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Developing a Safety Climate Assessment Tool for Omani Construction Industry

Tariq Umar, University of the West of England, UK*
https://orcid.org/0000-0002-1197-8181

Nnedinma Umeokafor, Liverpool John Moores University, UK
https://orcid.org/0000-0002-4010-5806

ABSTRACT

One of the methods that could improve the safety performance of construction organizations is the safety climate approach, which is helpful to know the existing maturity level of the safety climate and to develop plans to achieve the required level of maturity. Most of the existing safety climate tools were developed considering different industries in developed countries while construction was based only on few tools. Construction projects in the Gulf Cooperation Council (GCC) member countries are at a peak. This article, therefore, attempts to develop a safety climate assessment tool for the Omani construction industry. A mixed research method consisting of systematic review (N = 32), structured questionnaire (N = 102), and email interview (N = 19) was adopted in this research. An assessment tool that has seven factors and 62 simple questions that the participants have to answer on a Likert scale of 1 to 5 is finally developed.

KEYWORDS

Assessment, Construction Industry, Health and Safety, Knowledge Management, Management, Research Methodology, Safety Climate

1. INTRODUCTION

Statistics from several sources reveals that construction is regarded as one of the most hazardous industry. For instance, the International Labour Organization data for the year 2015 reveals that every year, more than 100,000 workers die on construction sites due to different occupational safety and health conditions. This means that the number of deaths on construction sites is roughly equal to 274 deaths per day. This number is nearly 30% of all occupational deadly injuries (ILO, 2015). The situation in the GCC countries is particularly alarming due to several reasons discussed in detailed by Umar et al., (2019) and Umar (2022). The construction projects are at a peak as the region is in the stage of developing its major infrastructures. Recently, the deaths of construction workers in the construction of a stadium for the football world cup 2022 have attracted the attention of media and international organizations. Some of these reports show the number of construction workers that died in the project has already reached 1,200. Some of the reports estimate that the number of

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deaths in this project will reach 4,000 by the end of 2020 when it is completed (Safety Media, 2018; ITUC, 2014; Ganji, 2016). The Human Rights Watch report indicates that the total workforce in Qatar is approximately two million, with 95% of this workforce being expatriates. A total of 800,000 expatriates (40%) are employed by the construction sector (Human Rights Watch, 2018). The report further shows that in only 2012, a total of 520 workers from India, Bangladesh, and Nepal died due to different work-related accidents and conditions in Qatar. Different reports indicate most of the construction workforce (= 90%) in these GCC countries are from Asian countries (Middle East Annual Conference, 2014; GOSI, 2018; OSC, 2016; LMRA, 2018; GRC, 2018; GRSIA, 2017; MHRE, 2018). There are several ways to improve the safety performance of construction organization and one of them is using the safety climate approach (Clarke, 2006; Oah and Moon, 2018). The main goal of this research was to develop a safety climate assessment tool for construction organizations in Oman. Since the construction workers demography in the GCC construction is somehow the same, there is a possibility that this tool can be used in other GCC countries. Different authors recognized that a mature safety climate and a rich safety culture contribute to achieve a safe workplace (Zohar, 2002; Clarke, 2006, 2010; Neal and Griffin, 2006; Wallace et al., 2006; Nielsen and Lyngby Mikkelsen, 2007; Pousette et al., 2008; Kuenzi and Schminke, 2009; Kines et al., 2011; Umar and Egbu, 2018). The literature review suggests that although there are differences between the two terms i.e., safety climate and safety culture, however these concepts for improved safety performance have attracted more concentration across a broad number of industrial businesses including construction (Flin et al., 2000). One the reason behind this suggested by Bergh et al., (2013) is that rich safety culture and a mature safety climate are considered among the most important elements in attaining a safer workplace. 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 with 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). A similar concept of safety climate approach was also explained by Umar and Wamuziri (2017) and described relevant safety climate factors or dimensions can be measured among different categories of staff working in a construction organization or in a project undertaken by the construction organization. The results will reflect the safety climate of the organization or the safety climate of the specific project. After the assessment of safety climate factors, construction organizations will be able to identify and prioritize the weak area for improvement. They further suggested that safety climate leading factors can be reviewed on a five-level scoring scale to assess what level of safety culture for that factor is achieved by construction organization. The maturity level for all the factors can be classified as a uniformed, reactive, complaint, proactive and exemplary. Construction organizations can make a short term (1-2 months), mid-term (6-12 months) and long term (1-2 years) plans if the required level for the factors is not adopted by using different ideas. The main question is what could be the safety climate factors that need to be included in a safety climate assessment tool. This was partially investigated by Umar and Egbu (2018) through a semi-structured interview held with the construction profession in the GCC region. They, however, recommended that such factors should be derived considering the view of the members in a construction team. Similarly, the literature review of the existing safety climate assessment tools reflects that most of them were developed considering the industries in some advanced countries (Zohar, 2010). Apart from that, construction was the base for only a few assessment tools. The perceptions of the safety climate could be different among different industries and regions (Barbaranelli et al., 2015). This article, therefore, aims to investigate the safety climate factors in Oman construction considering the whole team members. The outcome of this research, on one hand, provides a tool for the construction organization in Oman to assess their safety climate but also contributes to the existing knowledge of body in relation to the extent of safety climate factors that are considered significant in the Oman construction industry context. A research approach considering both quantitative and qualitative methods were adopted to achieve this. Based on the finding, a safety climate assessment tool is proposed for the Omani construction industry. The research methodology is further explained in the next section.

2. RESEARCH METHODOLOGY

Both qualitative and quantitative research methods know as mixed research approach which is commonly used in construction management research were employed to achieve the aim of this research (Umar, 2021). In the first stage, the most prevailing safety climate factors were extracted from the existing safety climate tools used in construction through the systematic review (Martins et al., 2019). This was done using specific keywords in different databases. PRISMA guidelines were followed in this search (Moher et al., 2009; Umar, 2021). Briefly, the safety climate factors used in this research are shown in table 1. In the second stage, a quantitative research strategy was employed. Briefly, the 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). The factors included in this questionnaire were based on data collected in the first stage. Although research conducted by Umar and Egbu (2018) also aimed to determine the key factors which highly influence the safety climate in Oman, however, there were some limitations in their study related to the data collection. They collected the data in two parts. The data collected in the first part was from the existing literature in which the most common safety climate factors were identified. The data

Table 1. Parameters of the Review Protocol for Safety Climate Factors

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 into a new safety climate assessment tool (this condition is not applicable on the study related to GCC region) Articles/ Reports / news articles in non-English language	Web of Science PRO QUEST SCOPUS Science Direct Google Chrome	32	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

collected in the second part of the research was from a specific group of construction professionals. Since the construction team of an organization or construction project consists of Managers, Engineers, Site Supervisor Foreman, and Workers, therefore their view of different safety climate factors derived from the semi-structured interviews was considered to be important. This research, therefore, attempts to collect the data from the whole construction which was done using a structured questionnaire administrated among different respondents. Data collection through a structure questionnaire is a normal practice in research studies of similar nature (Al-Haraisa et al., 2021; Ramanujam and Padmavathi, 2021; Hanaysha et al., 2021).

