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Perceptions of Safety Climate in Construction Projects between Workers and Managers/Supervisors in the Developing Country of Iran

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Abstract: What are the different perceptions on safety climate (SC) by workers and managers/supervisors engaged in the construction industry of developing countries? Reconciling these two differing views is pivotal for mitigating and avoiding both the injured and fatal accidents in the construction industry, especially in those developing countries where safety conditions are poor and unpredictable, and safety measures are inadequate in most cases. To answer this research question, the collective perceptions of 118 construction workers and 123 managers/supervisors on the SC in construction projects in Iran were gleaned and investigated. In particular, these perceptions were initially collected by two different empirical surveys validated by a sample of university professors and construction managers and then analyzed through the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity under factor analysis, together with a one-sample *t*-test. Results indicated that "workers' attitudes and perceptions", "safety knowledge and training", "working relationships and roles of colleagues", and "workers' risk perceptions" are important categories of SC factors perceived by construction workers, whereas "safety rules and management practices" is the essential category of SC factors discerned by managers/supervisors. The difference in perceptions between workers and managers/supervisors is considered to be beneficial for an overall understanding of SC in general and for developing countries in particular. Moreover, a series of effective suggestions for improving SC in the construction industry of developing countries are provided with reference to each category. The views of SC factors are reinforced as a social process combining the synergies of workers and managers/supervisors, as well as proper safety training to be pushed forward as an essential activity that should be incorporated in human resources development of construction organizations so as to improve the existing level of SC, leading to fewer accidents at the industry level.

Keywords: safety climate; safety culture; construction industry; construction management; project management; safety behavior; developing countries; Iran

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1. Introduction

The socio-economic development of countries is often dependent on their construction industry, which is classified as a high hazard industry where workers are normally engaged in activities that can expose them to serious hazards. Although great developments have been made as a result of improving preventive measures, the rates of both fatalities and injuries are still unacceptably high [1,2]. In this regard, unsafe behaviors are known to be

direct causes of accidents and have been discovered to be predicted by the perceived safety climate (SC) [3]. SC is considered a subset of organizational climate; "it implies a subjective perception and evaluation of safety issues related to the organization, its members, structures and processes, based on the experience of the organizational environment and social relationships" [4], p. 950. A literature review of SC has been able to predict important safety results, such as perceived risks, accidents and injuries [5], in that ethnic minorities perceive risks differently with respect to local workers and are more prone to be victims of accidents than their local counterparts [6], and that workers with religious beliefs tend to have more positive perceptions of SC than those without such beliefs [7].

However, notwithstanding the proliferation of research produced [8,9], very few research studies have compared safety climate scores between management staff and workers, as pointed out by a recent review of SC in the construction industry [10], p. 544. This is an important research gap necessary to be filled up due to the fact that, unlike workers, management's responses to safety climate questions may reflect a more idealized SC. Moreover, most construction research studies focusing on sustainable construction in general [11,12], and SC in construction in particular, have been conducted in developed countries with a homogenous western cultural environment, such as the USA, UK and Canada, or some Eastern countries, such as China, Singapore, Hong Kong, and Australia [13]. Since very few have focused their attention on developing countries [14–16], this study leaves a research gap due to the fact that cultural dimensions are positively correlated with SC because SC invariably influences the safety perceptions and behaviors of construction workers [15,17]. Looking at the perceptions of SC in developing countries, this is even more important due to the higher number of injuries and fatalities when compared to developed countries, mainly due to the scarce spending on and inadequate execution of construction site safety measures [18]. From this, the following research question clearly emerges: "What are the different perceptions on safety climate by workers and managers/supervisors engaged in the construction industry of developing countries?"

In order to answer the above research question, two respective separate surveys were conducted to collect data and opinions from 118 workers and 123 managers/supervisors engaged in the Iranian construction industry. Survey results were analyzed through the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity under factor analysis, together with a one-sample *t*-test. The results revealed that workers' attitudes and perceptions, safety knowledge and training, working relationships and roles of colleagues, and workers' risk perceptions, are perceived by workers as playing a significant role in impacting their perceptions on SC, whereas only managers and supervisors have not perceived "safety rules and management practices" as an effective category of employees' perceptions of SC factors.

The results of this study aim to shed light on the different perceptions on SC by workers and managers/supervisors engaged in the construction industry of developing countries. In this regard, the generated results will become very important for industrial practitioners, especially project managers and safety managers employed in the construction sector of developing countries. They provide not only a general description of the perceived state of safety climate at their construction sites in developing countries, but also put forward some valuable suggestions for preventive safety actions based on a clear identification of each major safety issue. Yet, the existing literature exploring the perceptions of SC is advanced by considering the case of developing countries that reflects both perceptions of worker employees and managers/supervisors. From this, this work does not intend to propose another scale of SC, mainly because "much of the work in this field has focused on methodological rather than theoretical or conceptual issues" ([13], p. 1517), but to offer a holistic evaluation of SC factors and their contextual peculiarities.

