Exploring Safety Climate Factors in Construction

Abstract: This paper aims to explore and to make explicit of the existing safety climate assessment tools and dimensions. The concept of safety climate is firstly discussed with a review of different safety climate factors from the published literature. A qualitative research method was employed to explore the safety climate factors through a systematic review using four databases and specific keywords. A total of 68 papers were selected for the screening process. The screening process allowed to select the final 18 safety climate assessment tools and papers consisting of 98 safety climate factors spanning over a period of 39 years (1980 – 2019). Construction organizations may consider these factors to assess the current maturity level of their safety climate and to develop plans to achieve the required level. It is recommended that the factors discussed in this paper may be validated first before they are incorporated in the assessment of safety climate.

Keywords: Health & Safety, Management, Safety & hazards, Safety Climate, Assessment, Construction Industry, Safety in Construction, Safety Climate Factors.

1. Introduction:

Occupational and safety-related expenditure results in a huge cost and considered as an additional burden on the economy of the countries. A press release of the International Labour Organization shows an estimate of occupational safety and health-related issue cost an annual amount of 4% to the world gross domestic product (ILO, 2013). For the year 2018, the world gross domestic product was estimated at the US $ 87.51 trillion, thus the cost of occupational safety and health-related factors for the same year can be around US $ 3.5 trillion. It is difficult to gauge the cost of accidents involving injuries and deaths resulting from poor occupational safety and health condition as these have multiple implications. Umar and Egbu (2018-a) while discussing the root causes of accidents noted that there are five main stakeholders associated with accidents at the workplace. These stakeholders include the affected workers itself, the family and friends of those workers, the co-workers, the employer, and society. All these stakeholders have to bear the costs of poor occupational safety and health conditions for a long period of life. Many researchers have conducted their research around the causes of accidents,

thus the causes of accidents in different industries are well known and preventable in most cases (Umar and Egbu, 2018-b). Different studies have shown that the cost of an accident could more than the cost of prevention; however many organizations don't have such awareness thus they remain reluctant to spend on the problems such as accidents which don't arise more frequently (Umar et al, 2018-a). Similarly, safety and health-related factors don't get priority in many organizations and get the least attention from managers as reported by Umar and Wamuziri (2016). The model for improving the safety performance of construction organizations in Oman presented by Umar and Wamuziri (2016) also stress on the awareness of the benefits of improved safety performance. Similarly, health factors such as body mass index, blood pressure, and heart rate are also considered important in relation to the safety and productivity of workers (Umar et al., 2018-b).

The construction industry is growing rapidly in all countries and recognized as the main source for providing jobs to different workers globally. It is expected that the global construction industry will reach to 14 trillion US$ in 2025 which was 9.5 trillion US$ in 2014, reflecting an overall growth of 67% as shown in figure 1(Statista, 2017). In the Gulf Cooperation Council (GCC) member countries, the economy is heavily reliant on oil and gas export and contributes up to 50% of the total gross domestic product (GDP) (Umar and Wamuziri, 2017). In recent years, the dip in oil and gas prices somehow has affected the GCC construction industry as well (Umar and Egbu, 2018). A comparison of the contract awarded in the GCC countries, in the first quarter of 2017 and 2018, therefore, shows an overall decline of US $ 5.0 Billion (Ventures, 2018). The construction contract awarded in the first three months of 2017 and 2018, in GCC countries is shown in figure 2. While there is an impact on the construction industry due to the overall economic situation, different studies have shown that the construction industry will be growing in the near future. Umar et al. (2018-a), while discussing the occupational safety and health regulations in Oman, reported that the value of the construction industry in Oman will grow to 6.88 Billion Omani Rial by 2026, which was 2.26 Billion Omani Rial in 2016. Moreover, the construction GDP in Oman is forecast to grow to 15.4% of the total GDP by 2026. Overall, they reported that the construction growth rate is forecasted to be at peak in 2020 (figure 3).

Figure 1: Global Construction Industry Growth (Statista, 2017).

Figure 2: Comparison of Awarded Construction Contracts In GCC (Ventures, 2018).

Figure 3: Oman Infrastructure and Construction Industry Forecasts (2016-2026).

With all this growth and improvement in the construction industry, it is also regarded as the second most hazardous industry after manufacturing. If it is considered that the occupational safety and health-related costs will be 4% of the total costs of the construction projects in 2018, the total costs of occupational safety and health will thus be equal to US $ 0.456 trillion. Similarly, Umar (2016) reported the cost of accidents in Omani construction industry considering two criteria using the available data which includes the number of workers in the construction industry and the value of construction projects in a financial year. He concluded that the compensation costs of accidents are to be 3.74 million/year based on the number of workers in the construction industry. The reported costs of accidents based on the value of construction projects were estimated at US$ 3.237 billion. The International Labour Organization data for the year 2015 indicate that every year 108,000 workers died on construction site due to different occupational safety and health conditions. In the developing world, There are higher risks (3~6 times more) of death linked with construction work in developing countries (ILO, 2015). Although there is no organization in Oman which collect and analyze construction accidents, different studies have shown that these accidents result into a huge cost to Omani economy (Umar and Wamuziri, 2016). For instance Umar et al. (2018) while considering the occupational safety and health regulations in Oman reported that the accidents related expenditures in Oman rose from 1 Million OMR (=2.6 Million US$) in 2012 to 2.9 Million OMR (=7.53 Million US$) in 2016, reflecting an increase of 1.9 Million OMR in five years or 0.38 Million OMR in one year. Similarly, Umar and Egbu (2018-a), while evaluating the main causes of accidents in construction in Oman, reported a total of 623 different types of accidents that took place in only one project as shown in table 1. This project estimated budget was US $ 305.90 Million and there many similar projects in execution stage that time, however, the authors were not able to obtain the accidents data in these projects due to several reasons. First of all, there is no organization in Oman which aimed to collect and analyzed the construction accidents in Oman on regular basis, and secondly, construction organizations reluctant to the public their record of accidents as they feel this may affect their organization reputation. Similarly, another research

study which aimed to investigate the causes of the delay in construction projects in Oman reported the accidents at the site as one of the main causes of delay in construction projects (Umar, 2018).

Table 1: Different Types of Accidents in a Construction Project in Oman

Considering all these challenges associated with safety and health in the construction industry, many researchers have proposed solutions on how to overcome them by improving the safety and wellbeing of the peoples working in this industry. These solutions cover the incorporation of safety in all stages of a construction project from design until the demolition of the project. A study conducted by Bong et al., (2015) investigated the role designer in workplace health and safety in the construction industry of South Africa and concluded that Designers are aware of the hazards on sites and design firms are willing to embrace the guidelines if they are protected from liability. Umar (2016-b) while defining the safety leadership in construction stressed on the key attributes of safety leadership and noted that without a clear definition towards safety leadership, a misalignment between safety expectations may occur which can create a misappropriation towards safety efforts. In the last two decades, the appreciation and importance of administrative, managerial and social factors for an improved safety performance has significantly increased. The focus on the safety culture and safety climate has been expanded. This article presents the research of using safety climate approach to improve safety performance in construction organizations. There have been a number of safety climate tools developed by many researcher and organizations which have been used in different industries. The varieties of the existing safety climate tools and factors could cause confusion among the decision-makers when they wish to use a specific tool or factor. The level of such confusion could be greater in the construction industry as most of the existing tools have been developed focusing on other industries such as manufacturing. This research, therefore, aims to review the existing safety climate factors used in different safety tools since 1980 and identify the most prevailing factors that can be used in the construction industry of Oman. The safety climate factors identified in this research will help to decision-makers especially those from the construction industry, to choose the most appropriate safety climate factors for the assessment of the safety climate of their organization or project. The terms of safety culture and safety climate are first discussed in the next section. The safety climate tools developed by different researchers and organizations in

the past 38 years (1980-2019) have been identified using an internet search considering the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram described by Moher et al., (2009). This model required a transparent step by step approach to be adopted in the qualitative or quantitative analysis. These steps include identification, screening, eligibility and final inclusion of the studies considered in the analysis. The safety climate factors used in these tools are discussed in the later section with a specific reference to the construction industry. Finally a framework is proposed to use these factors in a safety climate assessment tool.

