International Journal of Ecosystems and Ecology Science (IJEES) **Vol. 13 (2):** 61-70 (2023)
https://doi.org/10.31407/ijees https://doi.org/10.31407/ijees13.2

SAFETY CLIMATE DIMENSIONS AS PREDICTORS FOR WORKER'S SATISFACTION REGARDING SAFETY LEVEL

Mohammed Alamoudi[1*]

[1*]*King Abdulaziz University, Faculty of Engineering, Department of Industrial Engineering, P.O. Box 80204, Jeddah 21589, Saudi Arabia;*

[*]Corresponding Author Mohammed Alamoudi, e-mail: mhsalamoudi@kau.edu.sa;

Received December 2022; Accepted January 2023; Published February 2023;

DOI: https://doi.org/10.31407/ijees13.208

ABSTRACT

Promoting awareness among construction workers about safety practices helps reduce occupational injuries. Therefore, the aims of this study are: First, to know which factors affect significantly the satisfaction level in each SC dimension using regression models. Second, to sort the factors in each dimension based on their significant effect on the satisfaction level. Third, to rank the dimensions based on their correlation with the overall satisfaction regarding safety. In the current study, 296 construction workers participated. The value of the Cronbach's alpha for all dimensions was 70%, and for each one it was between 71% and 86%, which indicates suitable level of reliability. According to the results, the sequence of the most significant dimensions were: The safety priorities and capabilities of management, management empowerment in safety, peer trust, trust in safety systems, and employees' safety commitment. The outcomes of this study will assist safety managers and decision makers in allocating resources on the most significant factors in the construction sector.

Key words: Safety climate, construction sector, regression analysis, correlation.

INTRODUCTION

In most countries, the construction sector is regarded as one of the most important economic pillars and as one of the most rapidly growing industries particularly in the developing countries. Unfortunately, with the importance of this sector, the number of accidents has increased. According to the Health and Safety Executive, 25% in the United Kingdom, 50% in Ireland, and 40% in Japan of all accidents occur on construction sites (Bomel 2001). In Saudi Arabia, with over than 12,000 accidents, the construction industry remained one of the most dangerous ones, in 2021 (Saudi Contractors Authority 2022). According to records, there were 199,100 workplace injuries in the US construction sector in 2018 (BLS. 2018). Furthermore, in the U.K., From 2016 to 2019, the annual number of occupational injuries in the construction sector was 54,000 (HSE 2020). Thus, most firms prioritize obtaining high levels of occupational safety. Consequently, there is a need to deconstruct and thoroughly examine the aspects influencing safety in this sector.

Construction is considered as labor-intensive industries that rely heavily on human workers. Safety is an essential element to run a construction work successfully. Therefore, reducing injuries in construction sector is an area of great importance. Safety practices help reduce injuries and fatalities in construction sector. There are various factors

that alter the safety performance of construction personnel. Therefore, one of the most relevant topics in safety engineering that evaluate several safety factors is safety climate (SC). To enhance workplace safety performance, SC has been extensively explored (Cooper and Phillips 2004; Glendon and Litherland 2001; Griffin and Neal 2000; Neal, Griffin, and Hart 2000). The term SC is defined as perceptions of policies, procedures, and practices relating to safety in the workplace (Choudhry and Fang 2008). The assessment of SC has been regarded as an important evaluation tool, because its evaluation is viewed as a technique of gathering knowledge regarding safety issues practically before they cause worker accidents (Bamel, Pandey, and Gupta 2020; Fugas, Silva, and Meliá 2012). Additionally, SC investigations can show cultural and organizational variables that cause accidents (Seo et al. 2004). The key advantage of analyzing workers' SC is its relationship with safety measures, accidents, and risky behaviors. As a result, the SC evaluation gives information on workers' perceptions of safety in the workplace, resulting in an efficient tool for assessing their safety performance in a given scenario (Gao et al. 2016; Pinion et al. 2018; Zahoor et al. 2017). Therefore, it is believed that researching SC is an important aspect in the avoidance of accidents and the enhancement of workplace safety (Wu et al. 2019). In fact, a low SC correlates to a poor degree of danger detection as well as safety risk perception (Pandit et al. 2019). As a result, numerous techniques of assessing SC have been presented (Marín et al. 2019), which are primarily based on Zohar's research of the various aspects of SC (Zohar 2010). Given the necessity of emphasizing human-centered methods for enhancing safety management, various research have looked into SC in various industries, such as, the construction industry (Kim et al. 2019; Mosly and Makki 2020), oil and mining industry (Jiskani et al. 2020; Kvalheim and Dahl 2016), healthcare (Lin, Lin, and Lou 2017), fire department (Taylor et al. 2019), and aviation sector (O'Connor et al. 2011).