2. Theoretical Background

2.1. Safety Climate and Safety Management in the Construction Industry

Risk refers to the exposure to a hazard (risk factor). Thus, safety is an antonym for risk and aims to eliminate the actual risks present at the worksite [19–22]. Safety also seeks to prevent the impact of agents that minimize the expected quality of the product or offset the result of the work, thus wasting the efforts made to realize something [23]. Within the construction industry, safety management focuses on reducing the likelihood of the occurrence of major disasters and work-related accidents. The key factors influencing safety management in this context include financial stress, unsafe working conditions, safety training, uncontrollable site hazards, and compliance of key contractors, managers, and workers with safety responsibilities [24].

Stemming from the above, a series of scholars have identified that in order to improve the safety conditions of a construction worksite, more focus has recently been placed on SC [25,26], defined as the perception of employees on the importance of safety in the organization at a specific time [10,27,28]. From this, SC is a subset of safety culture and it examines the perceptions of employees regarding the worksite, the level of interest in safety management, and the degree of participation in safety procedures [29]. SC can also be described as a temporary and brief image of a culture that is reflected in the employees' shared perceptions of the organization at a particular time [30]. In this regard, one study [31] identified the key dimensions of SC in construction projects and showed: (i) the impact of safety management support and staff involvement in the SC of the construction team, and that (ii) safety practices and policies were among the most important dimensions of SC. Therefore, the importance of the SC is related to the ability to predict safe behavior [32]. From this, SC has been defined as a set of policies, methods, and rewards related to safety issues perceived by employees [33].

2.2. Safety Perceptions and Understanding

Understanding the SC at the worksites and the attitudes of workers is an important factor in assessing safety needs [34]. In this regard, SC is conceived as a sum of the beliefs of employees about their perceptions of safety at the worksite [35]. Perceptions of workers of safety at the worksite are directly correlated with occupational accidents; employees who understand their job safety are less likely to be involved in an accident than employees who perceive their job as relatively dangerous. Moreover, employees who perceive themselves as working in a safe environment report a lower level of work-related anxiety and stress [36]. Hence, SC is a reference that guides behaviors. However, employees' perceptions about safety and attitudes in an organization are different to those at the worksite and need to be identified in different situations, such as different job positions and types of contract. This has been also advanced by a review [10], in which, unlike workers, management's responses to safety climate questions may reflect a more idealized SC.

Some studies have been conducted on the different perceptions of workers and managers/supervisors in the construction industry. One example is a survey of the perceptions of workers and supervisors of three Australian organizations in the field of construction [37]. The results showed that the first level of understanding of supervisors for the commitment of senior managers toward safety plays an important role as a communication mechanism between SC and injury rate. However, the majority of studies did investigate those two populations independently. For instance, some scholars examined the perceptions of safety leaders of SC in a large construction organization in Australia and identified that leadership was a key factor for a positive SC in construction projects [38]. A model for the formation of a psychological SC in construction project management, based on workers' perceptions, was developed [39]. This model showed that management can create the desired mental SC from a structural, perceptual, interactive, and cultural perspective. One study [7] investigated the perceptions of workers (without any comparison with managers/supervisors) on SC in construction projects. The results of this research showed that workers with religious backgrounds take more interest in positive safety perceptions in comparison with those

with no religious beliefs. Furthermore, workers employed by subcontractors often have a more positive perception regarding safety when compared to those directly employed by the main contractor. These results can assist in the establishment of the safety culture and improvements on safety performance in the construction sector. Although studies on SC and safety culture have been around for more than three decades, no universally accepted theory regarding SC or safety culture exists.

In light of the above, a series of empirical papers have been produced, leading to different and, sometimes, contrasting results. Indeed, stemming from the fact that surveys with a sufficient sample size are the most common data collection methodologies used in SC studies, different categorizations emerge for factors in SC surveys. For example, some scholars reported the following clusters: organizational, management, and human [40]. Within these categories, there are a series of sub-factors, such as the perceptions of safety management commitment, safety management systems perceptions, risk perceptions, work pressure, workload, speed of work, and general competence of workers. The summary of discussions regarding SC indicates that the identified dimensions of SC studies are mainly related to the perception of employees of their organizational characteristics and competence. Based on surveys, SC assessment is performed by examining perceptions of workers on safety management commitment, safety management systems perceptions, employee competence and risk perception, physical work environment, safety monitoring and inspection, and relationships. There is no account, within these surveys, of the perception of managers/supervisors.

For this study, factors affecting SC that were extracted from the literature review are presented in Table 1. Stemming from this account of the literature, this work uses surveys to assess the attitudes and perceptions of employees and managers/supervisors in order to describe the construction SC in Iran.

Table 1. Safety climate contributors extracted from desktop literature review.