A simple questionnaire was adopted for recording the response of the respondents using a Likert scale. Part I of the questionnaire is related to the personal / background information of the respondents. This information includes the birth year, gender, position/role, academic qualification, experience, age group and country of birth. In Part II of the questionnaire, the respondents were asked to rate their responses related to management commitment on a scale of 1 to 5. (1= strongly disagree, 5 = strongly agree). In part II there is a total of 10 questions. These questions are related to "management commitment". Part III is related to the "alignment and integration of safety as value" and there is a set of 11 different questions. In Part IV, there are 10 questions that are related to "accountability at all level". In part V, which is related to "improvement of site safety leadership", has a set of 8 questions. There are 7 questions in part VI entitle as "empowering and involving workers". Part VII of this questionnaire is related to "improvement of communication" and it has 9 questions. There are 7 questions in part VIII (training at all levels). Part IX is related to "encouragement and involvement of owner/client" and it has 10 questions. In part X of the questionnaire, the respondents were requested to rate the relevancy of different safety climate factors. The last section of the questionnaire (part XI) is provided for the comments of the participants. If the participants may have any comments, it will be written in this part of the questionnaire.

The questionnaire was developed in the English language and the necessary assistance was provided to the respondents who were not able to read and write in English. One of the options to translate the questionnaire into the local languages of the respondents; however, it was not a feasible option due to the diversity of the sample available. Respondents were from different Asian countries which increases the reliability of the sample. For instance, the construction industry workforce as reported by the Oman Society of Contractors is consists of 92% of the foreigner workers and there are only 8% of the Omani working in this industry (Umar, 2017). Similarly, the National Centre of Statistics and Information (Oman) data for the year 2014 shows that the Indian workers (5,550,470) were on the top in private sectors in Oman followed by Bangladeshi (537321) and Pakistani (210,632) workers as shown in table 2 (NCSI, 2015).

Data was collected from a variety of respondents that includes managers, engineers, site supervisors, foreman, and workers. A construction organization registered as an excellent grade with the Tender Board of Oman was considered to be the best place to have the appropriate number of the required respondents in each group (TBO, 2018). The normality of the data was checked through the ratio between skewness and its standard error, and the ratio between kurtosis and its standard error (Yeo and Johnson, 2000). The data was considered normal if the ratio was between – 1.96 to + 1.96 (Thode, 2002). Briefly, Skewness is a measure of symmetry, or more precisely, the lack of symmetry (Das and Imon, 2016). A distribution, or data set, is symmetric if it looks the same to the left and right of the center point. Similarly, Kurtosis is a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution. Data sets with high kurtosis tend to have heavy tails or outliers. Data sets with low kurtosis tend to have light tails, or lack of outliers (D'Agostino, 2017).

The questionnaires received with signed in informed consent were used in the analysis and results. The raw data obtained from the questionnaires were processed using SPSS data analysis software which is commonly used for statistical analysis (Anjum et al., 2019). To calculate means scores for each factor or dimension of safety climate and individual, the raw data from different items were used. As a rule, for data analysis, only the answered items of the questionnaire were used. If

Table 2. Distribution of Expatriate by Nationalities and Gender in Private Sectors in Oman (NCSI, 2015)

Nationality	Male	Female	Total
Indians	5,523,963	26,507	**5,550,470**
Bangladeshi	515,628	21,693	**537,321**
Pakistani	209,881	751	**210,632**
Indonesian	608	35,109	**35,717**
Ethiopian	312	32,968	**33,280**
Philipinos	9,013	17,112	**26,125**
Egyptians	12,251	1,896	**14,147**
Nepales	8,888	3,257	**12,145**
Sirilankans	5,309	6,218	**11,527**
Other Nationalities	35,157	15,421	**50,578**
Total	**6,321,010**	**160,932**	**6,481,942**

in a specific dimension or factor, a respondent has answered less than 50% of the items, thus all answers were excluded for that dimension. This was done based on the fact that a mean score based on less than 50% of items is not considered as valid. For the calculation of the mean score of each dimension and group, the mean score of different dimensions or factors and individuals were used. In further analysis, the mean scores for all the dimensions were utilized. An independent sample T-test (two-tailed) was conducted to see if there is any notable variation among two independent groups. A probability value (p-value) less than 0.05 from a two-tailed T-test was treated statistically powerful for all tests. Cronbach's alpha coefficient which is also known as the coefficient of reliability was calculated to check the internal consistency of the different safety climate factors. The mean values of each item in different safety climate factors were used to rank items in the same factor. Item ranked as 1, mean that the item in a safety climate factor was considered important by the respondents to enhance the maturity level of that factor. The content analysis technique was adopted to examine comments written in the last section of the questionnaire. Graneheim and Lundman (2004) guidelines were used for content analysis. Based on this method the meaning units which have the same central meaning, from the comments section were organized from most common to least common. Content analysis is a research method that is applied to make replicable and valid inferences by defining and coding textual materials (Hsieh and Shannon, 2005). Through a systematic examination of data such as documents, oral communication, and graphics, qualitative data can be translated into quantitative data. Although this approach of research has been used widely in the social sciences, only recently has it become more common among organizational researchers. The content analysis technique is common now in organizational research because it permits researchers to find and evaluate the nuances of organizational behaviours, stakeholder feelings, and social tendency. It connects both the quantitative and qualitative research methods by playing the role of a bridge. In one aspect, the content analysis permits researchers to evaluate socio-cognitive and perceptual constructs which are hard to examine through usual quantitative research methods. Similarly, at the same time, it gives a chance to the researchers to collect large samples that are normally hard to adopt in purely qualitative research (Neuendorf, 2016). The assessment tool developed in this research was validated using a qualitative research method in which the views of construction industry professionals were sought through email interviewing. A similar approach was also adopted by Tiu et al. (2021) in their study on evaluation of food safety knowledge and practices of street food vending in the Philippines. Face to face and emails interviews are some of the common approaches used for qualitative research strategy (Umar, 2022).