Measuring SC provides an assessment of the general safety perception in an occupational settings. However, evaluating SC by itself is not enough. There is a need to dissect in detail to find out what the major and minor factors that could affect the level of SC. Therefore, researchers have used different mathematical models to predict the association of safety measures associated with the level of SC. These models provide a map for safety managers and decision makers to make accurate interventions to improve safety level. Regression models have been developed to understand and promote safety in construction sector. These models were powerful approaches in identifying practices that promote safety. Table 1 below summarizes the major studies that used different regression models to identify the major elements influencing SC.

Table 1. Summary of previous studies that applied regression models in assessing SC and determining the significant factors.

Authors	Statistical Tool	Sector	Significant factors
(Cooper and Phillips 2004)	Multiple regression Analysis	Manufacturing	Safety training Safety behavior.
(Saraih et al. 2021)	Regression Analysis	Manufacturing	Practices for safety management. Adherence to safety standards.
(Makki and Mosly 2021)	Logistic regression	Construction	Supervision, guidance, and inspection. Health-care coverage. Management's dedication to safety. Safety justice of management. Impact of coworkers.
(Brubakk et al. 2021)	Linear and logistic regression models.	Health care	Reporting of incidents. Teamwork. A work environment that is patient-centered. Staff dedication.
(Choudhry and Fang 2008)	Multiple regression analysis	Construction	Management commitment. Employee participation.
(Bosak, Coetsee, and Cullinane 2013)	Hierarchical regression analyses	manufacturing	Management dedication to safety. Safety priority. Production pressure.
(Tsung-Chih 2006)	Multiple regression analysis	laboratories	Managers' commitment. Action to safety.
(Choosong et al. 2022)	Multiple regression analysis	manufacturing	A positive perception regarding safety engagement.
(Geczik et al. 2022)	Regression analyses	fire department	Management Commitment Safety behavior. Organizational outcomes, and safety outcomes.
(Fang, Chen, and Wong 2006)	Logistic regression	construction	Safety experience and skill. Management competence. Individual safety attitude.

However, according to the literature, none of the previous research examined and sorted the dimensions and the critical items affecting SC in the construction sector, particularly in Saudi Arabia. Thus, the research questions that would be answered by the current study are:

- In each dimension, what are the most significant aspect that affect safety?
- What are the significant dimensions that significantly affect SC?
- On which factors and dimensions should the safety managers or decision-makers focus on?

Therefore, the aims of this research are; First, to know which factors affect significantly the satisfaction level in each SC dimension. Second, to sort the factors in each dimension based on their significant effect on the satisfaction level. Third, to rank the dimensions based in their importance.

MATERIAL AND METHOD

Methodology

The ultimate objective of the current research is to identify and rank the most important dimensions and items that significantly affect the SC. This will help managers and decision makers to allocate their resources in the most crucial elements that will improve the overall safety level in their organization. The framework of the current study starts by designing and distributing a questionnaire that evaluate the safety level in the construction sector. After collecting the data, a multiple regression model was developed for each dimension in the questionnaire. Tthese models predict the satisfaction level in each dimension based on the significant factors. Moreover, the correlation of the SC score in each dimension with the overall satisfaction level was calculated in order to rank the most important dimension that affect the overall satisfaction. Figure 1 below summarizes the framework of the study.