No.	Categories	Safety Climate Factors	References
1	Workers' attitudes and perceptions	Safety understanding and perceptions of personnel	[32,36,41,42]
2		Nationality and culture	[7,42]
3		Religion	[7,42]
4		Fatalism	[7]
5		Optimism	[14]
6		Economic characteristics, psychological characteristics, and self-esteem of employees	[41,42]
7	Safety knowledge and training	Risk defining, safety training	[30,41,43,44]
8		Competence, responsibility, knowledge and personal motivation	[41,45–49]
9		Approaches and safety equipment	[14,43]
10		Work pace, pressure, and value	[14,31,41,46,47]
11	Working relationships and roles of colleagues	Responsible for security and communications and supervisor support	[14,38,50]
12		Employee engagement in safety and knowledge transfer through team collaboration	[20,30,41,48,49]

Table 1. *Cont.*

No.	Categories	Safety Climate Factors	References
13	Workers' risk perceptions	Security of worksite	[31,48]
14		Safety level at worksite and workers' perceptions	[32,36,41,46,48,51]
15		Employee risk-taking at work (severe effects of age, sex, experience)	[41]
16	Safety rules and management practices	Safety rules and regulations	[14,30,31,46]
17		Positive safety decisions and efficiency of procurement	[32,46,48,50,51]
18		Commitment, recognition, and perception of management toward safety	[20,29–32,36,38,44,46,47]
19		Employment	[7,41,42]
20		Job security	[14,41]
21		The effects of safe behaviors on the promotion of employees	[41]
22		The effects of safe behaviors on social situations	[41]

3. Research Methodology

3.1. Research Design

In line with other similar studies [46,52], the data collection method and analysis have been described in four steps.

First, a comprehensive literature review was conducted to identify a list of major causes and consequences of safety failures (Table 1). Second, an expert workshop was organized and an empirical survey form was developed to review the list of factors with university professors and project managers to fine-tune and confirm the contents and to ensure the adequacy and clarity of the key factors under study.

The research context is the Iranian construction industry, which has been considered as a suitable country due to the fact that, according to statistics from the Social Security Organization of Iran in 2012, 5479 work-related accidents were registered in the construction industry, accounting for 26.69% of all work-related accidents throughout the country.

Third, once the key factors impacting safety climate were finalized, two respective surveys were launched to measure safety climate. One of the surveys targeted construction workers and examined their attitudes and behaviours towards safety at construction sites. The other survey aimed at managers and supervisors to assess their attitudes towards safety and monitor their project safety performance. As it is natural that the perceptions of safety performance vary among workers and managers/supervisors working at the same construction site, data and opinions were gathered that were as large as possible to ensure the collection of representative understanding of these perceptions and to maintain statistical validity. In this regard, a structured interview followed by an empirical survey on the effect of each identified factor on workers' perceptions about SC was undertaken to collate and summarize the influencing factors. Fourth, the collected data were analyzed by using the SPSS software program.

3.2. Sample Size, Data Collection and Tools for Data Analysis

Initially, Cochran's formula with an unlimited statistical population was applied to determine the sample size of the participants in the study (Equation (1)).

$$n = \frac{z\alpha_{/2}{}^2\sigma^2}{e_0{}^2}, \quad (1)$$

where: $z\alpha_{/2} = 1.96$, and $e_0 = 0.05$, $\sigma_1^2 = 0.768$, and $\sigma_2^2 = 0.800$.

Thus,

$$n_1 = \frac{z\alpha_{/2}{}^2\sigma_1^2}{e_0{}^2} = \frac{3.8416 \times 0.768}{0.0025} = 118 \; n_2 = \frac{z\alpha_{/2}{}^2\sigma_2^2}{e_0{}^2} = \frac{3.8416 \times 0.800}{0.0025} = 123 \quad (2)$$

In Equation (1), the value of σ^2 represents the variance obtained from the pilot study, which included 20 subject matter experts. The data collected from the 20 experts regarding the workers' survey resulted in a variance value of 0.768. The data obtained from the 20 experts who reviewed the managers' and supervisors' survey led to a variance equal to 0.800. The value of the Z-score, $z\alpha_{/2}$, is also a constant value that depends on the confidence interval and the error level. In this study, the error level (e_0) was set to 0.05, and thus, the confidence level is 95%. Therefore, the value of $z\alpha_{/2}$ at the 95% confidence level is 1.96. Plugging this information into Equation (1), the sample size for the surveys of workers and managers/supervisors is 118 and 123, respectively (see Equation (2)). The breakdown of respondents and their characteristics is outlined in Table 2.

Table 2. Demographics of survey respondents.