2.1 Sample Size

As discussed in the introduction section, the population in the GCC construction industry has a similar background as it belongs to a specific region; Oman was used to collect the data in this research. General, the sample size is calculated from the population size. In this research the population size is reflected by two variables i.e., i) the number of construction workers in Oman and ii) the number of construction companies under consideration. For example, in the first case, the total workforce in Oman is 700,000 and in the second case, the number of construction companies under consideration i.e., excellent and first grade is 683 (table 3) (Umar and Egbu, 2017; TBO, 2018). Similarly, to calculate the sample size the margin of error is also chosen. The margin of error represents the percentage that describes how closely the answer of the sample gave is to the "true value" is in the population. The smaller the margin of error is, the closer to having the exact answer at a given confidence level. The confidence level is a measure of how certain the sample accurately reflects the population, within its margin of error. Common standards used by researchers are 90%, 95%, and 99%. Mathematically the sample size can be calculated by using equation 1 and equation 2. These equations give a sample size of 307 and 319 if the confidence level and margin of error are set as 95% and 5% respectively. Clearly, the sample size is highly influenced by the population size. In other words, the sample size increases if the population size increase and this is basically helpful to generalize the results. In some cases, the sample size calculated by these equations could not be helpful or even not adoptable. For instance, if the population is the 'population of China'; then the sample size calculated through these equations will be very large and thus could not be achieved. Considering the scope and the aim of this research, it was aimed to have at least 100 responded from the selected. Mathematically it was justified through the equation developed Green (1991) as mentioned in equation 3.

$$Sample\,Size = \frac{\frac{z^2\ X\,p\left(1-P\right)}{e^2}}{1+\left(\frac{z^2\,X\,p\left(1-P\right)}{e^2\,N}\right)} \tag{1}$$

N = Population Size
e = Margin of error
z = z-score

e which is the margin of error is noted in percentage, for the purpose of calculation this is converted into decimal form (for example, if the margin of error is considered as 3%, then in equation 1 it will be used as 0.03).

Table 3. Contractors Registered with the Tender Board of Oman (TBO, 2018)

S.No.	Grade of Company registered in the construction work category	Number of Companies Registered
1	Excellent Grade	401
2	First Grade	282
3	Second Grade	286
4	Third Grade	293
5	Fourth Grade	772
	Total:	**2034**

Similarly, a simpler formula for sample calculation was suggested by Yamane (1967) as shown in equation 2:

$$n = \frac{N}{1 + N\ (e)^2} \tag{2}$$

where:

n = size of sample
N = size of population
e = precision level

$$N > 50 + 8p \tag{3}$$

where:

N = Sample Size
p = number of predictors

Using the above equation and considering the safety climate questionnaire which aims to target at least 100 responses, the p-value can be 5 or 6. Thus the sample size can be as under.

For p = 5:

$> 50 + 8x5 = 90 < 100$; thus OK

For p = 6:

$> 50 + 8x6 = 98 < 100$; thus OK

Thus, in both cases, the sample size is valid. The actual responses collected in this part of the research were, however, 102. Similarly, sample size can also be validated through the variable "age of the respondents" using equation 4 (Garber and Hoel, 2015):

$$N = \left(\frac{Z\sigma}{d}\right)^2 \tag{4}$$

where:

N = Minimum sample size
Z = Constant value which depends on confidence level, for instance, if the confidence level is 95% then the Z value will be 1.96 (table 4)
σ = Standard deviation
d = error

The sample size used in this research was also validated through this equation and was found to be adequate.

Table 4. Z-Score for Different Confidence Level (Bryman, 2016; Garber and Hoel, 2015)

Required Confidence Percentage	z-score
80.0%	1.28
85.0%	1.44
90.0%	1.65
95.0%	1.96
99.0%	2.58

2.2 Safety Climate Assessment Tool

Based on the results and analysis of the data collected in the above section, a safety climate tool assessment tool was developed. All the safety climate factors which achieved a mean score of more than 3 were considered significant and were therefore used in the new tool. Factors which achieved high mean score were ranked first and were numbered accordingly. Sub-items in each tool were also ranked based on their mean score. The final safety climate assessment tool was then circulated through email to a total of 50 mangers of the selected construction organizations. In the current decade, the data collection through emails has attracted the attention of several researchers as it is thought to be an effective way to collect qualitative data (Burns, 2010). Fritz and Vandermause (2018) concluded that qualitative researchers seeking deeply reflective answers and geographically diverse samples may wish to consider using in-depth email interviews. The criteria adopted to select the respondents were that each interviewee should have at least five years' experience in Oman; the interviewee's company must be an international company and registered as an "excellent grade" or "grade one" company with the Tender Board of Oman. Tender board of Oman takes care of all government tenders valued at 3 Million (Omani Rials = 7.79 Million US $) or more (TBO, 2018). The purpose of this exercise was to obtain feedback on the newly developed safety climate assessment tool from the industry professionals.

3. RESULTS AND ANALYSIS

A total of 290 questionnaires were distributed to four main construction organizations which were executing major construction project in Oman. One hundred and two (102) duly filled questionnaires were returned representing a response rate of 37.17%. Four questionnaires (3.92%) out of 102 were rejected due to several reasons. The most common reason for rejecting the questionnaires was that more than 50% of the questions were not answered. The sample size was validated using equation 4, considering the following parameters:

$Z = 1.96$
Standard deviation (σ) = 7.10 (calculated from age of respondents using SPSS program)
Error (d) = 1.71 (5% of the mean value of the age)

Based on these parameters, equation 4 gives the value of acceptable sample size (N) as 66.25 (~ 67), which is far less than the sample size used in this research (= 102). The number of responses from organization 1, 2, 3 and 4 were 28 (25.57%), 23 (23.46%), 26 (26.53%) and 21 (21.42%) respectively. All the respondents who participated in this survey were expatriate males belong to different nationalities as shown in figure 1. The respondents were indifferent occupations including managers, engineers, supervisors, foremen and general workers as shown in figure 2. Similarly, the respondents were from different age groups and were having different educational qualifications and