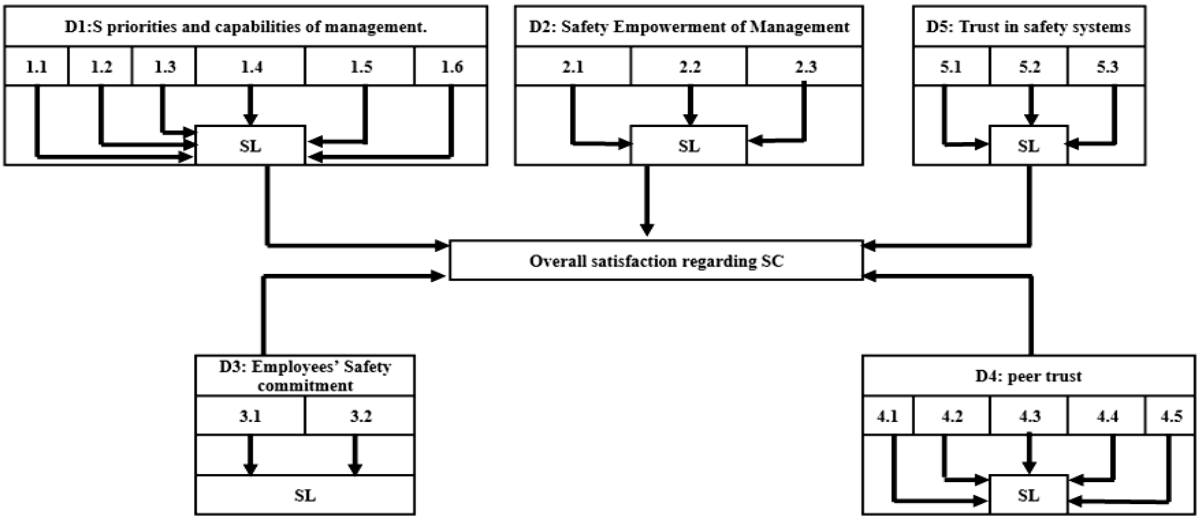

Figure 1. The framework of the current study. A regression equation was developed for each dimension to predict the satisfaction level (SL). Moreover, the correlation between the score dimensions and the overall satisfaction was calculated to sort the dimensions based in their importance.

Safety Climate Survey

A survey was constructed and distributed to the construction employees in Saudi Arabia. The survey consisted of 5 dimensions. Each dimension consisted of several items to assess the level of the SC. Moreover, the satisfaction level in each dimension was measured. At the end of the survey, an overall satisfaction level of the entire SC was evaluated. The survey consists of 19 questions distributed in five dimensions. Each question has a Likert scale rating of 1: strongly disagree, 2: disagree, 3: agree, and 4: strongly agree. One question evaluating overall satisfaction with regard to that dimension is added in each one. Briefly, the purpose of the questionnaire is to diagnose the SC and the satisfaction levels in each dimension, and to evaluate the overall satisfaction level for the SC. The dimensions of the

survey are: Dimension 1, safety priorities and capabilities of management. If managers are believed to be devoted to safety and to prioritize safety over other goals, safe conduct is expected to be rewarded and therefore perpetuated. Dimension 2, Management empowerment in safety, which assesses how employees perceive management empowerment and support for their engagement in safety decision making. Dimension 3, employees' safety commitment, which analyzes how employees react to workplace safety by displaying a commitment to safety, active safety promotion, and concern for one another's safety. Dimension 4, peer trust, which assesses how employees trust and communicate with one another. Dimension 5, trust in safety systems, which assesses how workers assess their safety systems, such as safety objectives, training programs and safety rounds. Table 1 below depicts the SC dimensions and the questions (items) in each one.

Table 2. Safety Climate (SC) dimensions, with their questions.

D1: safety priorities and capabilities of management	1.1	Management places a premium on safety.
	1.2	Safety information is communicated by management.
	1.3	Management makes stringent decisions on safety problems.
	1.4	Management is committed to following safety regulations.
	1.5	Management immediately takes remedial action.
	1.6	Safety objectives
	SL	Your Satisfaction level in D1.
D2: Management empowerment in safety	2.1	Management expertise in developing effective safety regulations.
	2.2	Employees are involved in policies affecting their safety.
	2.3	Management emphasizes worker competence in safety.
	SL	Your Satisfaction level in D2.
D3: Employees' Safety commitment	3.1	Workers share responsibilities for a well-organized workplace.
	3.2	Workers deal with newly identified dangers.
	SL	Your Satisfaction level in D3.
D4: peer trust	4.1	When a danger occurs, workers attempt to find a remedy.
	4.2	When employees work together, they feel safe.
	4.3	Workers have faith in one another's abilities.
	4.4	Workers consider each other's safety advice.
	4.5	Workers are free to discuss safety concerns.
	SL	Your Satisfaction level in D4.
D5: trust in safety systems	5.1	The importance of safety managers
	5.2	The importance of safety checkups.
	5.3	The importance of training.
	SL	Your Satisfaction level in D5.
Please state your overall satisfaction level to the SC in your organization		

Participants

Data was gathered from a number of Saudi construction firms. The questionnaires were distributed to 337 workers on significant projects. Participants might withdraw at any moment, and secrecy was guaranteed. Around 41 replies were excluded from the analysis due to missing or inaccurate data or exceeding the response time limit. At construction sites, safety managers and supervisors explained the survey to participants. Table 3 displays the recorded demographic statistics. Workers were not obliged to provide any personal information.

Table 3. Demographic Statistics of the participants.