Basic Information	Category	No. of Workers (%)	Category	No. of Managers/Supervisors (%)
Education	Bachelor	49 (41%)	Doctorate	19 (15%)
	No diploma	38 (32%)	Master's	48 (39%)
	No diploma	31 (25%)	Bachelor	56 (46%)
Work Experience	Over 30	10 (8%)	Over 30	5 (4%)
	20 to 30	11 (9%)	20 to 30	10 (8%)
	10 to 20	32 (27%)	10 to 20	48 (39%)
	Below 10	65 (55%)	Below 10	60 (49%)
Gender	Female	10 (8%)	Female	29 (24%)
	Male	108 (92%)	Male	94 (76%)
Age	Over 50	16 (13%)	Over 50	15 (12%)
	40 to 50	17 (14%)	40 to 50	25 (20%)
	30 to 40	34 (29%)	30 to 40	38 (31%)
	Below 30	51 (43%)	Below 30	45 (36%)
Work Position	Worker	38 (32%)	Site manager	21 (17%)
			Deputy manager	25 (20%)
	Security guard	28 (24%)	Supervisor	25 (20%)
			CEO	27 (22%)
	Contractor	52 (44%)	Technical officer	11 (9%)
			Project manager	14 (11%)

Some scholars argued that the only way to measure SC is by conducting an SC questionnaire survey [52]; following this, the literature has adopted surveys as the primary research method to assess SC [7]. In this proposed study, one pivotal element to consider

is the potential difference in view and attitude between workers and managers. Indeed, some previous research shows that workers and managers have different attitudes toward different dimensions of SC, such as management commitment to safety [14,40,53–55]. Therefore, in this study, by taking into account the differences in attitudes, environmental factors, and the objective of the two groups of workers and managers/supervisors towards SC, two separate questionnaire surveys were used to collect data from workers and managers/supervisors.

Both questionnaire surveys included two sections. The first section gathered demographic information including nationality, age, gender, marital status, education level, religious belief, employment position and job tenure in order to gain a better understanding of the background of the respondents. The second section focused on safety climate, which was assessed based on the survey structure proposed by [7], which measures the perception of workers and managers/supervisors regarding SC. SC was measured using a method allowing for separate analyses of various safety factors and an integrated study of their interactions [36]. The second section of the survey distributed to the workers included 12 questions and the survey sent out to managers/supervisors, included seven questions. Respondents were asked to indicate their level of agreement with each of the questions using a five-point Likert scale from strongly disagree (1) to strongly disagree (5).

A number of large construction projects in several major cities in Iran that were accessible to the researchers were included in the study. As a nonrandom selection of projects might negatively affect the external validity of the outcome, it should be noted that the findings of this research may not be generalized across the entire industry [36].

The researchers visited the selected construction sites during the month of September 2020 to ensure the participation of construction workers and the completeness of their responses. Participants were provided with an overview of the research objective and were assured that their answers would be anonymous and used purely for the purpose of this research.

Results from the survey were investigated through descriptive and inferential statistics. In particular, descriptive statistics (shown in Table 2) were used to analyze the status of the research population (i.e., gender, age, education, service history, and job title). Then, the Kolmogorov–Smirnov test was used to test the normality of the dataset, while the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to determine whether factor analysis could be performed with confidence. In order to assess if the level of agreement of the respondents with the categories included in the survey is significant, a series of one-sample *t*-tests were conducted. Moreover, the Analysis of Variance (ANOVA) test was implemented to test participants' opinions about variables, which were examined based on their characteristics (i.e., education, work experience, gender, age, and work position).

3.3. Interviews with University Professors and Construction Managers

The literature review task resulted in a list of factors affecting safety climate (Table 1). Once this task was completed, a series of structured interviews was conducted with seven construction experts, professors, and construction managers to review the identified factors, with the ultimate objective of developing a complete list of factors that influence executives' perceptions of safety climate in construction projects. All interviewees had either a Master's or a Doctorate degree.

The subject matter experts were invited to indicate their opinions on agreement/disagreement on the identified factors affecting construction safety climate. They were then requested to identify and elaborate on other factors that could affect the perceptions of executives' personnel on SC in construction projects. Once this process was completed, the responses were collected, analyzed, categorized and discussed—following a deductive thematic analysis approach [56]—into the following five categories: (a) workers' attitudes and perceptions; (b) safety knowledge and training; (c) working relationships and roles of colleagues; (d) workers' risk perceptions; and (e) safety rules and management practices.

The first, second, third, and fourth categories encompassed 12 factors in total and were included in the survey that was distributed to construction workers. The fifth category, which consisted of seven factors included in the survey, targeted managers and supervisors.

3.4. Survey Administered towards Construction Workers

The first survey was developed to investigate the perceptions, attitudes and behaviors of construction workers toward safety at construction sites in Iran. The survey included the following 12 SC factors from the first four categories mentioned in Section 3.2. The category entitled "workers" attitudes and perceptions consisted of the following four factors: (i) employee safety perceptions and attitudes; (ii) fatalism; (iii) economic characteristics, psychological characteristics and self-esteem of employees; and (iv) nationality and national culture. The category on "safety knowledge and training" encompassed the following four factors: (i) workplace security; (ii) level of risk in the workplace and perception of workers' risk (severe effects of age, sex, experience); (iii) justification of risk, orientation and safety training; and (iv) personal competence, responsibility, knowledge, and motivation. The category on "working relationships and roles of colleagues" included the following two factors: (i) speed of work, pressure, and value of work; and (ii) safety precautions and equipment. Finally, the category on "workers" risk perceptions had the following two factors: (i) employees' participation in team safety and knowledge transfer through team collaboration; and (ii) responsible for security and communications and supervisor support such as talking to workers, visiting the site, distributing training materials to workers, and encouraging and giving feedback to workers. The researchers visited construction sites in Iran and upon gaining permission of the site managers (whether from the general contractor's side or subcontractor's side), the construction workers were asked to complete the survey. The purpose of the survey was explained to participants, their questions were answered, and they were assured that their answers would be kept confidential. The survey asked construction workers to indicate their level of agreement for each of the 12 factors in the survey. The respondents were asked their level of agreement on a scale from 1 (strongly disagree) to 5 (strongly agree). Responses were collected from 118 construction workers who are generally exposed to hazardous environmental conditions, specifically: scaffolding, heavy-duty carpentry, electricity, and painting.

