (2016)	+++	↑↑↑, P, N
Supporting environment	Christian et al. (2009), Mohammadfam et al. (2017)	+	↑↑↑, P, M
Workmate's influences	Chan et al. (2017), Fang et al. (2006), Seo et al. (2015), Zhou et al. (2008), Zhou et al. (2010), Schwatka et al. (2019)	+++	↑↑↑, P, M, N

Table 1 The description of contributory safety climate factors' influence on safety behaviour (continued)

	Studies (citation)	*Volume of papers*	*Associations with safety behaviour*
Safety supervision	Chen et al. (2017a), Hayes et al. (1998), Helmreich and Merritt (1998), Simard and Marchand (1994), Hsu et al. (2008), Mattila et al. (1994), Zohar (2000), Zohar and Luria (2005)	+++	↑↑, P, M,
Competence	Chan et al. (2017), Fang et al. (2006), Mohamed (2002)	+	↑
Work pressure	Chan et al. (2017), Cigularov et al. (2013), Cooper and Cartwright (1997), Glendon and Litherland (2001), Guo et al. (2016), Mohamed (2002)	+++	↑↑↑, ,M, N
Role overload	Barling et al. (2002), Chen et al. (2017b)	+	↑↑↑, ,M, N
Safety reporting	Reason (1997), Wiegmann et al. (2002), Hsu et al. (2010)	+	↑↑, M,
Team collaboration	Hsu et al. (2010), Lee and Harrison (2000), Helmreich and Merritt (1998)	+	↑↑↑, P, M
Responsibility for health and safety	Chan et al. (2017), Hon et al. (2012)	+	↑↑↑, P, M
Social support	Goldenhar et al. (2003), Mohamed et al. (2009)	+	↑↑↑, P,N
Risk taking behaviours	Chan et al. (2017), Fang et al. (2006), Mohamed (2002), Zhou et al. (2008)	++	↑↑, P, N, M
Interaction	Cheng et al. (2012), Glendon and Litherland (2001)	+	↑↑,
Safety engagement	Aksorn and Hadikusumo (2008), Choudhry and Fang (2008), Fang et al. (2004)	++	↑↑↑, P, M
Social challenges	Kartam et al. (2000), Suraji et al. (2001), Toole (2005), Zheng et al. (2010)	++	↑↑, P, N,
Perception of safety regulation	Chan et al. (2017), Choudhry et al. (2009), Fang et al. (2006), Glendon and Litherland (2001), Hon et al. (2012), Mohamed (2002), Seo et al. (2015), Wu et al. (2015), Zhou et al. (2010), Zhou et al. (2008)	+++	↑↑, P,M
Performance pressure	Al-Haadir and Panuwatwanich (2011), Choudhry and Fang (2008), Glendon and Litherland (2001), Hon et al. (2012)	++	↑↑, N
Safety resources	Glendon and Litherland (2001), Fang et al. (2006), Zhou et al. (2008), Zhou et al. (2010), Chan et al. (2017)	++	↑↑, P, M
Employees' safety participation	Guo et al. (2016), Neal et al. (2000), Griffin and Neal (2000), Vinodkumar and Bhasi (2010), Mitropoulos et al. (2005), Mohammadfam et al. (2017)	+++	↑↑, P, M

+++: Considerable volume of literature.

++: Several journal articles.

+: Little or no known literature.

↑↑↑: Strong evidence of significant association found.

↑↑: Moderate evidence of significant association found.

↑: Low evidence of significant association found.

P: Positive impact towards safety behaviour.

N: Negative impact towards safety behaviour.