Demographic Information		Participants (n = 296)
Age	20–30	78
	31–40	119
	41–50	72
	51–60	21
	>60	6
Education	Below primary education	12
	Primary education	147
	High-school education	92
	Higher education	45
Work Experience	<3	59
	3–5	97
	6–10	78
	11–15	32
	>15	30

Statistical Analysis

First, Cronbach's alpha was calculated to test the dimensions' reliability, globally (across all the dimensions), and individually for each dimension. Second, a regression equation model was developed for each dimension in order to find the significant factors affecting the satisfaction level inside each dimension. These models will be used to rand the factors that affect the satisfaction level in each dimension based on their weights (coefficients). Third, a correlation between the SC score in each dimension with the overall satisfaction level was calculated in order to rank the dimensions based on their importance. In all significance tests, p-value of 0.05 was applied. Moreover, SPSS was used for all statistical calculations.

Cronbach's alpha

Cronbach's alpha was utilized to assess the reliability of the study's dimensions and factors. Cronbach's alpha is a reliability coefficient measure that may be used to assess the internal consistency of tests, measurements, or survey items. This statistical method is used to test if a set of items consistently evaluates the same attribute. Cronbach's alpha, in other words, quantifies the degree of agreement. The reliability of Likert scale surveys was evaluated using Cronbach's alpha tests. Cronbach's alpha is calculated using the following equation:

$$\alpha = \frac{K}{K-1}\left[1 - \frac{\sum s_y^2}{s_x^2}\right]$$

Where,
K is the number of questions.
$\sum s_y^2$ is the sum of variance of the answers in each question.
s_x^2 is the variance of the total scores for all respondents.

Multiple Linear Regression Model

Linear regression analysis was applied in this study to examine the association between the SC's satisfaction level and the key items. The regression analysis model is applied to find how the satisfaction level of the SC may be predicted using the safety items and it is defined as:

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + \cdots + B_nX_n$$

Where,
Y is the satisfaction level (Dependent variable)
$X_1, \ldots, X_n$ *the items in each dimension, (independent variables)*
$B_0, \ldots, B_n$ *are the regression coefficients.*
Pearson's Correlation (ρ)
Pearson's Correlation (ρ) is a metric for calculating the linear correlation between two groups of data.

It is the ratio between the covariance and the product of standard deviations of two variables. Thus, it is a normalized measurement of the covariance, and it always varies between −1 and 1. Pearson's Correlation is calculated as follows:

$$\rho = \frac{cov(X, Y)}{\sigma_X \sigma_Y}$$

Where,
$cov(X, Y)$ *is the covariance of group X with group Y.*
σ_X *and* σ_Y *is the standard deviation of X, and Y, respectively.*

RESULTS

For each dimension, the coefficients of the regression equations model, the Cronbach's alpha, and the correlation of the scores in each dimension with the overall satisfaction are illustrated in Table 4. The value of the Cronbach's alpha for all dimensions was 70%, and for each dimension the value varied between 71% and 86%, which represents suitable reliability level (Chung et al. 1998).

Table 4. the coefficients of the regression equations model, the Cronbach's alpha, and the correlation between the score of each dimension with the overall satisfaction.

		D1	D2	D3	D4	D5
Coefficient	Question					
	1	0.19*	0.521**	0.769**	0.4**	0.241*
	2	0.3**	0.121*	0.649**	0.53**	0.073*
	3	0.227**	0.37**	-	0.877**	0.574**
	4	0.378**	-	-	0.751**	-
	5	0.152*	-	-	0.14*	-
	6	1.04**	-	-	-	-
R^2		0.79	0.743	0.606	0.814	0.724
Cronbach's α		0.77	0.86	0.72	0.73	0.75
Correlation (ρ) with OS		0.681	0.629	0.48	0.541	0.519

** P-value < 0.01
* P-value < 0.05

Discussion

Construction sector is considered one of the most hazardous industries because of the use of advanced, and heavy tools and machines. Promoting awareness among construction workers about safety practices helps reduce injuries. The main objective of this study are: to determine the weights of each item in each dimension, sort these items based on their weights, and rank the dimensions based on their correlation with the overall satisfaction level. According to the correlation between the scores in each dimension with the overall satisfaction of the workers, the ranking of dimension was as follow: The safety priorities and capabilities of management, management empowerment in safety, peer trust, trust in safety systems, and employees' safety commitment. Therefore, companies should focus on allocating resources based on the sequence mentioned in order to improve overall safety level with significant effect. Dimension 1: safety priorities and capabilities of management, which defines how managements are prioritizing safety over there work, and what their competencies in safety management are. This dimension was ranked the 1st position according to the correlation tables. Clearly, when management prohibits risk taking even if their schedule is tight, workers will perceive that their top management are appreciating their important assets, i.e., workers. Moreover, when the management is competent in safety, they will have enough knowledge and experience to assure their project and workers comply with safety standards, provide sufficient PPE, training session, and most importantly take immediate corrective action when risks are detected. When compared to workers, supervisors have a significantly better SC view (Mosly and Makki 2020). In this dimension the item that was ranked the 1st position was item 1.6, which was safety objectives. Specifying clear and direct safety objectives will give the workers, from