3.5. Survey Administered towards Managers and Supervisors

In addition to understanding safety from the perspective of workers, it is vital to examine management's perception of SC. Research efforts have focused on the role of management to build safety awareness and to support safe behavior and indicated that in order to assess the construction safety climate, safety management practices should be also considered [57]. Therefore, this study includes a second survey, similar to the survey that targeted construction workers. Two mechanisms were employed to distribute this survey and collect data: online and in-person (where the researchers visited the construction sites). The former mechanism was mainly used for managers and supervisors working in cities, and far from the researchers' location. For the latter data collection method, the researchers provided managers and supervisors with an overview of the research, articulated the objective and assured respondents that their responses will be kept strictly confidential. The survey examined the following seven safety climate factors from the category of safety rules and management practices: (i) safety rules and regulations; (ii) positive safety measures and effectiveness of safety logistics; (iii) existence of safety management systems implemented in the organization; (iv) work environment and lighting; (v) employee recruitment, promotion, and remuneration practices; (vi) job security; and (vii) the effects of safe behaviors on employee promotion. A total of 123 responses were collected and participants included managers (e.g., project managers, project engineers, site engineers) and supervisors (e.g., site supervisors).

4. Results of Interviews and Surveys

4.1. Results of Interviews with University Professors and Construction Managers

In order to identify the factors affecting the SC on construction projects, previous research efforts were carefully examined and synthesized: twenty-two factors were identified (Table 1) and, as already said, seven subject matter experts (academicians and practitioners) were then interviewed to review these factors. The structured interviews led some factors to be: (a) eliminated (i.e., commitment, recognition, and perception of management toward safety, religion, optimism, and the effects of safe behaviors on social situations); (b) replaced (the employment factor was replaced with "recruitment methods and staff encouragement and rewards"); (c) combined (the two factors of "safety level at worksite and workers' perception" and "employee risk-taking at work" were combined into 'safety level at worksite and workers' perception'); and (d) added ("existence of safety management systems implemented in the organization" and the "relaxation of the work environment and lighting"). As a result of these changes, a total of 19 factors were identified and divided into five different categories: (a) workers' attitudes and perceptions (four factors); (b) safety knowledge and training (four factors); (c) working relationships and roles of colleagues (two factors); (d) workers' risk perceptions (two factors); and (e) safety rules and management practices (seven factors).

4.2. Survey Results

As anticipated, the two separate questionnaire surveys were distributed to: (1) construction workers, and (2) managers and supervisors. Collected responses were first tested for reliability and then analyzed using factor analysis; the SPSS software was used to carry out the analysis.

The reliability test determines the extent to which, and if, the measuring instrument (i.e., the questionnaire) performs equally well under the same conditions. This means that if the researchers execute their questionnaire again or in parallel and the results turn out to be the same, then the questionnaire is reliable. Reliability was tested for each of the two questionnaire surveys and the results are displayed in Table 3. The results showed that the Cronbach's Alpha reliability value is more than 0.7, indicating that the reliability of the two questionnaire surveys is acceptable.

Table 3. Reliability of data collected from the surveys.

Respondents	Number of Questions	Cronbach's Alpha Reliability Value
Workers	12	0.724
Managers and Supervisors	7	0.765

The Kolmogorov–Smirnov test was performed to test the normality of the dataset. The results are outlined in Table 4. The resulting high p values (greater than 0.05) indicate that, at the 95% confidence level, the data are normal. In inferential statistics, the main condition for using various types of parametric and non-parametric statistical tests depends on the distribution of the dataset. If the data distribution is normal, then parametric methods can be used. If the data distribution is not normal, parametric methods should not be used [58]. Since the data distribution is normal in this study after checking (Table 4), parametric tests could be used.

Table 4. Significance values according to the Kolmogorov–Smirnov test for the surveys.

