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The Integration of NOSACQ-50 with Importance-Performance Analysis Technique to Evaluate and Analyze Safety Climate Dimensions in the Construction Sector in Saudi Arabia

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Abstract: In Saudi Arabia, one of the fastest-growing sectors is the construction industry. With the increasing numbers of accidents, it is worth reviewing the preventive solutions to the threats that have been identified. Therefore, the aim of this study was to apply the NOSACQ-50 survey to measure the safety climate (SC), and to dissect the strengths and weaknesses of each dimension in the survey using the importance-performance analysis (IPA) method. Based on the results, several strategies for improving the SC were recommended. A total of 296 construction workers were involved. According to the proposed method, the major strengths were management and worker commitment to safety, prioritizing safety during work, workers' trust safety systems, and management competence in safety. The weaknesses were unstrict judgment in safety issues, the absence of workers' suggestions in establishing safety rules, and near-miss incidents that went unreported. To mitigate these gaps, management should focus on strict judgement in safety-related issues, reporting all incident types, periodic meetings or reports with the workers, improved safety training, and checkup rounds. The outcomes of this study will assist organizations by providing a new validated SC assessment methodology that will help in determining aspects of strength and weakness that affect their SC, which will improve safety behavior and reduce accidents.

Keywords: safety climate; NOSACQ-50; importance-performance analysis; construction industry; occupational health and safety

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1. Introduction

In Saudi Arabia, the construction industry is considered one of the fastest-growing sectors with more than 170,000 construction companies hiring more than 2.8 million workers in 2021 [1]. Unfortunately, with these flourishing statistics, the number of accidents has increased. In 2021, the construction industry was still among the leading sectors in rate of injury with more than 12,000 accidents in Saudi Arabia. The most common causes of these incidents were falls from great heights (28.55%), collisions with objects (25.21%), sliding and falling (17.93%), and others (28.31%). The total medical bill for these incidents exceeded $175 million [2]. Worldwide, the construction sector has been extensively studied and analyzed in terms of cost estimation and forecasting [3–5], project management [6,7], environmental pollution [8,9], safety [10,11], and innovation [12,13]. However, few researchers have investigated the safety aspects of the construction sector, particularly in Saudi Arabia [14,15]. Thus, there is a need to dissect and extensively analyze the factors affecting safety in this industry.

Two terms are used interchangeably to indicate the safety level of a certain organization, namely, safety culture and safety climate (SC). Safety culture includes the values placed on safety and the extent to which employees accept their safety responsibilities in their company. Safety culture is often referred to as the "personality" of an organization, as it is a shared value of safety among the employees. A safety culture might take months or even years to form and can remain unchanged for a long period. However, safety

climate (SC) is a narrower term and can be described as the commitment to safety measures, policies, and practices at work, assuring that avoiding safety rules is not accepted [16]. The safety climate might fluctuate over time and depending on the company's circumstances. Therefore, SC is referred to as an organization's "mood" based on what workers experience at a certain period. Because it covers perceptions and attitudes regarding safety at a certain period, the SC is an excellent predictor of safety performance. If the SC is consistently excellent over time, it will undoubtedly have an influence on the safety culture since positive behaviors and attitudes will be reinforced [17]. The safety climate includes corporate policies, management attitudes, and worker perceptions of safety at their workplace. In short, the SC reflects workers' perceptions of the actual image of safety in the company [18]. The SC can be described as a leading indicator, as it may provide an indication of both an organization's safety performance and injuries before they occur [19]. Additionally, the SC can reveal organizational and cultural elements that contribute to accidents [20]. Significant research has emphasized that the major advantage of evaluating employees' SC is to assess commitment to safety procedures, and anticipate accidents and dangerous behavior. As a result, SC evaluation offers data on how workers perceive safety in their workplace, producing a useful tool for assessing how well they adhere to safety standards in a given setting [21]. Therefore, it is believed that analyzing SC is an essential part of determining the direction of the safety level and raising the bar for workplace safety. A negative SC might be related to a poor level of both hazard detection and risk prevention. Therefore, the SC needs to be measured continuously since it gives an idea of the safety culture in an organization. One way to diagnose the safety climate is by the Nordic Occupational Safety Climate Questionnaire (NOSACQ-50). The NOSACQ-50 was developed by a team of experts in occupational safety [16]. The NOSACQ-50 has been the subject of several studies in many industries to assess the SC, including the construction industry [22,23], oil and gas exploration [24,25], medical care [26,27], and firefighting [28].