their first days at work, how the company understands safety and how they are protecting their workers. Furthermore, participants responded that setting specific safety goals is highly essential to them since it demonstrates the firms' commitment to safety. Furthermore, it demonstrates managerial expertise in terms of workplace safety (Alamoudi 2022). The 2nd item was 1.4: Management is committed to following safety regulations. Another important attribute, in addition to safety objectives, is how the company is translating and delivering these objectives in terms of training, experienced safety managers, PPE, and frequent maintenance of their equipment. The 3rd item was 1. 2, how management communicate safety information. Companies should deliver and convey safety information in a clear, easy, and understandable way to all workers regardless of their background and their education level. The 4th most important item was 1.3: strict judgment. This item means that companies are investigating the reasons of the risks or accidents without blaming workers to prevent its occurrence in the near future.

The dimension that was ranked the 2nd place was the D2: Management safety empowerment, which shows how companies are emphasizing and elaborating safe environment to their workers. Clearly, workers' perceptions of management empowerment and support for safety decisions involvement, will increase safety levels. Item 2.1 was ranked the 1st position in this dimension. According to the regression model, designing safety rules by itself is not enough, but the creation of effective safety directory, guidelines, and instructions will reduce risks and accidents probabilities. The 2nd most crucial item in this dimension was 2.3: management emphasized worker competence in safety. Workers say that to enhance the safety level, manager should ensure that all workers must be experienced and well trained on how to deal with risks and hazards. According to the participants, the least important item was 2.2: Employees are involved in policies affecting their safety. The reason behind that might be management do not listen to the workers either because of the language barrier, or they might think that workers may not have enough experience and knowledge in safety. However, field workers are considered the first line soldiers who face dangers directly during their work every day. Therefore, management should always listen to their workers and apply what they think is important and appropriate.

Communication, learning, and trust among peers the (D4) was on the 3rd position according to the workers' rating. This dimension indicates how workers are trusting, communicating, and learning from each other at their workplace. If team members communicate well with one another, the SC may have a significant influence on the project's safety level (Zamani, Banihashemi, and Abbasi 2020). A research that investigated the association between safety and quality using information and communication technology discovered that this technology might lead to a 90% reduction in risky behaviors (Shohet et al. 2019). Maintaining high levels of safety through communication can have synergistic benefits among workers (Rani et al. 2022). Communication between management and workers on safety is critical for improving safety performance (Alsamadani et al. 2013; Chan et al. 2014). In terms of items, workers competence was the 1st one. Of course, working with expert people will give the workers the confidence in terms of safety and facing dangers. Previous research has revealed that more experienced workers had more trustworthy views (Han et al. 2019). Furthermore, item 4.2, which indicates that workers feel safe when working together, was on the 2nd position. According to one study, workers who worked in a positive coworker SC, were able to change their negative effect of risk perception into a positive effect of motivation and behavior (Xia et al. 2020). On the 3rd position, item 4.4 was ranked. Workers usually listen to each other when getting instructions regarding safety, because as mentioned earlier workers are the first people who face dangers together. This result confirms the result of the previous one that workers feel confident when working with well-trained people. On the final position, item 4.5 was positioned. This item shows if workers talk freely about safety or not. The reason behind this positioning could be that management do not listen to workers about safety recommendations, because they might think that workers do not have enough experience in safety or because of the language barrier as mentioned earlier.

On the 4th position, D5: trust in safety system, was positioned. This dimension indicates the importance of safety supervisors and managers, safety checkups, and training session in risk prevention. In terms of items, the most important one was safety training sessions. Several studies have examined the association of SC with safety training programs. A study conducted in Hong Kong and China, discovered that safety training programs can enhance the safety atmosphere of construction employees (Patel and Jha 2016). In addition, It was discovered that certain construction workers did not obtain adequate formal safety training, which was linked to poor SC and safety outcomes (Meng et al. 2021). Safety manager was the 2nd important one. Clearly, the presence of competent safety manager will assure that all workers follow safety rules, and strategies. Top management in construction sites, such as project managers, have an important role in deciding site safety. Safety managers must perform the necessary remedial steps to decrease the likelihood of accidents caused by personnel' risky work conduct (Meng et al. 2021). Moreover, expert managers will provide adequate training sessions for the workers. This result confirms item 1.1 outcome. Item 5.3: safety checkups, was ranked as the 3rd position. Safety checkup rounds conducted by expert

safety managers, or supervisors enable the discovery of risk and hazards before its occurrence, which may prevent serious accidents in the future.