Category (Variable)	Respondents	N	Mean	SD	Kolmogorov–Smirnov Z	*p*-Value (sig.)
Workers' attitudes and perceptions	Workers	118	3.751	0.585	1.676	0.570
Safety knowledge and training	Workers	118	3.928	0.734	2.081	0.065
Working relationships and roles of colleagues	Workers	118	3.406	1.091	1.507	0.061
Workers' risk perceptions	Workers	118	3.604	0.849	1.217	0.103
Safety rules and management practices	Managers and Supervisors	123	2.652	0.608	1.415	0.056

Prior to employing factor analysis, an additional analysis needs to be performed to identify if the variables can be factorized. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were performed and the results are shown in Table 5. The resulting values of the KMO test of 0.781 and 0.800 for the workers' and managers and supervisors' questionnaire surveys, respectively, are greater than the 0.7 threshold, indicating significant results. The resulting values of the Bartlett's test of sphericity are less than 0.05, indicating the significance of the results. Therefore, due to the significant results of the KMO and Bartlett's test, it can be concluded that factor analysis can be performed with confidence.

Table 5. The values of the KMO test and Bartlett's test for the surveys.

Respondents	KMO Value	Bartlett's Test of Sphericity (*p*-Value)
Workers	0.781	0.000
Managers and Supervisors	0.800	0.000

The results of Table 6 show that the final or extracted factors explain the variance greater than 0.05 for each variable. If the explained variance is less than 0.05, it should be treated with caution, taking into account the factor loadings of that variable and the importance of having that variable in the study, eliminating, modifying, or maintaining the variable. Since the value of the variance extracted is greater than 0.05 for all variables, all variables are correctly selected, and no variables need to be deleted or modified.

Table 6. The values of variance of the surveys' variables.

Category (Variable)	Respondents	N	Mean	SD	Variance
Workers' attitudes and perceptions	Workers	118	3.751	0.585	0.342
Safety knowledge and training	Workers	118	3.928	0.735	0.540
Working relationships and roles of colleagues	Workers	118	3.407	1.092	1.192
Workers' risk perceptions	Workers	118	3.604	0.849	0.722
Safety rules and management practices	Managers and Supervisors	123	2.652	0.608	0.370

In order to assess whether the level of agreement of respondents with the categories included in the survey is significant, a series of one-sample *t*-tests were performed to

compare whether the average level of agreement with a category is statistically different from 3, where 3 represents the neutral option of the five-point Likert scale of measurement.

According to Table 7, results of the *t*-test culminated in low *p*-values (less than 0.05) for all variables, and upper and lower limits were positive except for the category in the managers and supervisors' questionnaire entitled "safety rules and management practices". The significant results indicate that, at the 95% confidence level, "workers" attitudes and perceptions, "safety knowledge and training", "working relationships and roles of colleagues", and "workers' risk perceptions" are perceived by workers to play a significant role in impacting the perceptions on safety climate. In fact, only managers and supervisors have not perceived "safety rules and management practices" as an effective category of employees' perceptions of SC.

Table 7. Results of the one-sample *t*-test for the two surveys.

Category (Variable)	Respondent	*t*-Value	*df*	*p*-Value (sig.)	Mean Difference	Lower Limit	Upper Limit
Workers' attitudes and perceptions	Workers	13.953	117	0.000	0.751	0.645	0.858
Safety knowledge and training	Workers	13.722	117	0.000	0.928	0.794	1.062
Working relationships and roles of colleagues	Workers	4.047	117	0.000	0.407	0.208	0.606
Workers' risk perceptions	Workers	7.730	117	0.000	0.604	0.450	0.759
Safety rules and management practices	Managers and Supervisors	−6.347	122	0.000	−0.348	−0.46	−0.239

Using the Analysis of Variance (ANOVA) test, participants' opinions about variables can be examined based on their characteristics (i.e., education, work experience, gender, age, and work position). The results are shown in Table 8.

Table 8. Differences in respondents' opinions according to their characteristics based on the ANOVA test results.

Category	Characteristics of Respondents				
	Education	Work Experience	Gender	Age	Work Position
Workers' attitudes and perceptions	0.490	0.140	0.690	0.003	0.640
Safety knowledge and training	0.504	0.460	0.070	0.361	0.860
Working relationships and roles of colleagues	0.330	0.090	0.840	0.348	0.320
Workers' risk perceptions	0.250	0.640	0.340	0.091	0.240
Safety rules and management practices	0.223	0.220	0.004	0.460	0.060

Due to the fact that the significance value for the variable of "safety rules and management practices" is less than 0.05, there was significant disagreement between male and female managers/supervisors regarding this variable (gender). In addition, due to the fact that the significance value for the variable of "workers' attitudes and perceptions" is less than 0.05, there was significant disagreement between workers of different ages regarding this variable (age).

Regarding other variables, it should be acknowledged that since the significance values for them is larger than 0.05, there is no significant disagreement on these variables

between workers and managers/supervisors with different statuses (i.e., education, work experience, gender, age, and work position).