One of the valuable techniques that measures individuals' perceived performance, and the importance of certain aspects of it, is the importance-performance analysis (IPA) tool. The IPA tool divides a chart into four quadrants using an X-axis for importance and a *Y*-axis for performance in a two-dimensional matrix. Items placed in the quadrants may have different managerial strategies. The fundamental objective of IPA is to facilitate data interpretation while diagnosing the performance of various aspects and generating useful corrective management actions [29]. Considering the outcomes of IPA, several improvement strategies can be suggested. Additionally, major strengths and weaknesses are identified, and the IPA provides insights on the areas on which managers should concentrate [30,31]. It prioritizes management initiatives in terms of best resource allocation. Although it was initially created for marketing studies, its application has spread to a number of industries, such as education [32,33], healthcare [34], banking [35,36], and information technologies [37]. However, according to the literature review, none of the previous research has used IPA in assessing SC.

The Literature Review

Due to its validity and reliability, several research studies have applied the NOSACQ-50 questionnaire in measuring SC on construction sites, as illustrated in Table 1.

However, according to the literature review, the research gap is that none of the previous studies have determined which attribute is affecting its corresponding dimension internally. Therefore, the research questions would be:

- What is the overall level of SC in the construction sectors?
- What are the attributes and aspects that weaken the SC level?
- What strategies should the company adopt to solve their weaknesses?

Table 1. Summary of previous research that has used NOSACQ-50 in assessing SC in the construction sector.

Year	Author	Objective
2015	Schwatka et al. [38].	Measuring the SC by focusing on top management, supervisor, and coworker dedication to safety.
2019	Kwon et al. [39].	Evaluating workers' safety perceptions on a construction site and analyzing safety issues using the NOSACQ-50 questionnaire.
2018	Ha at al. [40].	Assessing the level of SC in a construction company based on business scale and organizational culture.
2019	Son et al. [41].	Assessing a construction company's SC level based on business size, organizational culture, enterprise type, and construction industry.
2020	Lee et al. [42].	Using NOSACQ-50 to investigate the relationship between SC and productivity in actual building projects.
2018	Nadhim et al. [43].	Investigating the association between the SC and safety performance in the context of retrofitting activities utilizing NOSACQ-50.
2011	Holte et al. [44].	Investigating risk factors for accidents among young construction workers.
2019	Marín et al. [45].	Investigating and analyzing the perceptions of SC across three levels of construction personnel: workers, field supervisors, and site managers.

The main objectives of the current study are: first, to measure the SC at construction sites; second—which is the main contribution of this study—to integrate the NOSACQ 50 with the IPA techniques to dissect in detail the main strengths and weaknesses of each dimension by determining which aspect is affecting the score of each dimension; third, based on the results of the IPA tool, several strategies will be recommended to improve the SC at construction sites. This study will assist organizations with a new SC assessment methodology that will help them to determine the strengths and weaknesses that affect their safety level. Moreover, for construction companies, the results of the current study will help them to apply the recommended strategies to solve their weaknesses. Effective strategies for each area of potential weakness in the dimensions of the questionnaire, such as strict judgement in safety-related issues, reporting incidents, periodic meetings with the workers to discuss safety-related issues, allowing their suggestions to be incorporated into the company's rules and regulations, training, checkup rounds, and communication might improve the dimension's score, and in turn improve the SC and safety performance [46].