2. Safety Climate and Safety Culture:

The focus on elements which impact safety and safety improvements within organizations has been significantly shifted in the last century. Scientists and experts have established the safety culture and safety climate as fundamental elements in curtailing injuries, illnesses, and deaths at the workstation. Safety climate may be classified as a subgroup of organizational climate which provides a direction to safety management, complementing the frequent predominant engineering path. An understanding of the safety climate elements can be helpful in improving the safety performance of a construction organization. Additionally, safety climate findings are regarded to be more precise (e.g. multi-sliced) and provide pro-active ground for improving safety, rather than reactive (after the fact) in which data from accident numbers and accident and incident investigations are used (Seo et al., 2004). Hale and Hovden (1998) define three periods of safety which includes the technical period (the 1920's), the human factor period (1970's) and the management system period (1980's). The third period of safety spread-out the attention to include safety culture and safety climate. The approach of safety culture was accurately presented and delineated after the Chernobyl accident which took placed in 1986 (INSAG, 1992). Thus, enthusiasm in the approach of safety culture has been significantly increased as safety researchers and practitioners have solicited to characterize and operationalize this approach (Clarke, 2000). One of the reasons for this is that rich safety culture and a mature safety climate are considered among the most important elements in attaining a safe workplace (Bergh et al., 2013; Umar et al., 2019). To enhance the level of safety culture and safety climate, it is crucial to, first gauge the existing level of safety culture and safety climate, then agree what level of safety culture and safety climate is required, obtainable and desired, and then to make strategies to accomplish the safety culture and safety climate, which is desired (AIChE, 2012).

158 The safety climate can be defined as common understandings between the employees of a social
159 unit, of policies, procedures, and practices connected to safety in a business ((Kines, et al., 2011).
160 The Centre for Construction Research and Training (CPWR) defined safety climate as
161 workgroup members' common thoughts of management and workgroup safety-related policies,
162 procedures and practices (CPWR, 2014). Many construction organizations are trying to enhance
163 their safety climate dimensions as a way to step closer to the target of obtaining zero accidents at
164 workplaces (CPWR, 2014). Similarly, Zohar (1980) described the safety climate as a view of
165 workers' understandings about the respective significance of safer acts in their work-related
166 behaviour. There are several definitions of safety culture endorsed by many researchers;
167 however, the Cox and Cox (1991) definition appear to be more concise and simple. They
168 described safety culture, as the attitudes, beliefs, understandings, and values that employees
169 contribute in connection to safety. Scientists and experts have established safety culture and
170 safety climate as fundamental elements in curtailing injuries, illnesses, and deaths at
171 workstations. A recent study conducted by Chan et al. (2017-a) considering the Hong Kong
172 construction industry with increasing number ethnic minorities workers, concluded that the
173 safety climate is significantly associated with the degree of safety participation and safety
174 compliance. Similarly, Umar et al. (2017-b) in their research on the factors that influence safety
175 climate in construction concluded that it is important to involve all the team members of
176 construction project including the managers, engineers, supervisors, and workers to ascertain the
177 factors that may have a high influence on safety climate in a local context. A study on safety
178 climate which targets only a specific occupational group in construction will, therefore, represent
179 only the view of that particular group and thus cannot be considered as a view of the whole
180 construction team. Any safety climate assessment tool developed on such studies will provide
181 misleading results and will mislead the decision-makers. The process of using safety climate
182 assessment tool to improve safety performance in construction organizations as described by
183 Umar and Wamuziri (2017) is shown in figure 1. The concept of using safety climate approach
184 in Gulf Cooperation Council (GCC) member countries was first truly discussed by Umar and
185 Wamuziri (2017). Umar and Egbu (2018) reported different safety climate factors relevant to the
186 construction industry in Oman. The main drawback of this study was that the data was only
187 collected from a small number of respondents using a semi-structured interview approach. The
188 only justification for using this approach of research with a limited number of respondents
189 mentioned by the authors was the nature of study which they claimed as an exploratory. The next

section describes the method adopted to identify the main safety climate assessment tools developed in the past 39 years spanning from 1980 -2019. In the later section, the safety climate factors or dimensions used in these tools are discussed.

Figure 4. Process of Using Safety Climate to Improve Safety Performance (Umar and Wamuziri, 2017).

3. Research Methodology:

The research methods in social science are commonly classified as quantitative or qualitative. Quantitative research stresses quantification in data collection and examination. It takes a deducible way to the connection among theory and research and stress are kept on the confirmation of theories. Quantitative research method integrates the norms and practices of the natural scientific model and positivism. It views the social phenomenon as an outer objective truth (Cooper et al., 2006). On the other side, a qualitative research approach stresses on words and contexts despite quantification in data collection (Opdenakker, 2006). It stresses an introductory approach in the relationship between theory and research and focus is settled on the formation of theories. Majority of the researchers prefer to incorporate both qualitative and qualitative methods, referred to as a combined research method and highly appreciated in the literature due to certain advantages (Umar and Egbu, 2018). The research, however, presented in this paper is somehow exploratory in nature; therefore a qualitative method with limited use of the quantitative method was considered to be a more suitable method for data collection. The process of the research adopted here was guided by Bryman (2016) as shown in figure 5.

Figure 5. Process of Qualitative Research

Bryman (2012) while describing the different research methods related to the qualitative research outlined one of the methods as the collection of qualitative analysis of texts and documents. He further explained that websites and webpages can be the potential and reliable sources for both quantitative and qualitative research methods. The main research question for this research was the simple one “what is the most common safety climate factors used in safety climate assessment tools”. To collect the relevant data, four main databased were searched for the relevant papers. Since it was revealed from the literature review that in the last 40 years, the

topic of safety climate and safety climate assessment tools have therefore attracted the attention of researchers in construction management. Clearly, a huge work in the area of safety climate was carried out since 1980, which was defined as a management system period by Hale and Hovden (1998). This was the period of safety which results in the inclusion of safety culture to the safety management system. The approach of safety culture was accurately presented and delineated after the Chernobyl accident which took placed in 1986 (INSAG, 1992). Thus for search criteria, the period of 1980-2019, spanning over a period of 39 years was selected. Two terms "safety climate assessment tools" and "safety climate factors" were used for the search purpose. For screening purpose, only the safety climates factors and tools which were used in construction, utilities and oil, and gas sectors were selected. To ensure that a systematic review process is adopted in this study, the research method for the review was guided by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The PRIMA guidelines required to follow a four steps process to include the final of studies in the systematic review and meta-analysis. These steps include the Identification, Screening, Eligibility, and Inclusion of the existing studies.