Figure 1. Distribution of respondent Based on Their Nationalities

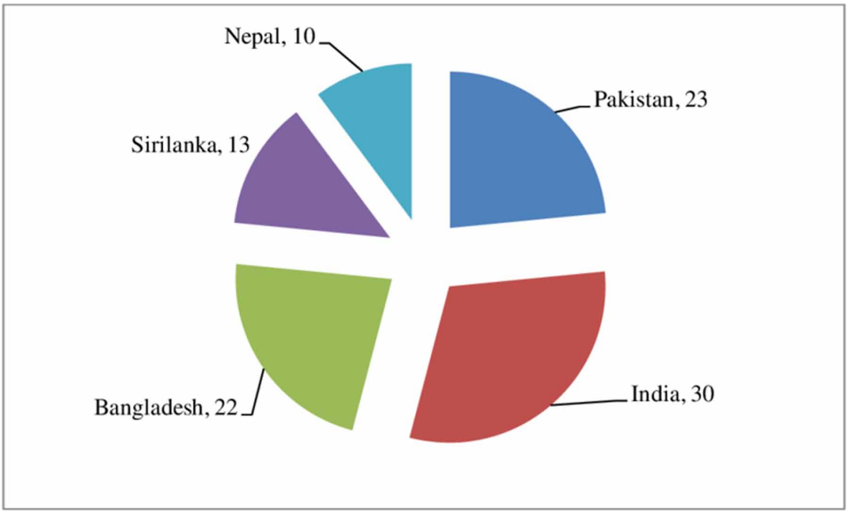
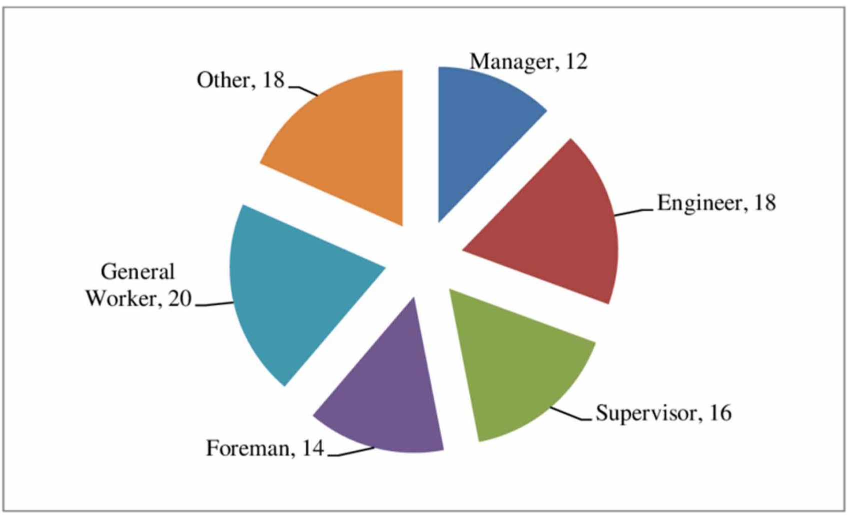


Figure 2. Occupation of Respondents



experience as shown in figures 3, 4 and 5 respectively. The ratio between skewness and its standards error for age was 0.59. Similarly, the ratio between kurtosis and its standard error for age was 1.24. Both the ratios were found to be less than +1.96 and reflect the normality of data. The correlation between age and qualification of the respondents was found to be significant at the 0.05 level (2 tailed). The internal reliability of all the Likert items along with qualification, position, and country of respondents was checked by calculating Cronbach's Alpha (α) using SPSS and was found to be 0.630.

The Spearman's Correlation Coefficient was also calculated to measure the strength and direction of the association between different variables. The elements considered for this analysis were age, position, qualification, experience, age group, country and all the eight safety climate factors used in the questionnaire. The results show the correlations among some elements are significant at 0.01 and 0.05 (two-tailed). Overall, the relationships do exist in these elements, however in some case, it