Dimension 3 was ranked the 5th position. This dimension measures the workers' commitment to safety in their workplace. Item 3.3 was ranked the 1st position. This item indicates workers' responsibility towards their colleagues in terms of safety assurance. Workers are sharing safety responsibility, because they are sharing workplaces, tools, and equipment as well. Moreover, when workers are competent in safety, trusting each other, and sharing responsibility, they will strive to reach high level of safety. Furthermore, a study that assessed workplace SC discovered that supervisors who perceived a safe environment and employees who are devoted to safety interrelate to build an effective and safe workplace system (Stackhouse and Turner 2019). On the 2nd position item 3.4 was located. It indicates if workers are addressing newly recognized threats or not. The reason behind this position could be that workers might fear sanctions from their top management or the language differences that does not allow them to express and explain their suggestions (Roelofs et al. 2011). Nevertheless, Preventing near-miss incidents may save lives in the future (Hawkins and Fuller 1996).

CONCLUSIONS

Because of the rapid pace and usage of complex and heavy tools and machines, construction is considered as one of the most hazardous industries. Promoting awareness among construction workers about safety practices helps reduce injuries. Therefore, the aims of this study are: First, to know which factors affect significantly the satisfaction level in each SC dimension. Second, to sort the factors in each dimension based on their weights on the satisfaction level. Third, to rank the dimensions based on their importance. The outcomes of this research will provide decision makers and managers on which aspect they should focus and allocate their resources on. In summary, according to the results of D1: safety priorities and capabilities of management, the most important item was specifying clear and understandable safety objectives. In D2: management safety empowerment, the most crucial item was management competence in designing safety rules. In D4: communication, learning, and trust among peer, the most vital item was workers' competence in dealing with risks and hazards. In D5: workers' trust in safety systems, the most essential item was training session on how to mitigate risks and improve safety level. In D3: and employees' safety commitment, the most critical item was workers' common responsibility in safety. The study's limitations should be mentioned. To begin with, only field employees took part in the study; There were no office employees or supervisors included, and they may see the SC differently from field employees. As a result, future research might use the suggested approach to assess and compare SC across different levels of the workforce, and to identify the precise differences in each dimension of the SC. Second, the survey used evaluated the SC subjectively. Nevertheless, incorporating objective assessments, such as the number of injuries or accidents, may help to eliminate personal biases. Furthermore, future study might use the suggested technique in a comparative between existing and enhanced SC in a certain industry.

REFERENCES

1. Alamoudi, Mohammed. 2022. "The Integration of NOSACQ-50 with Importance-Performance Analysis Technique to Evaluate and Analyze Safety Climate Dimensions in the Construction Sector in Saudi Arabia." *Buildings* 12(11): 1855;
2. Alsamadani, Rayyan, Matthew R. Hallowell, Amy Javernick-Will, and Jacinto Cabello. 2013. "Relationships among Language Proficiency, Communication Patterns, and Safety Performance in Small Work Crews in the United States." *Journal of Construction Engineering and Management* 139(9): 1125–34;
3. Bamel, Umesh Kumar, Ritesh Pandey, and Amit Gupta. 2020. "Safety Climate: Systematic Literature Network Analysis of 38 Years (1980-2018) of Research." *Accident Analysis & Prevention* 135: 105387;
4. BLS. 2018. "Employer-Reported Workplace Injuries and Illnesses—2018." *https://www.bls.gov/news.release/archives/osh_11072019.pdf*.;
5. Bomel. 2001. *Improving Health and Safety in Construction, Phase 1: Data Collection, Review and Structuring*. Sudbury: HSE Books;