4. Results and Discussion:

A total of 68 papers and reports using specified keywords were selected for download from the databases. 18 safety climate assessment tools and papers were able to pass the screening criteria as shown in table 2. Briefly, the number of assessment tools and papers found through this databases search was one in each year of 1980, 1991, 1997, 2000, 2004, 2005, 2006 and 2010. There were two safety climate assessment tools and papers in 2008, three assessment tools found in 2011. One relevant paper was found in 2016, three in 2017 and one in 2018. The numbers of leading safety climate factors used in these assessment tools stood at 98. The result shows that in the first 19 years from 1980 to 1999 only three (17%) safety climate assessment tools were developed. In the next phase of 17 years from 2000 to 2018, the number of safety climate assessment tools was 15 (83%). There were two safety climate assessment tools (11%) which were not divided into factors or dimensions, while the remaining safety climate tools (89%) were divided into factors or dimensions, ranging from 2 to 8 factors in each tool. The most common and top-ranked factors used in these tools were;

a) Management or Organizational Commitment towards Safety

b) Safety Training

c) Employees Involvement in Safety

d) Workers Safety Behavior

e) Safety Communication

f) Safety Accountability and Justice

g) Supervisory Leadership

Table 2: Details of Safety Climate Assessment Tools Factors

In the next section, these leading safety climate factors are discussed in details.

4.1. Management or Organizational Commitment towards Safety:

One of the most common factors used in the identified safety climate tools can be referred to as management or organizational commitment towards safety. The first safety climate assessment tools designed by Zohar in 1980 was consist of 40 items covering eight different safety climate dimensions or factors and the first one was management attitude toward safety (Zohar, 1980). Management or organizational commitment toward safety can be displayed in a variety of ways. The literature review around management commitment suggests that in organizations where the number of accidents was low, top managers of that organizations were found to be involved personally in all safety-related issues on a routine basis (Cohen et al. 1975; Zohar, 1980). On the other hand, a similar commitment was not evident in organizations with a high rate of accidents (Shafai-Sahrai, 1971; Cleveland et al. 1978; Zohar, 1980). In commercial organizations, the business priorities are informed through the top managers of that organization. Thus directly or indirectly these mangers are the main source of information related to the priorities and goals of such organizations (Kines et al. 2011). They further while quoting the organizational climate theories, noted that the worker's safety behavior is based on the organization rules, policies, procedures, and practices. If in these rules, policies, procedures, and practices safety gets priority, it will be reflected through workers safe acts. Similarly, if safety remains one of the organizational priorities, it will be informed through the top managers of organizations which could be helpful in promoting a safe working environment. The results of this research show that "management commitment" is one of the main factors used in nine (70%) different safety climate assessment tools. Overall, the discussion suggests that organizational or management

commitment has a major impact to promote safety culture in the organizations, thus need to be considered as part of the safety climate assessment tool.

4.2. Safety Training:

Zohar (1980) while discussing and comparing the organizations with high of accidents and low rates of accidents found that emphasize on safety training was the second factors which differentiate these organizations. Similarly, in mature organizations safety training for new workers was found to be an integral part of their orientation. In such organizations, follow up and periodic training of workers was carried out on a routine basis in these organizations (NSC, 1969; Cohen et al., 1975). In a review of different safety climate tools conducted by Flin et al. (2000), observed that necessary safety training for workers was one of the main factors used in these tools. A research study carried out by Zahoor et al. (2016) related to occupational safety and health performance in the Pakistani construction industry, concluded that safety training was on the top of the most neglected factors. They further concluded that construction organizations which don't address the training issue could face a higher injuries rate in their organizations. In construction projects, workers are expected to works with different machines and equipment during the execution cycle of the project. This it is important that such workers should have enough knowledge of the operation of the equipment. Umar and Egbu (2018a) while finding the root causes of accidents in construction projects analyzed a total of 623 accidents in a highway project and noted that 14% of total accidents were caused machines and equipment. Such accidents can only be reduced when workers have appropriate training which incorporates both operational and safety components of machines. The finding of the research conducted by Neal et al. (2000) emphasizes that apart from specific safety training (work-related), a training which highlights the importance of safety has a greater effect to enhance the overall organizational climate. This fact was well established in a workshop organized by the Center to Protect Workers' Rights (CPWR) and The National Institute for Occupational Safety and Health (NIOSH) in the United States in June 2013. The aim of this workshop was to improve the understanding of the safety climate in construction (CPWR (2017). A total of 72 nominated construction stakeholders representing the broad of the industry participated in this workshop including, 25% representation from contracting organizations, 12% from employer associations, 14% from workers associations, 40% from researchers and academics, 6% from consulting organizations (6%), and 4% from insurance companies. The participants concluded that safety

315 training is one of the main factors of safety climate and needs to use in the assessment tools. In
316 general, the observation leads to the conclusion that the safety climate of a construction
317 organization or a construction project could not be completely measured without considering the
318 factor of safety training.
319
320 **4.3. Employees Involvement in Safety:**
321 Employee's safety involvement refers to the activities undertaken by workers at the workplace
322 which includes the assistance of colleagues, encouraging safety compliance at the workstation,
323 demonstration of safety initiatives and attempt to enhance the safety performance at the
324 workstation. The employee's perceptions related to safety risk and control can be directly linked
325 to their participation and responsibility for safety. It has been evident by Walter and Haines
326 (1988) that employees mostly give importance to discrete responsibility when it comes to work
327 with associated safety and health matters. This finding further appears to be consistence with the
328 finding of Frenkel et al. (1980) and Nelkin and Brown (1984). They noted that employees
329 depend on their personal efforts to manage the occupational safety or health-related issue to work
330 station despite to ask the help or assistance from management or other sources. This is however
331 not the case in construction workers. The study conducted by Dedobbeleer and Beland (1991) on
332 the measurement of safety climate at construction projects observed that construction workers
333 consider safety as a nexus between the workers and organizational management. The safety
334 climate factors suggested by the above two authors, therefore, have only two factors i.e. (i)
335 organizational commitment towards safety and (ii) employees participation. Since the knowledge
336 and understanding of safety climate have widely expanded, therefore considering only
337 management commitment and worker involvement in a safety climate assessment tool may not
338 serve the purpose. The limited number factor in this tool was, therefore, one the main drawbacks,
339 but this doesn't warrant on the credibility of these factors. Participation of workers in safety was
340 one of the factors in the safety climate tool developed by the Health and Safety Executive in the
341 UK (HSE, 1997). Workers participation in safety were further regarded as an important factor in
342 most of the safety climate assessment tools. For instance, the safety climate tool developed by
343 Seo et al. (2004) considered the worker's participation important not only in the safety-related
344 matters but also in the decision associated with safety. This factor was continuously considered
345 and placed in the safety climate assessment tools developed in later years (Pousette et al. 2008;
346 CISCIS, 2008; CPWR, 2017).