5. Discussion of Survey Results

Results of the study initially provide five categories as the most important for SC, namely: (i) workers' attitudes and perceptions; (ii) safety knowledge and training; (iii) working relationships and roles of colleagues; (iv) workers' risk perceptions; and (v) safety rules and management practices. These are partly aligned with the four core dimensions of SC discovered by an empirical study [59]—collecting empirical data from 21 Chinese construction enterprises—which are: (i) safety priority; (ii) safety supervision, training, and communication; (iii) safety rules and procedures; and (iv) safety involvement. Similarities can emerge also with the SC factor model in construction research and practice resulting from a recent systematic literature review [60]. In particular, according to these scholars, "management commitment" and "safety system" are the most important factors, while "group safety climate", "workers' involvement" and "supervisor's role" are less important. However, their study has the limitation of having collected articles dealing only with workers' perceptions of SC. Yet, the proposed five categories from this work are also almost consistent with those which emerged from a meta-analysis on SC and safety performance [61], which identified (i) management commitment to safety; (ii) supervisor's safety role; (iii) safety rules and producers; (iv) training; and (v) individual responsibility for health and safety as the important factors in assessing construction SC and, most importantly, the association with performance. In brief, despite the different headings of each cluster, they seem to be almost aligned and to substantiate the same dimensions of SC.

If considering other studies on SC conducted in Iran, some common elements also emerge. Indeed, the five categories proposed in this study are almost comprehensive of the items pointed out in two other works. The first, contextualized in Iran and published in 2011 [32], i.e., the "safety attitudes of workers", the "level of risk in construction site" and "working relationships" found highly dangerous situations among construction workers; and the second, in 2014 [30], i.e., the "managerial commitment", "safety communications", "safe environment", "responsibility of managers", "perception of risk", "job satisfaction", and "knowledge and awareness of safety issues" see also [62,63]. However, they only considered workers' perceptions in their analysis; maybe this is the cause of why safety knowledge and training did not emerge as a pivotal element for SC.

When delving deeper into the workers and managers/supervisors' perceptions of SC, some interesting results emerge. In fact, factors entitled "workers' attitudes and perceptions", "safety knowledge and training", "working relationships and roles of colleagues", and "workers' risk perceptions" have an impact on the SC of construction projects when considering the perception of workers. In other words, low-level employees perceive both staff self-perception and safety training and collaboration among employees to be effective in the SC of construction projects, as well as rules, controls and management practices. This is in line with the consideration of SC formation and projects as social processes [64] and with prior literature [65] emphasizing training—on self-awareness, visioning, apparent sincerity, social awareness, social astuteness, and relationship management—as a pivotal activity to be incorporated into human resource development of construction organizations in order to improve their level SC leading to fewer accidents at the industry level. Yet, in this work, the results of the questionnaire about low-level staff regarding the impact of the role of management and supervisor support on SC are aligned with other research [35,39,66]. These results are in contrast with those from a developed country such as Australia [46]; indeed, for that country, employees do not consider "working relationships and roles of colleagues" as an influencing factor of SC. Hence, In Iran, similarly to Hong Kong [67], the importance of fellow workers in the SC of the construction industry seems to be superior compared to developed countries. However, within our work, we did not identify employees' "work pressure" as a determinant for SC; this was found to be least important by some scholars [14,68]. In particular, the latter study identified

that job stress is negatively highly related with the perception of SC by employees in the Canadian construction industry, badly affecting related performance. The same is valid also with reference to another developing country: Hong Kong. Indeed, [69] found that safety attitudes predict occupational injuries, and psychological distress predicts accident rates and, within this relationship, psychological distress was found to be a mediator of the relationship between safety attitudes and accident rates.

For managers/supervisors, "safety rules and management practices" did not affect the SC of construction projects. While looking at prior studies, the results of the questionnaire of managers and supervisors are in contrast with another work [32], which believes that the role of employees' perception of SC is more than the role of management rules and practices. In contrast, "workers' safety commitment" and "safety knowledge and training" have been found to be more important for managers/supervisors (compared to workers). Therefore, there is a significant difference between perceptions at the level of managers and employees and general-level and low-level staff. This result is in contrast with some prior literature, such as [70], which did not find significant differences between the manager-assessed SC and the worker-assessed SC scores, but is in line with other works, such as [71], which found, through an experimental study of SC in Taiwan, that there were significant statistical differences in perceptions between supervisors and public servants, as well as between young and old employees. Another contribution [72], which surveyed 266 workers, 55 supervisors, and 32 site managers from 26 Colombian construction companies, found that workers assigned more importance to "management safety empowerment" rather than the managers/supervisors themselves.

However, despite the results from workers and managers/supervisors partly seeming to be in contrast, it is also true that the factors relevant for each category of respondents complement each other. Indeed, it is supposed, and has also been advanced by other scholars [4], that the amelioration of "safety rules and management practices", which are pivotal for managers/supervisors, are at the basis of the behavioral change of workers (substantiated, in practice, by the factors chosen by workers). This has also been confirmed by another more recent study [73] that, in the context of ethnic minority and migrant workers in the Hong Kong's construction industry, provided empirical evidence of the mechanisms by which SC affects safety behaviors and outcomes, and this can be mainly advanced by a coordinated safety communication among construction workers [74]. With the work "coordinated", the fact can be noted that managers should maintain their hierarchical position but, at the same time, leave co-workers to build their social identity; in fact, as found by [75], the association between social identity and SC is usually stronger at the workgroup level than at the construction site level. Therefore, and in line with other research [76], it is suggested that a positive and strong safety climate can be built by top-level managers, which is able to ensure that mutual safety obligations between supervisors and workers are fulfilled.