Figure 3. Distribution of Respondents Based on their Age Group

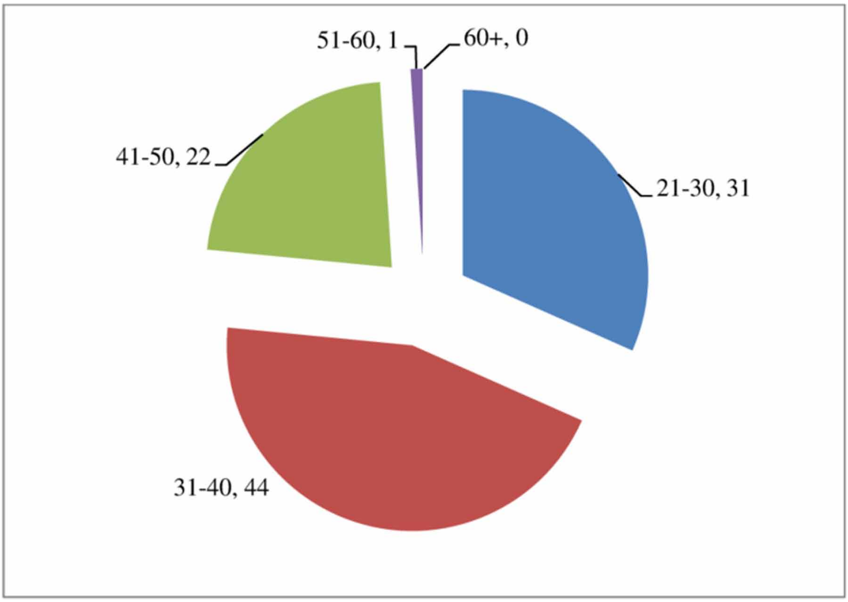
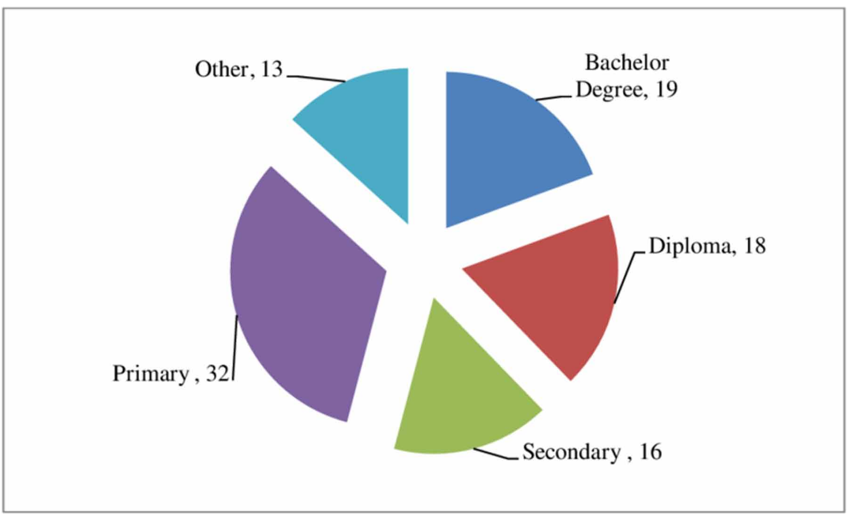
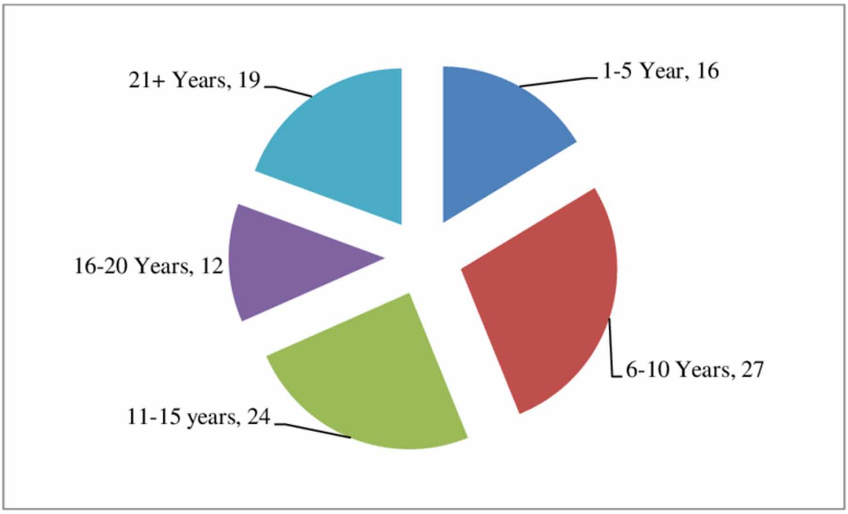


Figure 4. Distribution of Respondents Based on their Qualification



is stronger and positive or negative, and in some cases, it is weaker and either positive or negative. For instance, there is a strong positive (Spearman's Correlation Coefficient = 0.933) relationship of the respondent's ages and experience which is significant at 0.01 (two-tailed). A negative relationship was however observed between respondents' positions with safety climate factors number 3 (- 0.24) and 4 (- 0.199) at a significance level of 0.01 (two-tailed). Similarly, one-way ANOVA test was also conducted to measure the significance of all factors used in the safety climate questionnaire. The factors considered for this analysis were age, age group, position, experience, qualification, and country. The p-value 0.05 or lower was considered as significant. The results show that item

Figure 5. Distribution of Respondents Based on the Experience



No. 9 and item No. 10 of the factor "aligning and integrating safety as a value" was significant (p = 0.03 and 0.017) when positions of the respondents were considered. Similarly, item No. 2 and item No. 3 in the "ensuring accountability" factor was significant at a p-value equal to 0.06 and 0.049 respectively when compared with the positions of the respondents. Item No. 5 in the "empowerment and involvement of the workers" factor was found to be significant with a p-value of 0.034. The p-value of item No. 6 in "improving communication" was 0.017 and thus considered as significant. The results show that there is no item significant in "owner and client involvement" as the p-value of all the items was more than 0.05. Since there was a relationship among the considered elements considering Spearman's Correlation Coefficient that was either stronger or weaker and positive or negative, and the significance of the items established through the results of one-way ANOVA test, the ranking of the different safety climate factors was done through their mean scores. The mean values of each safety climate factor which respondents rated on a Likert scale of 1 to 5 are given in table 5. Two safety climate factors "Alignment and Integration of Safety as a Value" and "Training at All Level" got the highest mean score of 4.15 followed by "Improved Safety Leadership" and "Management Commitment" which got the mean score of 4.12 and 4.08 respectively. Overall, five safety climate factors achieved a mean score of more than 4. The mean score of two safety climate factors was near to 4 (3.80 and 3.87 respectively). One safety climate factor 'encouraging owner/client involvement' secured a mean score of 2.78.

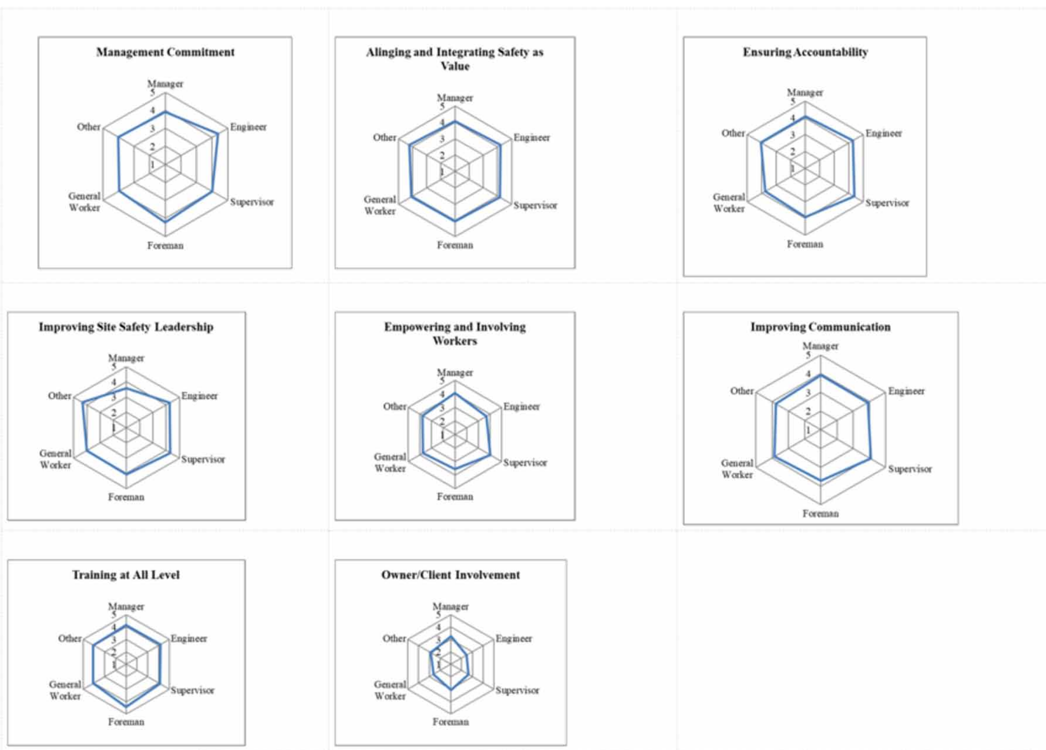
The mean score of different safety climate factors calculated from different occupational groups is given in figure 6. The mean score of all the safety climate factors, except owner/ client involvement was considered significant. As mentioned in table 5, the mean score of "owner/client involvement" was 2.78, based on total respondents (N = 98) and was thus ranked as VII. Similarly, the same factor "owner/client involvement" mean score is 3.25 by occupational group of "Managers", (N = 12); by "Engineers", (N = 18) it is 2.444; by "Supervisors" where N = 16, it is 2.625; by "Foremen", where N = 14, it is 3.071; by "General Workers" (N = 20), it is 2.6 and by "other" where N = 18, it is 2.889. Overall, considering both the aggregate mean score (2.78) where N = 98, and the mean score of the safety climate factor "owner/client involvement" it is lower than 3. Only the mean score by "foremen" is 3.071, however, the N = 14.