4.4. Workers Safety Behavior:

The current literature around safety and health-related issue suggest that personal factors including noncompliance with safety guideline either by an error or mistake could result into accidents at the workplace (Neal et al. 2000; DeArmond et al. 2011; Umar and Egbu, 2018-a). An important factor to understand that why occupational accidents take place at the workstation is to see the contribution of workplace behavior jointly developed by the group of workers in that place. Fung et al. (2016) in their research on safety awareness of construction workers explored the external factors with the psychological climate that the workers possess on their safety awareness. The model proposed by Umar and Egbu (2018-a) to trace the causes of accidents involves a variety of factors associated directly with workers behavior. When this model was applied to a highway project to access the causes of accidents in that project, it was revealed that 41% of the accidents on that project were due to those factors directly linked with the workers. Simulation-Based research conducted by Nasirzadeh et al. (2017) observed that unsafe behavior of different agents is varied throughout the project duration due to the interactions with other agents as well as the safety-related regulations that exist in the site. Campbell et al. (1993) viewed the worker's individual factors such as adherence and compliance of safety procedure, important in safety performance, but these factors are highly influenced by workers knowledge, skill, and ambition. Earlier the model for safety performance proposed by Neal and Griffin (1997) had two factors for safety performance i.e. compliance and participation of workers. The results of a research conducted by Clarke (2006) using the meta-analysis technique, suggested that there is a difference between safety compliance and safety performance. The safety compliance can be referred to the adherence of organizational safety guidance and performing the work-related task in a safe way. DeArmond et al. (2011) reported that safety behavior may not only contribute to safety performance directly, but it is very helpful to promote a safe working environment when workers participate in meeting and training related to safety.

Recent research exploring the safe behavior concluded that safety attitude, safety knowledge, and supporting workplace are the main indicators of safety behavior. The improvement in safety attitude and safety knowledge may result in the highest feasible proportion of safety behavior among the workers (Mohammadfam et al., 2017). A recent study conducted by Chan et al. (2017-b) suggests that there is growing evidence that reflects that a large number of ethnic minorities are employed in the construction industry in many countries to meet the labor

shortage. The study also suggests that these workers have high fatal and non-fatal injuries rate as compared to local workers. A similar situation of construction workers was also reported by Lyu et al. (2018). Both the studies further reveal that perceptions on safety climate of such workers from ethnic minorities' are significantly varied by nationality, marital status, family members support, and drinking habit. Majority of the workers in GCC countries are from overseas, thus their behavior and safety climate perceptions could be highly affected by the factors such as nationality, marital status, family members support, and drinking habit. The review of safety climate assessment tools reported in table 2, shows that safety behavior directly or indirectly as part of the majority (64%) of the tools. The worker's safety behavior appears to be an important factor of the safety climate assessment tools, thus need to be considered part of the safety climate in construction.

4.5. Safety Communication:

Generally, frequent communication and interaction with colleagues are mandatory channels to develop or improve social setup including organizational climate. The existing literature suggests that most of the researchers considered communication as a factor which constitutes the organizational climate. For instance, James and James (1989) viewed that organizational climate can be assessed considering the factors related to the individual and or workplace. Similarly, Siew (2015) considered Poor communication on safety and health-related issues as a major cause of incidents/accidents and recognized it as a key challenge to construction practitioners. The general organization's climate can be measured by considering the working environment which may include factors such as leadership, role, and communication (James and McIntyre, 1996). There have been a number of studies which concludes that effective safety communication is one of the safety climate factors which can be used to predict the safety performance of a specific organization (Zohar, 1980; Zohar and Luria, 2005; Pousette et al., 2008; Kines et al., 2011). When the organization encourages open communication on the safety-related issue, it spread a strong message on how safety is given values in that organization (Hofmann and Stetzer, 1998). Safety communication is therefore not only to be regarded for sharing information, but it is a channel to share ideas and views to help others to learn new things and to incorporate the innovative thought in the existing procedures. Jeffcott et al. (2006) emphasized the learning process to develop a safety culture. They suggested that the collection, analysis, and sharing of relevant data is very important to develop such a culture, where the workers don’t hesitate to

report their mistake or error. Workers normally share their mistake or error when they have full trust on the management, thus open and rich communication becomes a more important factor in organizational safety climate not only for safety performance but also to maintain the trust of their workers (Kines et al., 2011). Safety communication, therefore, should be effective and should be multiway, from management to employees, from employees to the management and among the employees. Similarly, Hale (2000) also emphasized the need for open communication in organizations to improve their safety performance. One of the other aspects of safety communication which is related is the language barrier, is more important in the Omani construction industry due to its diversity. For instance, the Omani construction industry is heavily populated (92%) by foreigner workers (Umar and Egbu, 2018-b). These workers belong to different Asian and African countries. These workers have a low educational level and can only speak and understand their native languages. This situation results in similar communication barriers outlined by Gittleman et al. (2010). Construction organizations in Oman, therefore, will have to assess the level of communication barriers first before they can further improve the safety communication in their organizations. This discussion further leads the authors that safety communication is one of the important dimension of the safety climate and need to be considered in such an assessment.

4.6. Safety Accountability and Justice:

It is considered as an important factor that organizations should maintain a fair and just system to deal with the safety-related issues and to ensure that their employees feel no fear to report the errors and mistakes. Reason (1997) while discussing the safety culture, argued that in a mature safe working environment, the workers should be convinced to report the error to their supervisors. Similarly, it is very important the error and mistake either results into an accident or not needs to be dealt properly and the responsibility of such situation should be fixed carefully as the blame can result into an obstacle in learning (Jeffcott et al. 2006). Similarly, the employees who act unsafely knowing well that his act is unsafe and the employees who act unsafely by mistake should not be considered for the same punishments (Weiner et al. 2008). This can be however challenging to differentiate among such unsafe acts. A just working environment, therefore, needs to base on the trust, but there has to be a clear line between an acceptable and non-acceptable behavior. Organ (1997) defined the organizational citizenship behavior as a volunteer behavior which is very difficult to be recognized by organizations reward procedures,

however, such behavior promotes the effective functioning of organizations. He further stated that the workers, who take actively the safety responsibility of their's-selves and others and participate in safety-related activities, display the organizational citizenship behavior. Kines et al. (2011) argued that workers safety behavior and safety responsibility are positively influenced by the organization rules and procedure which are applicable to the safety matters. In other words, an effective just system for dealing accidents and unsafe act in an organization will promote safe behavior in workers and will encourage them to accept the responsibility of safety. Recently, Umar and Wamuziri (2017) in their research on the improvement of safety performance using safety climate factors discussed safety justice as an integral factor of constructions' safety climate. They further considered that safety managers in construction organizations need to be accountable for safety expectation through their annual appraisal and performance evaluation. Such factors need to be considered further in their promotion to a higher position, pay rising or renewal of the contract. Overall, the organizations need to provide a fair system which should reflect the accountability and justice for safety. The investigations of the root causes of accidents are compulsory to ensure blame-free accountability. Similarly, the workers need to be rewarded for the exceptional safe act to promote safety and to display a fair system. The review of the safety climate assessment tools discussed in this research reveals that safety accountability and safety justice were among the most common factors considered by several authors in their safety climate assessment tools, which trigger out that such factors need to be considered in the assessment of safety climate of construction organizations or construction projects.