From the above, the difference in perceptions between the worker employees and managers/supervisors can be considered as beneficial for an overall understanding of SC in general and for developing countries in particular. In this regard, the prioritization of SC categories presents a good opportunity to propose a series of effective suggestions for improving and enhancing the perceptions of workers and managers/supervisors on SC at job sites in the context of developing countries towards achieving better safety performance.

6. Conclusions, Implications for Practice and Limitations of Study

The current study explored the underlying factors that impact SC in the Iranian construction industry by investigating the perceptions of construction workers and managers/supervisors in Iran. Results of this study identified safety knowledge, safety training, and safety performance as the primary influencing factors on SC. Staff attitude and perceptions, safety rules and management practices, understanding of employees' risk, and the relationship between work and cooperation comprise the second to the fifth level of priority.

Thanks to the results provided, some implications for practice can be drawn. In particular, Table 9 presents a list of recommended effective suggestions, based on the results, derived by the authors to improve SC within the construction industry. The suggestions are listed by category ranking.

Table 9. Recommended effective suggestions for improving safety climate in the construction industry.

Priority	Category	Suggestions
1	Safety knowledge, training and safety performance	• Hold workshops and classes on safety practices, warning signs, and issues. • Encourage staff to observe safety issues while performing activities. • Develop comprehensive safety guidelines and standards. • Develop guidelines for controlling operations on safety issues. • Use signs and posters in the workplace to remind employees of the importance of safety. • Influence the attitude and perception of staff on the safety climate of construction projects.
2	Staff attitudes and perceptions	• Change employees' attitudes toward safety issues using motivational strategies such as enabling incentives and rewards. • Promote a culture in the organization on safety issues. • Use indirect and attractive methods, such as reward, film screening, etc., to inform and change the attitude of employees regarding safety issues.
3	Safety rules and management practices	• Increase motivation and create a strong work attitude toward employee safety. • Monitor safety compliance in all activities. Management should insist that safety monitoring is the first issue to be discussed in each operational unit's report. • Increase monitoring of staff safety awareness and receive feedback and suggestions from supervisors and staff in this area. • Anticipate hazards and potential events during the project's process and consider strategies, guidelines, regulations, and training for accident prevention.
4	Workers' risk perception	• Use change management to change employees' perceptions of not paying attention to safety issues. • Use videos, photos, and other training tools to alert employees if they do not comply with safety requirements. • Hold classes and workshops to educate staff on the importance of observing safety issues. • Pay attention to the level of knowledge and experience of staff regarding non-compliance with safety issues during recruitment and hiring.
5	Working relationships and roles of colleagues	• Establish friendly communication between managers and staff to address safety issues in project implementation. • Create an encouraging and collaborative culture so that employees remind each other about safety issues and concerns. • Encourage staff to do activities based on friendly groups and teams.

The achieved results and the effective suggestions have raised the theoretical and practical debate of SC in developing countries in general and Iran in particular. Indeed, the generated results do not only confirm some prior research studies on the perceptions of SC by workers in Iran [30,32,62,63], but also extend them by underlining the indispensable role of safety knowledge and training, which has never emerged in these studies. Yet, while the differences in perceptions between workers and managers/supervisors and the importance of fellow workers in the SC of the construction industry are aligned with other previous research work on SC in developing countries [67,72], this paper reinforces the views of SC formation as a social process by stressing working relationships and roles of

peer colleagues as pivotal for reunifying the two perceptions and improving the level of SC, leading to fewer accidents at the industry level, which has not emerged strongly in previously reported works.

The main limitations of this work are: (i) changes in people's attitudes, beliefs and thoughts are affected by changing conditions, which ensues in the results of this study not being generalizable to different periods and it is just a case for the decline of SC in developing countries; and (ii) provinces that formed the context of the research were selected by convenient sampling. A lack of access to other provinces, due to time and space constraints, can affect, again, the generalizability of the study.

Stemming from the above two limitations, the results of this work should be taken as the basis for further comparison with results of research obtained from other developing countries. In particular, carrying out a comparative study, based on a similar methodology [77], in each developed country, and comparing results can really advance research on the perception of SC. Furthermore, it is suggested to compare the safety attitudes and perceptions of Iranian construction managers/supervisors with the actual safety practices implemented by them to investigate whether consistency exists between perception and practice. Further research can also examine the impact of cultural and demographic factors on SC in order to develop a cause–effect model; this could determine the correlation between demographic and cultural dimensions and employees' attitudes and perceptions as well as managers' and supervisors' safety practices. Last but not the least, it would be pivotal, and an extension to this study, to investigate how shared climate safety perceptions evolve as a result of ongoing employee–manager/supervisor leadership and manager/supervisor–employee interactions; this co-evolving mechanism can form the starting platform for a renovation of SC research.

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