2. Methodology

2.1. Nordic Safety Climate Questionnaire (NOSACQ-50)

The NOSACQ-50 is a diagnostic and interventional tool for evaluating the state of an organization's SC. It reveals how the employees view safety inside the company. There is growing scientific evidence to demonstrate the association between SC and safety performance [47]. Therefore, investigating the SC is essential in identifying the direction and level of safety at workplaces. A negative SC is associated with a poor degree of risk, and hazard awareness recognition and prevention [46]. The NOSACQ-50 was developed and validated across the five Nordic nations, i.e., Denmark, Finland, Iceland, Norway, and Sweden. Moreover, the survey was translated into more than 28 languages, and has been applied to various sectors, as mentioned earlier. The survey consists of 50 questions divided into seven sections, i.e., dimensions, and each question has a Likert scale rating of 1: strongly disagree, 2: disagree, 3: agree, and 4: strongly agree. The dimensions of the survey with its questions are summarized in Table 2. After collecting all the data for the respondents, the average value of each dimension is calculated. The mean value will suggest corrective action that should be taken to improve the safety climate [48]. If the mean score is greater than 3.3, it means that this dimension is at a good level and the companies should maintain

and continue developments. If the score is between 3 and 3.3, it means that the dimension is at a fairly good level with minor improvement required. If the average score is between 2.7 and 2.99, it indicates that the dimension needs improvement since it is at a low average score. Finally, if the average is below 2.7, it means that the dimension is at a low level with major improvement required. After calculating the average score of each dimension, the IPA tool is applied on each one to discover what its strengths and weaknesses are. In each dimension, one question that evaluates overall satisfaction with respect to that dimension is added. This addition is made in order to use it in the calculation of the "importance" of each measure in the survey. The survey consists of 7 dimensions, i.e., sections, as follows: Dimension 1, management's safety priority and abilities. Safe behavior is expected to be rewarded and thus reinforced if managers are perceived to be committed to safety and to prioritizing safety over other goals. Dimension 2, management safety empowerment, which measures how workers perceive management empowerment and support towards their employees in safety decision participation. Dimension 3, management safety justice, which measures how fairly workers perceive that their management is treating employees who are involved in accidents. Dimension 4, employees' safety commitment, which evaluates how workers relate to safety at work by demonstrating a commitment to safety, active safety promotion, and paying attention to each other's safety. Dimension 5, workers' prioritizing of safety and risk rejection, which assesses how far workers are prioritizing safety rather than work goals, and are not exposing themselves to risky situations or surrendering to risk-taking. Dimension 6, communication, learning, and trust among peers, which measures how workers trust and communicate with their co-workers. Dimension 7, workers' trust in safety systems, which evaluates how workers evaluate their safety systems, i.e., safety managers, safety rounds, training, and safety objectives.

Table 2. NOSACQ-50 safety dimensions, with their questions.

D1: Management's safety priority and abilities.	1.1	Management prioritizes safety.
	1.2	Management communicates safety information.
	1.3	Management strictly judges safety issues.
	1.4	Management committed to safety rules.
	1.5	Management prohibits taking risks during work.
	1.6	Management competence in safety.
	1.7	Management takes immediate corrective actions.
	1.8	Management makes attempts to prevent risks immediately.
	1.9	Management is competent in solving safety issues.
D2: Management Safety Empowerment	2.1	Management competence in designing effective safety rules.
	2.2	Everyone can improve safety in the workplace.
	2.3	Employees participate in decisions that affect their safety.
	2.4	Management considers employees' recommendations about safety.
	2.5	Management emphasizes worker competence in safety.
	2.6	Employees are asked for their suggestions in safety decisions.
	2.7	Employees are involved in safety decisions made by management.
D3: Management Safety Justice	3.1	Management collects data during investigations.
	3.2	Employees do not report near-miss accidents because of fear of sanctions.
	3.3	Management listens to all workers involved in accidents.
	3.4	Management searches for causes without blaming people.
	3.5	Management never blames employees for accidents.
	3.6	Management deals with all workers fairly.
D4: Employees' Safety commitment	4.1	Workers strive to reach high levels of safety.
	4.2	Workers have common responsibility for an organized workplace.
	4.3	Workers care about each other's safety.
	4.4	Workers address newly recognized threats.
	4.5	Workers assist one another in working safely.
	4.6	Workers are held accountable for each other's safety.