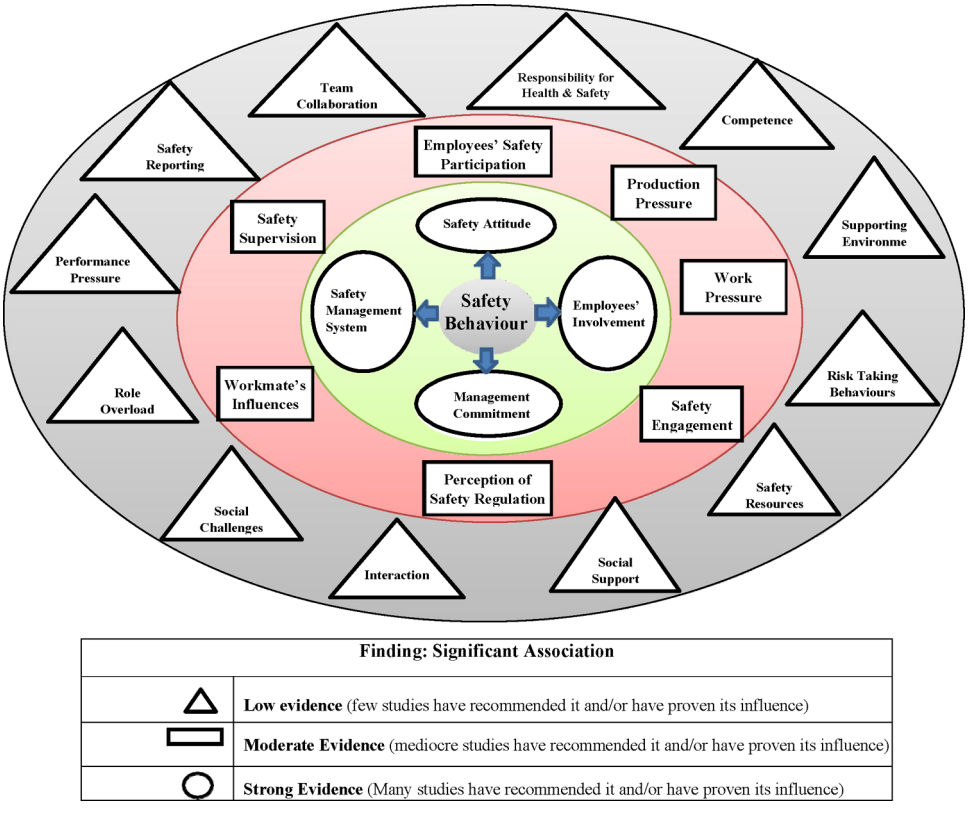
M: Used in model as factor to evaluate the safety behaviour.

5 The key influential safety climate factors on the safety behaviour in the construction industry

General speaking, the results provide a detailed explanation on the identified key safety climate factors from previous publications and confirm their implication in construction industry on the safety behaviour. Basically, the key influential factors include safety attitude, management commitment, safety management system and employees' involvement. After getting the preliminary results including the 23 safety climate factors which are represented in Figure 5 and Table 1, performing the categorisation of the 23 factors was the main operation for this section. In order to classify each factor impact, many standards were judged in this study to identify the impact of each factors towards the safety behaviour as follows: (i) checking evidence of significant association (low, moderate, strong) (Khosravi et al., 2014); (ii) finding an empirical association related to the volume of papers (Brown et al., 2018); (iii) the nature of the correlation between the safety climate factor and the safety behaviour (Khosravi et al., 2014); and (iv) inspecting the capability of using such factors to build a model in order to evaluate the safety behaviour (Zhou et al., 2008). All factors were undergone to a mega analysis and review based on the content of findings and their significant influence on safety behaviour in particular. From the result of Table 1 and based on the influence of contributory factors in previous studies, all 23 factors were categorised into three different dimensions as follows:

- The first level which has an enormous influence on safety behaviour is considered the key safety climate factors for this study: safety attitude, management commitment, safety management system, and employees' involvement. These factors are represented with circle shape in Figure 6 and are located close to the safety behaviour in the scheme to display their significant influence on safety behaviour.
- The second dimension of these factors that has a mediocre influence on safety behaviour includes seven factors: employees' safety participation, production pressure, work pressure, safety supervision workmate's influences, perception of safety regulation, and safety engagement. These factors are located one level far away from the safety behaviour after the first dimension of key factors and are represented with a rectangular shape to elaborate their moderate impact on safety behaviour.
- The third dimension incorporates 12 factors which have low evidence of their influence on the safety behaviour: responsibility for health and safety, competence, supporting environment, risk taking behaviours, safety resources, social support, interaction, social challenges, role overload, performance pressure, safety reporting, and team collaboration. All these factors are considered the last dimension with a low impact on safety behaviour which they are surrounding all previous factors (circle and rectangular) and are represented in the shape of a triangle as shown in Figure 6.