6. Bosak, Janine, W.J. Coetsee, and Sarah-Jane Cullinane. 2013. "Safety Climate Dimensions as Predictors for Risk Behavior." *Accident Analysis & Prevention* 55: 256–64;
7. Brubakk, Kirsten et al. 2021. "Hospital Work Environments Affect the Patient Safety Climate: A Longitudinal Follow-up Using a Logistic Regression Analysis Model." *PLOS ONE* 16(10): e0258471;
8. Chan, Albert P. C., Arshad Ali Javed, Francis K. W. Wong, and Carol K. H. Hon. 2014. "Improving Safety Communication of Ethnic Minorities in the Construction Industry of Hong Kong." In *ICCREM 2014*, Reston, VA: American Society of Civil Engineers, 463–74;
9. Choosong, Thitiworn, Supeecha Rungruang, Kittisak Choomalee, and Thanita Sirirak. 2022. "Exploratory Analysis of the Nordic Safety Climate Questionnaire - Thai Version and Safety Climate among Thai Employees." *International Journal of Occupational Safety and Health* 12(3): 171–79;
10. Choudhry, Rafiq M., and Dongping Fang. 2008. "Why Operatives Engage in Unsafe Work Behavior: Investigating Factors on Construction Sites." *Safety Science* 46(4): 566–84;
11. Chung, Kevin C., Matthew S. Pillsbury, Madonna R. Walters, and Rodney A. Hayward. 1998. "Reliability and Validity Testing of the Michigan Hand Outcomes Questionnaire." *The Journal of Hand Surgery* 23(4): 575–87;
12. Cooper, M.D., and R.A. Phillips. 2004. "Exploratory Analysis of the Safety Climate and Safety Behavior Relationship." *Journal of Safety Research* 35(5): 497–512;
13. Fang, Dongping, Yang Chen, and Louisa Wong. 2006. "Safety Climate in Construction Industry: A Case Study in Hong Kong." *Journal of Construction Engineering and Management* 132(6): 573–84;
14. Fugas, Carla S., Sílvia A. Silva, and José L. Meliá. 2012. "Another Look at Safety Climate and Safety Behavior: Deepening the Cognitive and Social Mediator Mechanisms." *Accident Analysis & Prevention* 45: 468–77;
15. Gao, Ran, Albert Chan, Wahyudi Utama, and Hafiz Zahoor. 2016. "Multilevel Safety Climate and Safety Performance in the Construction Industry: Development and Validation of a Top-Down Mechanism." *International Journal of Environmental Research and Public Health* 13(11): 1100;
16. Geczik, Ashley M. et al. 2022. "Size Matters: How Safety Climate and Downstream Outcomes Vary by Fire Department Organization Type." *Injury Epidemiology* 9(1): 11;
17. Glendon, A.I, and D.K Litherland. 2001. "Safety Climate Factors, Group Differences and Safety Behaviour in Road Construction." *Safety Science* 39(3): 157–88;
18. Griffin, Mark A., and Andrew Neal. 2000. "Perceptions of Safety at Work: A Framework for Linking Safety Climate to Safety Performance, Knowledge, and Motivation." *Journal of Occupational Health Psychology* 5(3): 347–58;
19. Han, Yu et al. 2019. "Defining and Testing a Safety Cognition Framework Incorporating Safety Hazard Perception." *Journal of Construction Engineering and Management* 145(12);
20. Hawkins, R D, and C W Fuller. 1996. "Risk Assessment in Professional Football: An Examination of Accidents and Incidents in the 1994 World Cup Finals." *British Journal of Sports Medicine* 30(2): 165–70.
21. HSE. 2020. "Construction Statistics in Great Britain.", *https://www.hse.gov.uk/statistics/industry/construction.pdf*;
22. Jiskani, Izhar Mithal et al. 2020. "Distinctive Model of Mine Safety for Sustainable Mining in Pakistan." *Mining, Metallurgy & Exploration* 37(4): 1023–37;
23. Kim, Ng Khean, Noor Fareen Abdul Rahim, Mohammad Iranmanesh, and Behzad Foroughi. 2019. "The Role of the Safety Climate in the Successful Implementation of Safety Management Systems." *Safety Science* 118: 48–56;
24. Kvalheim, Sverre A., and Øyvind Dahl. 2016. "Safety Compliance and Safety Climate: A Repeated Cross-Sectional Study in the Oil and Gas Industry." *Journal of Safety Research* 59: 33–41;
25. Lin, Ying-Siou, Yen-Chun Lin, and Meei-Fang Lou. 2017. "Concept Analysis of Safety Climate in Healthcare Providers." *Journal of Clinical Nursing* 26(11–12): 1737–47;
26. Makki, Anas A., and Ibrahim Mosly. 2021. "Predicting the Safety Climate in Construction Sites of Saudi Arabia: A Bootstrapped Multiple Ordinal Logistic Regression Modeling Approach." *Applied Sciences* 11(4): 1474;
27. Marín, Luz S., Hester Lipscomb, Manuel Cifuentes, and Laura Punnett. 2019. "Perceptions of Safety Climate across Construction Personnel: Associations with Injury Rates." *Safety Science* 118: 487–96;
28. Meng, Xiangcheng, Alan H.S. Chan, Lester K.H. Lui, and Yongle Fang. 2021. "Effects of Individual and Organizational Factors on Safety Consciousness and Safety Citizenship Behavior of Construction Workers: A Comparative Study between Hong Kong and Mainland China." *Safety Science* 135: 105116;