4.7. Supervisory Leadership:

The finding of the research conducted by the Seo et al, (2004) shows that commitment form management or organization towards safety and support associated with safety from site supervisor are the two main factors used more frequently in the safety climate tools. The role of safety leadership was considered important in the safety performance of the workers by Hofmann and Morgeson (2004). The existing literature on safety climate and safety culture reflects that many researchers reference leadership directly as a key for improved safety. Hofmann and Morgeson (2004) concluded that the leadership is further directly linked with other positives results in organization performance; for instance, it can improve and display an effective managerial commitment, production and can reduce absenteeism of workers. In reality, organization leaders have the responsibility to develop a mature culture within the organization

that is effective to deliver a safe working environment. Many researchers stressed that supervisors and managers have the initial responsibility to reflect their commitment to safety and such commitment needs to be clearly seen by the workers. For instance, the supervisors and managers are required to take quick actions on the matters arise from the accident reports as it is helpful in the development of workers trust on the management (Mayer et al. 1995; Burns et al. 2006). The literature review suggests that employees trust in management or organization play a significant role in developing a safety culture. The results of research conducted by Cox et al. (2006) shows that the worker's distrust in management has a negative effect on the effectiveness of the safety culture. Trust in management or organization was viewed so important factor of by Kines et al. (2011) that they recommend it to be used in safety climate assessment tool. The review of the safety climate tools presented in this research shows safety leadership was regarded as an important factor and was used directly or indirectly in these tools. For instance, the safety climate tools developed by Seo et al. (2004) and Center for Protection of Worker's Right (SPWR, 2017) used the supervisory leadership as a main or direct factor in their tools, similarly the tools developed by Kines et al. (2011) used it indirectly by merging it with the trust in management factor. Generally, supervisory leadership is to be expected to have safety leadership abilities. Similarly, safety leadership in construction is considered as an integral element of supervisory leadership that includes discipline, engagement, values, demonstration, vision, and promotion. The research conducted by Umar and Egbu (2018) on safety climate factors in Oman considered the site supervisor role to be an integral part of the safety climate assessment tools. Overall, the above discussion concludes that organization performance is highly linked to supervisory or managerial leadership. The case with safety performance is the same as it is considered to be highly influenced by the supervisors or managers roles and leadership abilities.

5. Framework for Using Safety Climate Approach:

To use the safety climate to improve the safety performance of construction organization, management of the organizations need to find what elements are significant to each safety climate factor discussed in the above section. To know this, they will need to develop a set of statements to support each factor and then validate these elements through a survey among the organization staff. The elements which are statistically significant should be used to develop a safety climate assessment tool. Each safety climate factors may have at least 10 elements. Such safety climate tool is then to be used to collect the data from different groups of workers. Each

element of a safety climate factor may be scored on a Likert scale of 1-5 (1 = strongly disagree, 5 = strongly agree). Construction organizations who wish to use this safety climate approach for the assessment of their organization or project safety climate will have to finally calculate the mean value of each safety climate factor using the collected data. These mean values can be presented on a radar chart to effectively display the area where the organization needs to focus. Based on the mean values of each safety climate factor, the maturity level will be determined. Similarly, based on the maturity level; the type of plan to achieve the required level of maturity will be established. As a guideline, if the mean score of a safety climate factor is ≤ 4, a short term plan (6 months) is appropriate to enhance the maturity level further. Similarly, if the mean score of a safety climate factor is ≤ 3, then a medium-term plan (6 – 12 months) is appropriate. Long term plan (12 – 24 months) is appropriate if the mean score of a safety climate factor is ≤ 2.

Figure 6 shows the results of the safety climate assessment (example) presented on a radar chart. The respondents in this assessment were, let say the site supervisors. The figure clearly shows that the organization needs to first focus on the "Management Commitment" as it has a mean score of just 2.1. Since the mean score of this factor is less than 3, therefore the organization will need to develop a medium-term plan (6 – 12 months) to improve the maturity of this factor. Similarly, the factor "Safety Training" has a mean score of 4.2. If the construction organization wishes to improve the maturity level of this factor further, a short term plan (6 months) will be implemented. After successfully implementing all the plans, the construction organization needs to assess the maturity level of all the factors. In other words, this has to be a continuous process.

Figure 6: Results of Safety Climate Assessment (Example)

It is also important the construction organizations in the GCC region ensure that their employees feel free to participate in such assessments. Construction organizations in the region will have to develop trust among the workers by ensuring that their responses should be considered anonymous and it will have no implication on their job security. The main drawback of the newly developed safety climate assessment tool is the language. It is currently written in English, however most of the white color construction workers currently unable to read and write English. In this situation, it is recommended that the data from such workers may be collected through an interview and the responses may be recorded on the tool. This idea, however, has some

disadvantages. For instance, the worker may feel under-pressure and would not be able to disagree with the items as someone is monitoring his/her response. In other words, the data collection is not anonymous. The other disadvantage of this method is that the workers in GCC region are from different nationalities and it would be difficult for construction organization to find the appropriate person to conduct the interview and record the response of the workers on the tool. Another solution for this situation is to develop a mobile application which could translate the tool into the mother language of the respondents. The application should have the ability to display and speak the translation of the tool into the local languages. Such application may also be connected to the main server of the organization and should have the ability to process the responses automatically.

The conclusion of the paper is provided in the next section.

6. Conclusion:

Due to the complexity of the construction industry and construction projects, safety remains a major challenge which needs to be addressed. One of the latest approaches to improve safety performance is the safety climate concept which was truly introduced as part of the safety management system during 1980. Safety climate was defined in a variety of ways by many researchers but in general, it is referred to the share perceptions of workers on different aspects of organizational procedures and protocols related to safety. The terms safety climate and its different dimensions were highly discussed and elaborated in the past 39 years since 1980. This article attempted to review these safety climate factors and make an explicit of the most prevailing factors. A qualitative research method incorporating the major databases spanning over 39 years (1980-2019) was used to identify the leading safety climate factors. After the screening process, a total of 18 safety climate tools with 98 safety climate dimensions were selected for a review in this article. The PRISMA flow diagram and guidelines were followed to search the existing literature. Finally, the most common safety climate factors including, a) Management or Organizational Commitment towards Safety; b) Safety Training; c) Employees Involvement in Safety; d) Workers Safety Behavior; e) Safety Communication; f) Safety Accountability and Justice and g) Supervisory Leadership, are discussed in more details. These leading safety climate factors can be assessed through a safety climate assessment tool which can be paper-based or electronic-based depending on the capability of organizations and workers.