Figure 6 The key safety climate factors based on their strength influence on safety behaviour in construction industry (see online version for colours)



5.1 Safety attitude

The attitudes are hypothetical constructs and exist within people; thus, attitudes cannot be observed alone but the consequences of an attitude can be measured (Steers and Porter, 1981). Furthermore, the attitude ranges on a continuum basis starting from very favourable to very unfavourable (Shin et al., 2014). In many cases, unsafe work practices, incidents and accidents are generated from managements' and workers' negative attitudes towards safety. When an accident occurs, it is often by transferring the blame to the workers advocating that the workers do not follow the relevant safety rules and procedures. Furthermore, the workers are having such negative behaviour on abiding by the safety rules and practices which are seldom investigated (Schröder et al., 2016). In order to understand how workers' safety attitudes lead to safe behaviours, their mental processes need to be closely investigated. Unsafe acts are often intentional (Donald and Canter, 1994), and attitudes are one of the key factors to foresee workers' intentions on behaviours (Ajzen, 1991). The implication for health and safety interventions from the Glendon and McKenna's (1995) theory is that any interventions to enhance safety performance should target both behavioural and attitudinal change situations; and the behavioural component refers to the tendency to act in a certain way towards the object or situation. Thus, workers' safety attitudes can be adjusted when they directly or indirectly experience accidents. Finally, it will be effective to help workers become

immersed in accident details in the process of sharing the accident information and ensure the safety policy. Many authors have proven the importance of safety attitude at workplace to improve safety climate (Shin et al., 2014; Zhou et al., 2008; Mohammadfam et al., 2017; Jitwasinkul et al., 2016; Hadikusumo et al., 2017).

5.2 Management commitment

Management commitment has been broadly recognised as a key element of organisational accomplishment in focused fields in regards to the achievement of specific viewpoints, for example, quality, generation, work satisfaction and security (Paşaoğlu, 2015). In overall, showing management commitment through its substantive activities enhances worker commitment and responsibility (Niehoff et al., 1990; Pinion et al., 2017). Similarly, frontline respondents expressed that they weigh the importance of safety concern from substantive action of management. Visible efforts from management exhibit deeper values and shared understanding held by management (Geldart et al., 2010; Fernández-Muñiz et al., 2007; Michael et al., 2005). Hadikusumo et al. (2017) said that "it could be addressed that the construction projects where managements exhibit and implements a higher standard of commitment to occupational safety are most likely to lower occurrences of at-risk behaviours and improved safety work behaviours". Based on the result which showed five of six key implications of management commitments, excluding the practices of resource allocations, have moderate correlation coefficients with at-risk work behaviours. Specifically, significant discoveries found that management commitment has been displayed to decidedly influence the work behaviours of climate safety individuals, with noteworthy illustrations starting from the occupational safety profession (Hadikusumo et al., 2017; Jitwasinkul and Hadikusumo, 2011).

5.3 Safety management system (SMS)

Safety management system (SMS) is identified as one main dimension of a 'positive safety climate', along with the other two aspects, i.e., management commitment and employee involvement, comprising management policies, programs and practices (Fernández-Muñiz et al., 2007). Flin et al. (2000) and Scharrer (2015) find that a factor relevant with 'safety system' appears in about two thirds of the safety climate studies. To a larger extent, SMS can influence and is influenced by the safety culture of the organisation. According to Liu et al. (2016), the management system can promote and support a strong safety culture by: (i) ensuring a common understanding of the key aspects of safety culture within the organisation; (ii) providing the means by which the organisation supports individuals and teams to carry out their tasks safely and successfully, taking into account the interaction between individuals, technology and the organisation; (iii) reinforcing a learning and questioning attitude at all levels of the organisation; and (iv) providing the means by which the organisation continually seeks to develop and improve its safety culture. The employees' experience of the SMS, including but not limited to safety training, safety rules/instructions/procedures, provision and maintenance of safety equipment, accident report, and safety representatives and committees, has observable impact on the safety climate (Clarke and Cooper, 2004), and several studies regard SMS as a precursor of employees' safety climate (Dejoy et al., 2004, Zhou et al., 2008; Machfudiyanto et al., 2017).

5.4 Employees' involvement

Employees' involvement is an oriented behaviour within the organisational communication flow and decision-making process which includes both the individual and the group participation. The involvement of employees can be classified from zero participation where the manager dominates all decision at workplace, to full participation, when all employees are concerned or influenced by any decision taken. The matter of fact that the employees at workplace can advise suggestions for improvement which may enhance the taken decision quality (Vredenburgh, 2002; Vinodkumar and Bhasi, 2010). This strengthening of specialists gives them expert, obligation and responsibility for required choices and guarantees that the two workers and administrations are associated with defining objectives and goals (Cohen and Cleveland, 1983; Zhou et al., 2008). It incites representatives to do their best work in shape of individuals or group, while easing the director to lead, plan and tutor. Many authors have addressed the positive influence of employees' involvement with safety performance and behaviour (Guo et al., 2016; Lee, 1998; Rundmo, 1994; Zhou et al., 2008; Cox and Cheyne, 2000; Crutchfield and Roughton, 2014). Thus, employees' involvement is considered as an important factor for safety climate as it relies on the workers' perception at the workplace. This contribution will help for safety specialists related the decision and also by distinguishing safety issues and providing the best protective and effective safety system.