The mean values of each item in different safety climate factors were calculated and these mean values were used to rank each item in each factor. An Item that is ranked first means that the item is significant to improve the maturity level of concerned safety climate factors. The significance of the

Table 5. Mean Score of Different Safety Climate factors

Safety Climate Factors	N	Minimum	Maximum	Mean	Std. Deviation	Rank
Management Commitment	98	1	5	4.08	0.94	III
Aligning And Integrating Safety As Value	98	1	5	4.15	0.89	I
Ensuring Accountability At All Level	98	1	5	4.07	0.83	V
Improving Site Safety Leadership	98	1	5	4.12	0.80	II
Empowering And Involving Workers	98	1	5	3.80	0.97	IV
Improving Communication	98	1	5	3.87	0.82	VI
Training At All Level	98	1	5	4.15	0.87	I
Encouraging Owner/Client Involvement	98	1	5	2.78	0.96	VII

Figure 6. Safety Climate Factors Scores by Different Occupational Group



items reduces as their ranking reduced. There was a total of 10 items in "Management Commitment". Based on the mean score of all the items, item 1, which refers to 'defining safety expectation in policies, procedures, and guidelines, and communicated across the organization' was raked as first. Similarly, "Aligning and Integrating Safety as Value" has 11 items and item 11 has been ranked first. This item is related to 'using safety performance metrics as leading indicators for evaluations. There were 10 items in "Ensuring Accountability At All Level" wherein item 3 'adopting an Owner Controlled Insurance

Program' was ranked first. The safety climate factor "Improving Site Safety Leadership" has a total of eight items and item 6 which is related to 'promoting learning environment by leadership' was on the top in raking by means score. Similarly, there have been seven items in "Empowering and Involving Workers" and item 1 'empowering workers through site orientations to actively participate in safety implementation', with a mean score of 3.969 was ranked first. Item 3 'communicating organization materials in a consistent positive safety climate message', in "Improving Communication" was ranked first among nine items. Similarly, there have been seven items in "Training At All Level" wherein item 7 'encouraging all field workers to identify training needs and develop materials' with a mean score of 4.235 ranked as first. The last safety climate factor which is "Encouraging Owner/Client Involvement" has a total of 10 items. Item 4 'presence of owner representative on-site to monitor and assist with safety implementation' with a mean score of 3.929 was ranked at the top. The whole raking of all the items in all safety climate factors is presented in table 6.

Table 6a. Ranking of Items in Different Safety Climate Factors

Management Commitment	Mean	Rank
Item 1	4	1
Item 2	3.796	6
Item 3	3.939	2
Item 4	3.806	4
Item 5	3.796	6
Item 6	3.806	4
Item 7	3.796	6
Item 8	3.663	10
Item 9	3.786	9
Item 10	3.898	3

Table 6b. Ranking of Items in Different Safety Climate Factors

Aligning and Integrating Safety as Value	Mean	Rank
Item 1	3.571	7
Item 2	3.276	10
Item 3	3.122	11
Item 4	3.612	5
Item 5	3.337	9
Item 6	3.347	8
Item 7	3.918	2
Item 8	3.745	4
Item 9	3.602	6
Item 10	3.867	3
Item 11	4.01	1

Table 6c. Ranking of Items in Different Safety Climate Factors

Ensuring Accountability at All Level	Mean	Rank
Item 1	3.918	2
Item 2	3.898	3
Item 3	3.939	1
Item 4	3.816	4
Item 5	3.769	5
Item 6	3.765	6
Item 7	3.571	9
Item 8	3.704	7
Item 9	3.551	10
Item 10	3.67	8

Table 6d. Ranking of Items in Different Safety Climate Factors

Improving Site Safety Leadership	Mean	Rank
Item 1	3.673	7
Item 2	3.898	3
Item 3	3.827	6
Item 4	3.888	4
Item 5	3.99	2
Item 6	4.062	1
Item 7	3.857	5
Item 8	3.531	8

Table 6e. Ranking of Items in Different Safety Climate Factors

Empowering and Involving Workers	Mean	Rank
Item 1	3.969	1
Item 2	3.878	4
Item 3	3.898	3
Item 4	3.765	7
Item 5	3.786	5
Item 6	3.776	6
Item 7	3.908	2

Table 6f. Ranking of Items in Different Safety Climate Factors

Improving Communication	Mean	Rank
Item 1	3.929	2
Item 2	3.918	3
Item 3	4.092	1
Item 4	3.724	9
Item 5	3.816	7
Item 6	3.898	5
Item 7	3.827	6
Item 8	3.908	4
Item 9	3.735	8