29. Mosly, Ibrahim, and Anas A. Makki. 2020. "Safety Climate Perceptions in the Construction Industry of Saudi Arabia: The Current Situation." *International Journal of Environmental Research and Public Health* 17(18): 6717;
30. Neal, A, M.A Griffin, and P.M Hart. 2000. "The Impact of Organizational Climate on Safety Climate and Individual Behavior." *Safety Science* 34(1–3): 99–109;
31. O'Connor, Paul, Angela O'Dea, Quinn Kennedy, and Samuel E. Buttrey. 2011. "Measuring Safety Climate in Aviation: A Review and Recommendations for the Future." *Safety Science* 49(2): 128–38;
32. Pandit, Bhavana, Alex Albert, Yashwardhan Patil, and Ahmed Jalil Al-Bayati. 2019. "Impact of Safety Climate on Hazard Recognition and Safety Risk Perception." *Safety Science* 113: 44–53;
33. Patel, D.A., and K.N. Jha. 2016. "Evaluation of Construction Projects Based on the Safe Work Behavior of Co-Employees through a Neural Network Model." *Safety Science* 89: 240–48;
34. Pinion, Clint, James Klyza, Shelley Brewer, and David Douphrate. 2018. "North American Engineering, Procurement, Fabrication and Construction Worker Safety Climate Perception Affected by Job Position." *Safety* 4(2): 14;
35. Rani, Hafnidar A. et al. 2022. "Factors Affecting Workplace Well-Being: Building Construction Projects." *Buildings* 12(7): 910;
36. Roelofs, Cora, Linda Sprague-Martinez, Maria Brunette, and Lenore Azaroff. 2011. "A Qualitative Investigation of Hispanic Construction Worker Perspectives on Factors Impacting Worksite Safety and Risk." *Environmental Health* 10(1): 84;
37. Saraih, Ummi Naiemah, V. I. Maniam, W. Muhamad Radzi Wan Norsyafawaty, and Md. Isa Evawaynie Valquis. 2021. "Safety Behaviour among Employees in the Malaysian Manufacturing Company: What Really Matters?" In , 020179;
38. Saudi Contractors Authority. 2022. "Construction Companies Statistics." *https://www.muqawil.org/public/publications/22382cf1827f13e0c8d180b742f29aaeec1a8524.pdf* ;
39. Seo, Dong-Chul, Mohammad R. Torabi, Earl H. Blair, and Nancy T. Ellis. 2004. "A Cross-Validation of Safety Climate Scale Using Confirmatory Factor Analytic Approach." *Journal of Safety Research* 35(4): 427–45;
40. Shohet, Igal M. et al. 2019. "Integrated Communication, Control, and Command of Construction Safety and Quality." *Journal of Construction Engineering and Management* 145(9);
41. Stackhouse, Madelynn, and Nick Turner. 2019. "How Do Organizational Practices Relate to Perceived System Safety Effectiveness? Perceptions of Safety Climate and Co-Worker Commitment to Safety as Workplace Safety Signals." *Journal of Safety Research* 70: 59–69;
42. Taylor, Jennifer A. et al. 2019. "Development and Validation of the Fire Service Safety Climate Scale." *Safety Science* 118: 126–44;
43. Tsung-Chih, Chin-Chung Li. 2006. "A Multiple Regression Analysis on Safety Performance in University Laboratories ." *World Transactions on Engineering and Technology Education* 5(3): 449–52;
44. Wu, Xiang, Jingqi Gao, Yuanlong Li, and Chunlin Wu. 2019. "Development of A Safety Climate Scale for Geological Prospecting Projects in China." *International Journal of Environmental Research and Public Health* 16(6): 1082;
45. Xia, Nini et al. 2020. "A Dual Perspective on Risk Perception and Its Effect on Safety Behavior: A Moderated Mediation Model of Safety Motivation, and Supervisor's and Coworkers' Safety Climate." *Accident Analysis & Prevention* 134: 105350;
46. Zahoor, Hafiz et al. 2017. "Modeling the Relationship between Safety Climate and Safety Performance in a Developing Construction Industry: A Cross-Cultural Validation Study." *International Journal of Environmental Research and Public Health* 14(4): 351;
47. Zamani, Vahid, Seyed Yaser Banihashemi, and Alireza Abbasi. 2020. "How Can Communication Networks among Excavator Crew Members in Construction Projects Affect the Relationship between Safety Climate and Safety Outcomes?" *Safety Science* 128: 104737;
48. Zohar, Dov. 2010. "Thirty Years of Safety Climate Research: Reflections and Future Directions." *Accident Analysis & Prevention* 42(5): 1517–22;