Each safety climate factors will be supported by a number of questions which respondents will score on a Likert scale of five. The results of such assessment will help the organizations to develop strategies to improve the perceptions of these factors by making short (~2 months), medium (~12 months) or long (~24 months) term plans. For instance, an organization can exemplarily demonstrate the management commitment towards safety by using a number of ideas including; i) Develop safety-related policies, guidelines, and procedures which are aligned with organizations that displayed best safety performance; ii) Visit construction site by senior management and adopt appropriate safety behavior; iii) Provide appropriate safety resources; iv) Participation of senior management in safety-related meetings; v) Aim for zero accidents at construction sites. The main limitation of this research is that the common safety climate factors are derived from the published literature only. For a more robust study, it is necessary to validate the results through a questionnaire or interview. This appears a limitation of the study, however, at the same times, this provides a room for further research. The study considered a specific period of time (1980 – 2018) assuming the fact that the terms safety culture and safety climate have attracted the focus of many researchers due to the evolution of human factors in organizations performance, but this does not mean that there could be no study prior to 1980 which focus on factors related to safety culture and safety climate. Most of the studies which are considered in this research were conducted in advanced countries, thus it could be difficult to conclude that the safety climate factors used in these studies could be relevant to the construction in developing countries. The maturity level of the construction industry is different in different countries. For instance, the construction industry in Oman is not that advanced as of the UK. The UK construction industry is highly regulated through different regulatory organizations and regulations such as Health and Safety Executive (HSE), Construction Design and Management (CDM regulations) and Construction Skills Certification Scheme (CSCS). Construction workers in these two countries will have a different interpretation and the importance of a specific safety climate factor may be varied. Thus, it is important to validate the safety climate factors derived in this research before they could be adopted in a specific country or region. The main challenge which is also important and needs to be explored is how small construction organizations with limited resources will be benefitted from the use of a safety climate approach to enhance their safety performance.

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825 9010.65.1.96.

826 **Appendix I: Parameters of the Review Protocol for Safety Climate Factors**
827

Keywords	Period	Inclusion Criteria	Exclusion Criteria	Database	Total Downloaded Articles/ Reports	Total Articles/ Reports/ Tools After Criteria	Derived Safety Climate Factors
Safety Climate Factors, Safety Climate Assessment Tool, Safety Climate Dimension	January, 1980 – April, 2019	Publications/ Reports / Tools on Safety climate in Construction Publications / reports that resulted into a new safety climate assessment tool Publications / reports on safety climate focusing GCC region	Publications/ Reports / tools articles where the keywords are not in the title, abstract or in the keywords Publications / reports that do not resulted in to a new safety climate assessment tool (this condition is not applicable on the study related to GCC region) Articles/ Reports in non-English language	Web Of Science Pro Quest Scopus Science Direct Google Chrome	68	18 Zohar, (1980); Dedobbeleer and Beland, (1991); HSE (UK), (1997); Neal et al.,(2000); Seo et al., (2004); Zohar and Luria, (2005); Parker et al., (2006); Pousette et al., (2008); CISCIS, (2008); Gittleman et al., (2010); Institute of Work and Health, (2011); DeArmond et al., (2011); Kines, et al., (2011); Umar and Wamuziri, 2016; Umar et al., 2017; Umar and Wamuziri, 2017; CPWR, (2017); Umar and Egbu, (2018)	1. Commitment from Management to Enhance Safety 2. Alignment and Integration of Safety as Value 3. Enforcing Accountability At All Level 4. Enhancing Workplace Safety Leadership 5. Empowerment and Involvement of Workers 6. Enhancing Communication 7. Ensuring Training for all staff 8. Encouragement of Owner and Client Participation

Figures

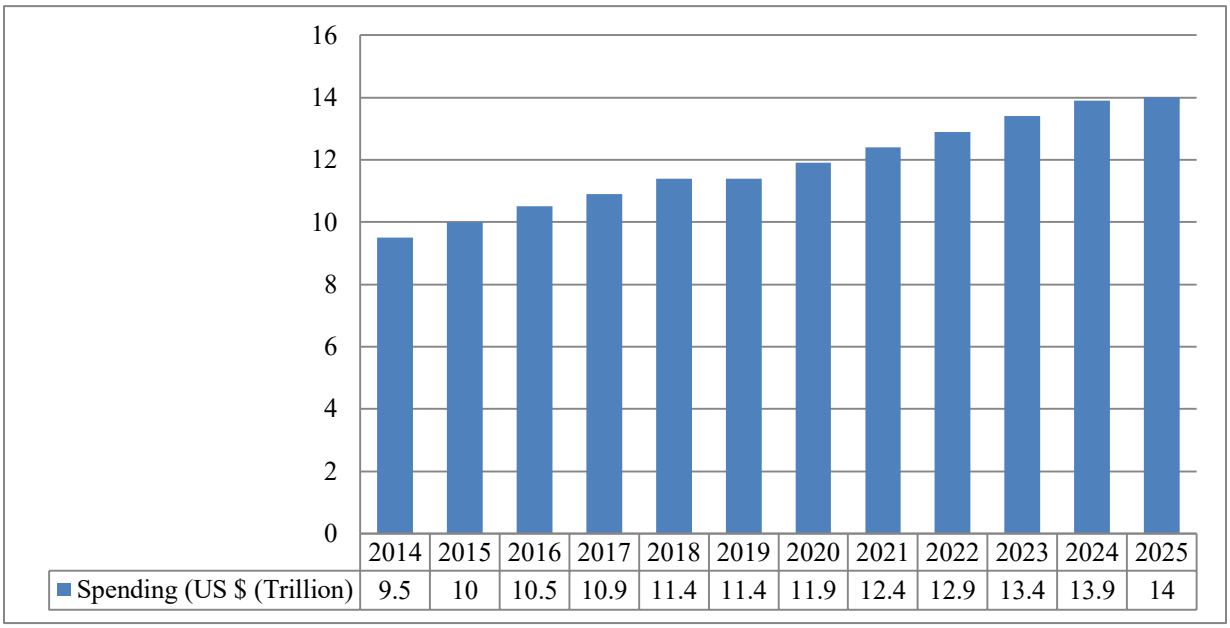


Figure 1: Global Construction Industry Growth (Statista, 2017).