6 Overall discussion

In overall, the impact of safety climate factors on safety behaviour has been examined but these studies have not concluded the key factors as this last has changed from one study to another. Therefore, this current research is contributing to determine the key factors which can influence on safety behaviour at different dimensions. Many authors (Li et al., 2017; Shen et al., 2015; Dedobbeleer and Béland, 1991, Guo et al., 2016; Zhou et al., 2008; Mohammadfam et al., 2017) indicate the importance to consider the impact of safety climate variables could be executed as multi-level mechanism. Hence, with different perspective and underlying theories, all models are often broken down into three fundamental dimensions (organisational, workgroup and individual levels) by the majority of the researchers' investigations. After performing the systematic analysis approach, 23 safety climate factors were deduced concerning their influence on the safety behaviour. Based on the influence of contributory factors in previous studies, all concluded 23 factors were categorised into three different dimensions where the first level which has an enormous influence on safety behaviour is considered the key safety climate factors as follows: safety attitude, management commitment, safety management system and employees' involvement. Furthermore, the second dimension of these factors that has a mediocre influence on safety behaviour includes seven factors which are: employees' safety participation, production pressure, work pressure, safety supervision, workmate's influences, perception of safety regulation, and safety engagement. At the end, as shown in Figure 6 the third dimension incorporates 12 factors which they have a low evidence of influence on the safety behaviour namely: responsibility for health and safety, competence, supporting environment, risk taking behaviours, safety resources, social support, interaction, social challenges, role overload,

performance pressure, safety reporting, and team collaboration. It can be set up that safe work behaviours have a significant association with four contributing factors at the top dimensions in regards of their positive impact, the significant correlation found by building models interpreting their effective impact to improve the safety performance in construction industry. They can portray inspirational impacts and supports inside and among workgroups and people as long as these key factors are defined at top of dimension.

The workgroup dimension particularly influences and impacts on the individual qualities and attitude related to the safety at workplace (Kines et al., 2010; Törner and Pousette, 2009). Thus, quantified casual model can be built based on the results of the current study using the key factors. Quantitative approaches can determine divergence in the impacts of causal relationship among safety climate factors. This quantification modelling can be done through inferential statistics such as structural equation modelling or by using Bayesian belief network (probabilistic model). For instance, structural equation modelling basically identifies regression for every factor as dependent variable against other variables based what the model points out to be major causes in any study. Overall, this operation is assessed by comparing the suggested hypothetical model via correlation matrix of variables gotten from observed results. Hence, it can be concluded that selecting the approach is related to the availability of data. The researchers also can perform the analysis and quantify the impacts of contributing key variables on safety behaviour at workplace by either stochastic or deterministic approaches.

As outcomes of building the model, different dimensions of the safety climate factors' impacts will be considered when taking into account the safety interventions to promote for safety behaviour and to eliminate or minimise the risk-work behaviour. The results promote the consideration of certain implications related to the contributing key safety climate factors which can allow the safety professionals and managers to create strategies and guidelines to improve safety behaviour at workplace.

7 Conclusion

Fatal accidents and injuries consistently occur in the construction industry, despite the technology nowadays found in the construction sector. The recent researches embarked to think differently how to tackle the risk in construction industry by putting the focus on the human behaviour as most of current findings proved the significance of safety behaviour at workplace in construction industry. This paper elaborated this notion by investigating the key influential safety climate factors towards the safety behaviour. This study determined 23 overarching factors which have an influence on safety behaviour. All 23 factors were categorised into three different dimensions, based on the impact of contributory factors in previous studies; where the first level which has an enormous influence on safety behaviour is considered the key safety climate factors as follows: safety attitude, management commitment, safety management system and employees' involvement. Moreover, the second dimension of these factors that has a mediocre influence on safety behaviour includes seven factors. The third dimension incorporates 12 factors which have a low evidence of influence on the safety behaviour. This paper promotes a nuanced understanding for the safety managers and experts in regards of the different influential dimensions of safety climate factors on safety behaviour. The new notion will guide them in ways to better target their

interventions and build efficient and effective safety regulation in this context. This paper provides a new approach to examine the influential safety climate factors via safety behaviour in construction industry. At the end, the results of this paper will aid the safety management area by encouraging the researchers to conduct more research on human factors and extend the empirical validation for the key influential factors. Another contribution also can be set up by proposing specific measures concerning the different dimension of safety climate factors that impact on safety behaviour.

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