Table 6h. Ranking of Items in Different Safety Climate Factors

Training at All Level	Mean	Rank
Item 1	3.949	2
Item 2	3.816	4
Item 3	3.908	3
Item 4	3.796	5
Item 5	3.755	6
Item 6	3.735	7
Item 7	4.235	1

Table 6h. Encouraging Owner/ Client Involvement

Encouraging Owner/ Client Involvement	Mean	Rank
Item 1	3.704	8
Item 2	3.878	3
Item 3	3.765	5
Item 4	3.929	1
Item 5	3.673	9
Item 6	3.918	2
Item 7	3.745	7
Item 8	3.765	5
Item 9	3.653	10
Item 10	3.816	4

The result and analysis suggest that all the factors except the item "Encouraging Owner/ Client Involvement" are considered significant by the respondents. This factor is therefore excluded from the proposed safety climate assessment tool. The newly developed safety climate assessment tool was circulated through email to a total of 50 managers working in different construction organizations. A total of 19 responses representing a response rate of 38% were received. All the feedback received from the construction managers were positive and reflected that the proposed safety climate assessment tool could be suitable for their organizations. The structure of the newly proposed safety climate assessment tool along with a brief guideline is discussed in the next section.

4. DISCUSSION AND CONCLUSION

The review of the existing safety climate assessment tools presented in table 1 reflects some inconsistencies in many ways. For instance, what are the safety climate factors that could be relevant to the Omani construction industry? The existing tools are unable to answer this. Similarly, there is inconsistency in the existing tools because some tools are divided into factors, but others are not (Gittleman et al., 2010). Some tools have only two factors and some of them have up to eight factors. The confusion increases as some of these tools having the same difference were developed in the same year (DeArmond et al. 2011; Kines, et al., 2011). Similarly, the number of questions (items) in these tools which respondents need to answer as part of the assessment varies from 8 to 56. In the presence of such inconsistencies, a specific safety climate assessment tool developed based on the data collected in Oman was necessary for Omani construction organizations so that they could use such tool to enhance their safety performance. The new safety climate assessment tool developed in this study has a total of seven factors and 62 simple questions.

The new safety climate assessment tool is a continuation of the existing tools however differs from the existing tools not only based on the number of factors/questions but also the ranking of the factors used. Many similar studies rank the "management commitment" as the top leading factor in safety climate, however, the results of this study rank the "management commitment" as the third important factor that highly influence the safety climate in Oman (Zohar, 1980; Dedobbeleer and Beland, 1991; HSE (UK), (1997); Neal et al., 2000; Seo et al. 2004; Pousette et al. 2008; Kines, et al., 2011; CPWR, 2017). Organizational and management commitment was also considered important by Al-Tarawneh (2021) as it has a significant impact of job performance. Such commitment also provides better environments that produce highly motivated employees to attain organizational goals (Galli, 2020). Similarly, based on the mean score, in this study "Aligning And Integrating Safety As Value" is ranked first, however, in most previous studies; this factor was not used directly. For instance, Neal et al., (2000) refer to this as management value. Zohar (1980) used two different factors in his study namely "effects of safe conduct on promotion and "effect of safe conduct on social status" placed in his tool at the third and fourth position. Both factors adopted by Zohar in his safety climate tool, however, indicate the safety needs to be valued for the promotion of workers and the positive impact of social factors of safe acts needs to be acknowledged. In construction organizations, safety can, however, be valued by several means which should not be limited to workers' promotions or the social factors. The views of the respondents in this study at one side consider the "aligning and integrating safety as value" as one of the most important factors which are ranked as first, but on the other side, it reflects that this factor is currently not properly considered and there could be a huge positive impact on the construction organization safety climate. One of the possible reasons that why safety is not considered as a value in construction organizations in Oman is that most of the workers in the industry are expatriate as mentioned in table 2 and do not have the full rights of local citizens. This reason, however, needs to be further investigated. Safety communication in this study is ranked as six. The review of the previous studies as mentioned in table 1 shows that safety communication was used in a total of four safety climate tools (Neal et al., 2000; Pousette et al. 2008; Kines, et al., 2011; CPWR, 2017). The study conducted by Neal et al., 2000, placed safety communication at second in their eight factored safety climate assessment tool. Similarly, Pousette et al. 2008, placed safety communications at third in a four factored safety climate tool. The safety communication was placed at six in an eight factored safety climate tool developed by Kines, et al. (2011), and number five in a seven factored tool developed by the centre for construction research and training United States (CPWR, 2017).

The results and analysis of the data collected from the survey questionnaire show that different safety climate factors could be used to assess the current maturity level of the organization or project safety climate. The existing maturity level could be further used to select the items in each safety climate factor and develop different types of plans to improve the maturity of these items. The results show that out of total eight safety climate factors, seven were considered relevant, while one factor “Encouraging Owner/Client Involvement” did not attract much attention of the respondents and achieved an overall score of 2.78 on a scale of 1 to 5. Although, the mean score of this factor in more than 2.5, however, as 3 refers to neutral in the questionnaire, therefore this trigger that the respondents do not consider ‘owner or client involvement’ as much important that could improve safety performance. The score of remaining safety climate factors was in a significant range and therefore considered important factors to improve safety performance. Based on the individual mean score, all safety climate factors were ranked from 1 to 8 as shown in table 7. Two safety climate factors (aligning and integrating safety as a value, and Training At All Level) achieved the highest and similar score; therefore, both of them are raked as first. Similarly, each safety climate is factored in different items that could be implemented by the decision-maker to enhance the maturity level of the concerned safety climate dimension. Construction organizations can select all the items in a safety climate factor or may choose some of the items depending on their capabilities and available resources. It is, however, recommended that if a construction organization could not consider all the items in a safety climate factor, they may choose the top raked items in acceding order. For instance, if the maturity level (mean score) of the safety climate factor “Management Commitment” is 2, and the construction organization wishes to achieve a maturity level of 4.5, then that construction organization may consider all the items in “Management Commitment”. Since the ranking of the safety climate factors and its items presented in this research are based on the data collected from a variety of respondents from a limited number of construction organizations, it is; therefore, appropriate that construction organizations to consider all the items in a particular factor.