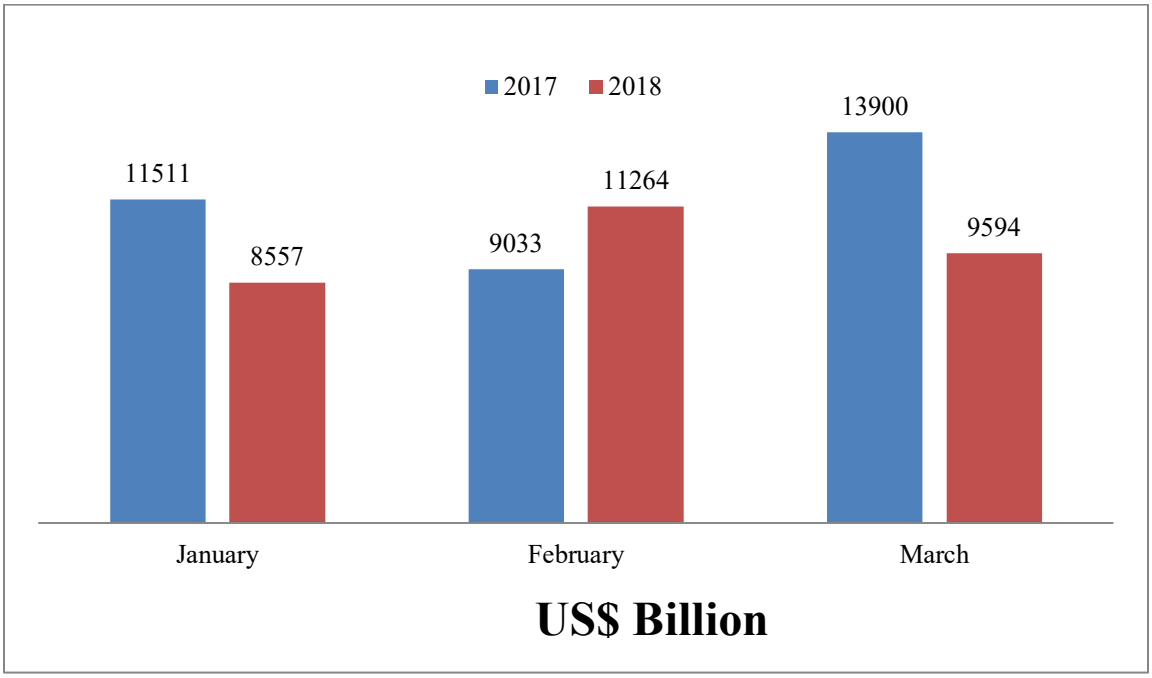
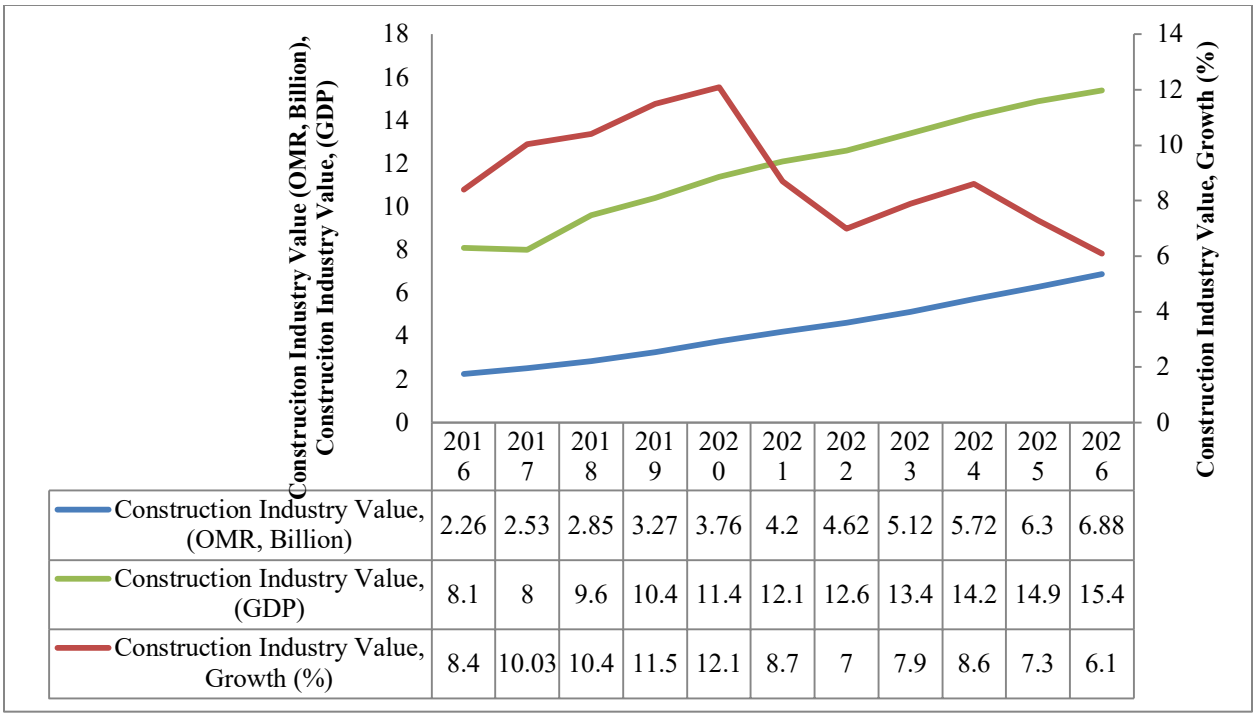


Figure 2: Comparison of Awarded Construction Contracts In GCC (Ventures, 2018).



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Construction Industry Value, (OMR, Billion)	2.26	2.53	2.85	3.27	3.76	4.2	4.62	5.12	5.72	6.3	6.88
Construction Industry Value, (GDP)	8.1	8	9.6	10.4	11.4	12.1	12.6	13.4	14.2	14.9	15.4
Construction Industry Value, Growth (%)	8.4	10.03	10.4	11.5	12.1	8.7	7	7.9	8.6	7.3	6.1

Figure 3: Oman Infrastructure and Construction Industry Forecasts (2016-2026).

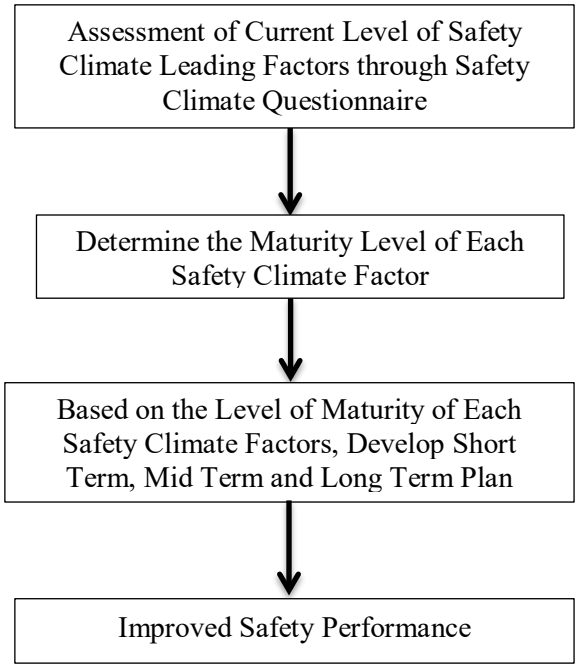


Figure 4. Process of Using Safety Climate to Improve Safety Performance (Umar and Wamuziri, 2017).