4.1. Structure of the Tool

Based on the result and analysis of the collected data, a safety climate assessment tool with a total of seven factors is prosed for construction organizations working in Oman. The safety climate factor “Encouraging Owner/Client Involvement” has been excluded from the tool due to a low mean

Table 7. ranking of Safety Climate Factors

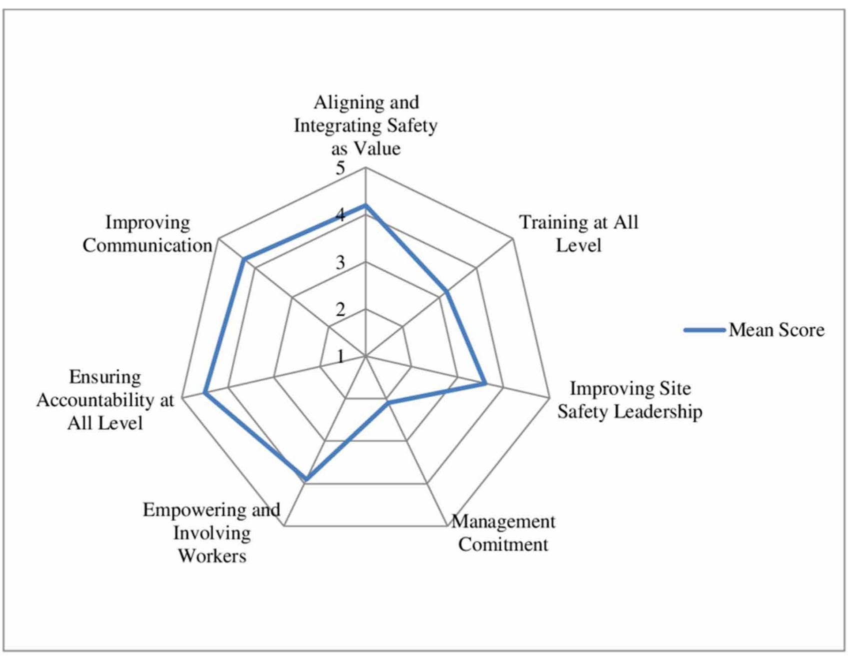
Safety Climate Factors	Rank
Aligning And Integrating Safety As Value	I
Training At All Level	I
Improving Site Safety Leadership	II
Management Commitment	III
Empowering And Involving Workers	IV
Ensuring Accountability At All Level	V
Improving Communication	VI
Encouraging Owner/Client Involvement	VII

score. Overall, there are nine main items in the proposed tool. The part I which has seven sub-items is related to ‘Personal / Background Information’. Part II of the tool is ‘Aligning and Integrating Safety as Value’ which has a total of 11 sub-items. Similarly, Part III of the proposed safety climate assessment tool is ‘Training At all Level’ which has a total of seven sub-items. Part IV of the tool is ‘Improving Site Safety Leadership’ which has a total of eight sub-items. Management commitment as a safety climate factor is included in part V and it has ten sub-items. Part VI of the safety climate assessment tool covers ‘Empowering and Involving Workers’ which is supported by seven sub-items. Ensuring Accountability at all Levels is covered in Part VII of the tool and has a total of 10 sub-items. Similarly, Part VIII covers ‘Improving Communication’ factors which have further nine sub-items. There is also Part IX in the proposed safety climate tool which can be used if the participants have any additional comments or feedback. Items in part II to part VIII have the option to record the response of the participant on a Likert scale of 1 to 5 (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree).

4.2. Guidelines to Use the Assessment Tool

Construction organizations that wish to use this safety climate tool for the assessment of their organization or project safety climate will have to finally calculate the mean value of each safety climate factor. 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 7 shows the results of a 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

Figure 7. Results of Safety Climate Assessment (Example)



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 "Aligning and Integrating Safety as Value" 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.

It is also important the construction organizations in Oman and the GCC region ensure that their employees feel free to participate in such an assessment. 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-collar 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 will not be anonymous. The other disadvantage of this method is that the workers in Oman and the GCC region are from different nationalities and it would be difficult for construction organizations to find the appropriate person to conduct the interview and record the response of the workers on the tool. Another solution to this situation is to develop a mobile application that 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.

Although the newly developed tool was appraised from the selected group managers working in different construction organizations, it is still important to monitor the effectiveness of the tool on a long-term basis. It is expected that the status and maturity of Oman and GCC construction will be enhancing in the near future, therefore the safety climate factors which are significant now may not be significant in the future. A review cycle for the current tool after each five is recommended. It is still not clear how small and medium construction organizations limited resources could be benefited from this tool. Since most of the construction organizations in Oman and the GCC region can be classified as small and medium enterprises, therefore further research in this area is therefore recommended to see how the safety climate approach will benefit such organizations.

The safety climate assessment tool along with appropriate guidelines is available on request to the corresponding author.

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Tariq Umar has completed his Ph.D. degree in construction management from London South Bank University and registered as a Chartered Civil Engineer (CEng)/International Professional Engineer (IntPE) with Engineering Council UK. He has more than 18 years of international experience involving different positions in industry and academia. He is an approved mentor of the Institution of Civil Engineers and helping graduate engineers to become professionally qualified engineers. He is also serving as member of the editorial board/advisor/reviewer for a number of journals. His research interests include, but are not limited to, construction management, safety and health, engineering sustainability, construction materials, renewable energy, waste and resources management, and construction 4.0. Tariq is also a fellow of AdvanceHE (FHEA). The following links provide some greater insight to his research contributions and professional history. Publons: https://publons.com/researcher/3523344/tariq-umar-phd-ceng-intpeuk-mice/ Scopus: https://www.scopus.com/authid/detail.uri?authorId=57191539961 Orcid: https://orcid.org/0000-0002-1197-8181 LinkedIn: https://www.linkedin.com/in/tariq-umar-phd-ceng-intpe-uk-mice-fhea-ab957852/ Engineering Council UK Case Study: https://www.engc.org.uk/news/case-studies/chartered-engineer-ceng/tariq-umar-phd-ceng-intpe-uk-mice/.

Nnedinma Umeokafor is a Chartered Construction Manager and a Senior Lecturer at Liverpool John Mores University, United Kingdom. His main area of research areas includes health, safety and wellbeing; regulation and compliance; construction and project management; and higher education research. He has over 60 output including articles in leading built environment, and health and safety journals, conferences proceedings and book chapters. While he is a Fellow of AdvanceHE (FHEA), a full member of Association for Project Management (MAPM), a Member of Institute of Leadership and Management (MInstLM), he is also a chartered member of Chartered Institute of Building (MCIOB).