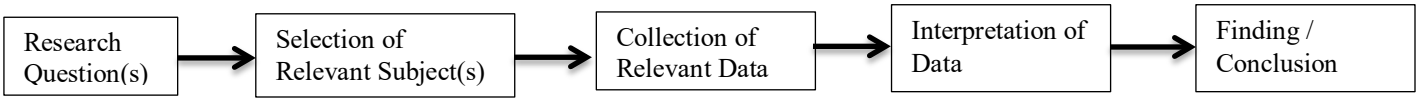


Figure 5. Process of Qualitative Research

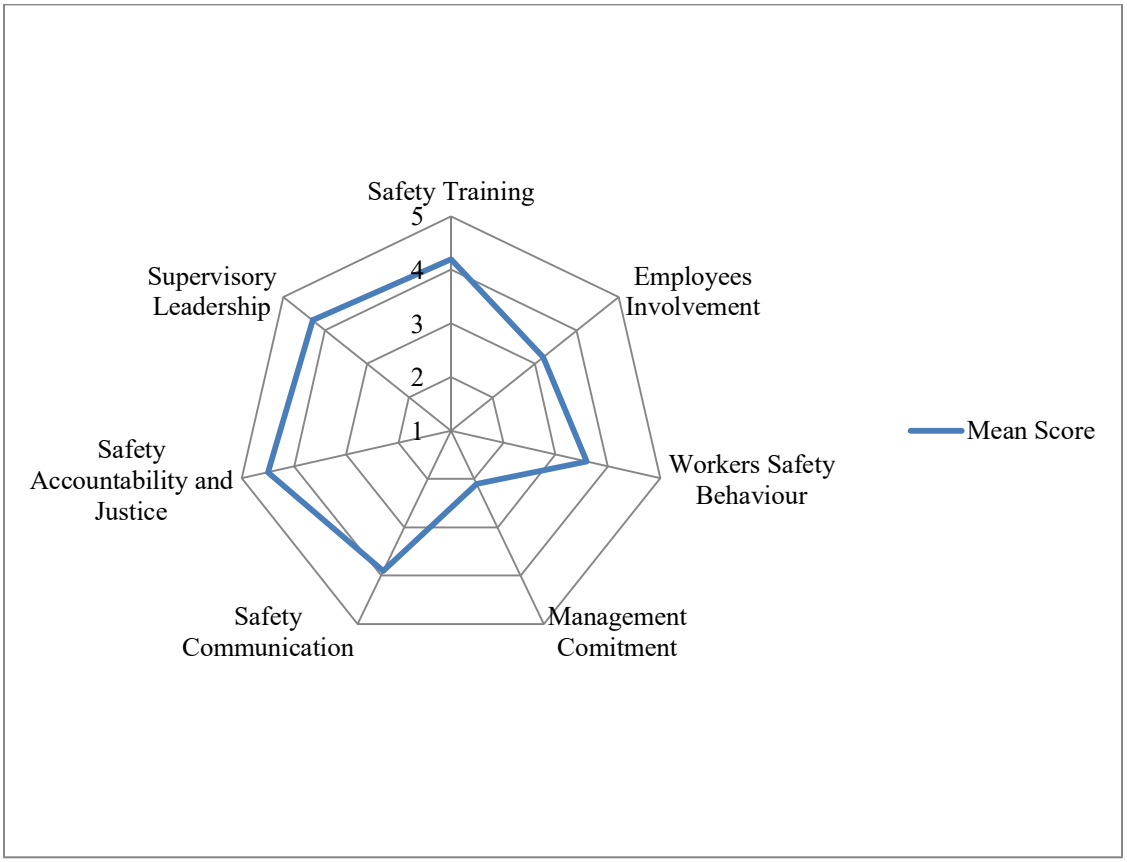


Figure 6: Results of Safety Climate Assessment (Example)

Tables

Year	Property / Equipment Damage	Alternate Work Injury (AWI)	First Aid Injury (FAI)	Loss Time Injury (LTI)	Medical Treatment Injury (MTI)	Total
2011	0	0	0	0	0	**0**
2012	7	1	1	0	2	**11**
2013	155	0	3	3	4	**165**
2014	164	2	0	5	5	**176**
2015	179	2	7	1	4	**193**
2016	75	0	3	0	0	**78**
Total:	**580**	**5**	**14**	**9**	**15**	**623**

Table 1: Different Types of Accidents in a Construction Project in Oman

Safety Climate Assessment Tool	Safety Climate Factors / Dimensions	Top ranked Factors
Zohar (1980)	(i) Management attitude toward safety; (ii) Work pace and safety; (iii) Effects of safe conduct on promotion; (iv) Effect of safe conduct on social status; (v) Perceived risks; (vi) Perceived importance of safety training; (vii) Perceived status of safety officer; (viii) Perceived status of safety committee	a) Management or Organizational Commitment towards Safety b) Safety Training c) Employees Involvement in Safety d) Workers Safety Behavior e) Safety Communication f) Safety Accountability and Justice g) Supervisory Leadership
Dedobbeleer and Beland (1991)	(i) Management commitment; (ii)Worker involvement	
HSE (UK) (1997)	(i) Organizational commitment; (ii) Health and Safety oriented behavior; (iii) Health and Safety Trust; (vi) Usability of Procedures; (v) Engagement in health and safety; (vi) Peer group attitude; (vii) Resources of health and safety (viii) Accidents and near miss reporting	
Neal et al. (2000)	(i) Management values; (ii) Communication; (iii) Training; (iv) Physical Work Environment; (v) Safety Systems; (vi) Knowledge; (vii) Motivation; (viii)Behavior	
Seo et al. (2004)	(i) Management commitment to safety; (ii) Supervisor safety support; (iii) Coworker safety support; (iv) Employee participation in safety-related decision making and activities; (v) Competence level of employees with regard to safety	
Zohar and Luria (2005)	(i) Active practices (monitoring, enforcing); (ii) Proactive practices (promoting learning, development); (iii) Declarative practices (declaring, informing); (iv) Active practices (Monitoring, controlling); (v) Proactive practices (Instructing, Guiding); (vi) Declarative practices (Declaring, Informing)	
Parker et al. (2006)	(i) Concrete organizational aspects; (ii) Abstract organizational concepts	
Pousette et al. (2008)	(i) Management safety priority; (ii) Safety management; (iii) Safety communication; (iv) Workgroup safety involvement	
CISCIS (2008)	(i) Commitment and concern for Occupational Safety and Health by organization and management; (ii) Resources for safety and its effectiveness; (iii) Risk taking behavior and perception of work risk; (iv) Perception of safety rules and procedures; (v) Personal involvement in safety and health; (vi) Safe working attitude and workmates' influence; (vii) Safety promotion and communication	
Gittleman et al. (2010)	The tool is not divided in to factors or dimensions	
Institute of Work and Health (2011)	The tool is not divided in to factors or dimensions	
DeArmond et al.	(i) Safety compliance; (ii) Safety participation	

(2011)		
Kines, et al. (2011)	(i) Management safety priority, commitment, and competence; (ii) Management safety empowerment; (iii) Management safety justice; (iv) Workers' safety commitment; (v) Workers' safety priority and risk non-acceptance; (vi) Safety communication, learning, and trust in co-workers safety competence; (vii) Trust in the efficacy of safety systems	
Umar and Wamuziri (2016)	(i) Management commitment; (ii) Safety empowerment; (iii) Safety justice; (iv) workers' safety commitment; (v) Safety priority and risk non-acceptance; (vi) Communication, learning and competence; and (vii) Trust in the efficacy of safety systems	
Umar et al. (2017)	(i) Management Commitment; (ii) Safety as a Value; (iii) Accountability; (iv) Leadership; (v) Empowering and Involving Workers; (vi) Communication; (vii) Training	
Umar and Wamuziri (2017)	(i) Improved management commitment; (ii) Integrating safety as a value; (iii) Accountability system; (iv) Improved leadership; (v) Empowered workers; (vi) Improved communication; (vii) Safety training; (viii) owner/client involvement.	
CPWR (2017)	(i) Demonstrating management Commitment; (ii) Aligning and integrating safety as a value; (iii) Ensuring accountability at all levels; (iv) Improving supervisory leadership; (v) Empowering and involving Employees; (vi) Improving communication; (vii) Training at all levels; (viii) Encouraging owner/client involvement	
Umar and Egbu (2018)	(i) Management commitment; (ii) Alignment and integration of safety as a value; (iii) Accountability across the board; (iv) Supervisory management; (v) Empowerment and involvement of workers; (vi) Improvement of communication; (vi) Training and education	

Table 2: Details of Safety Climate Assessment Tools Factors