Table 2. *Cont.*

D5: Workers' Priority for Safety and Risk Rejection	5.1	Workers consider risk as avoidable.
	5.2	Workers consider minor accidents to be indictors of safety issues.
	5.3	Workers refuse risk behaviors even if there are no injuries.
	5.4	Workers do not break safety rules even for the work's sake.
	5.5	Workers refuse to take risks even if the schedule is tight.
	5.6	Workers consider the work as inappropriate for weak people.
	5.7	Workers are opposed to taking risks at work.
D6: Communication, Learning, and Trust among Peers	6.1	Workers try to find a solution when a risk has occurred.
	6.2	Workers feel safe when working together.
	6.3	Workers trust each other's competence.
	6.4	Workers learn from their mistakes to improve safety.
	6.5	Workers listen to each other's suggestions on safety issues.
	6.6	Workers always talk about safety.
	6.7	Workers discuss safety when risks occur.
	6.8	Workers talk freely about safety issues.
D7: Workers' Trust in Safety Systems	7.1	Workers consider safety managers important in risk prevention.
	7.2	Workers consider safety checkups important in risk prevention.
	7.3	Workers consider training important in risk prevention.
	7.4	Workers consider early safety planning as important.
	7.5	Workers consider safety evaluation as important in detecting risks.
	7.6	Workers consider safety learning and practice as crucial.
	7.7	Workers consider safety objectives as important.

2.2. Importance-Performance Analysis (IPA)

The IPA technique plots individuals' ratings of performance and importance of a certain aspect into a two-dimensional chart that makes the data easier to understand and interpret [49]. The chart categorizes the aspects into four quadrants, as shown in Figure 1. Each quadrant reflects a distinct strategy for assisting managers in recognizing both the weaknesses and the required actions to enhance customer satisfaction. The x-axis defines the "importance" of the aspects, which is measured as the correlation between each question with the overall satisfaction for each dimension. The y-axis represents the "performance" of the aspects, which is measured as the percentage of favorability for each question [50].

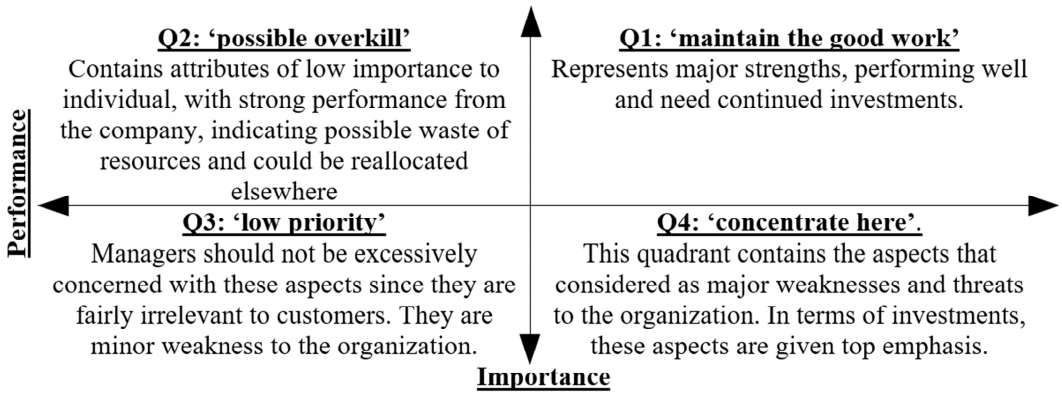


Figure 1. The quadrants in the standard IPA plot.

3. Participants

Data were collected from several Saudi Arabian construction companies. A total of 337 workers on large projects received the surveys. Participants might revoke their involvement at any time, and confidentiality was guaranteed. A total of 41 responses were disregarded from the study owing to missing or incorrect data or violating the allowed reply time. Safety supervisors explained the questionnaire to the participants at several construction sites. Demographic information that was documented is shown in Table 3. No personal information was required from the workers.

Table 3. Demographic information of the workers.

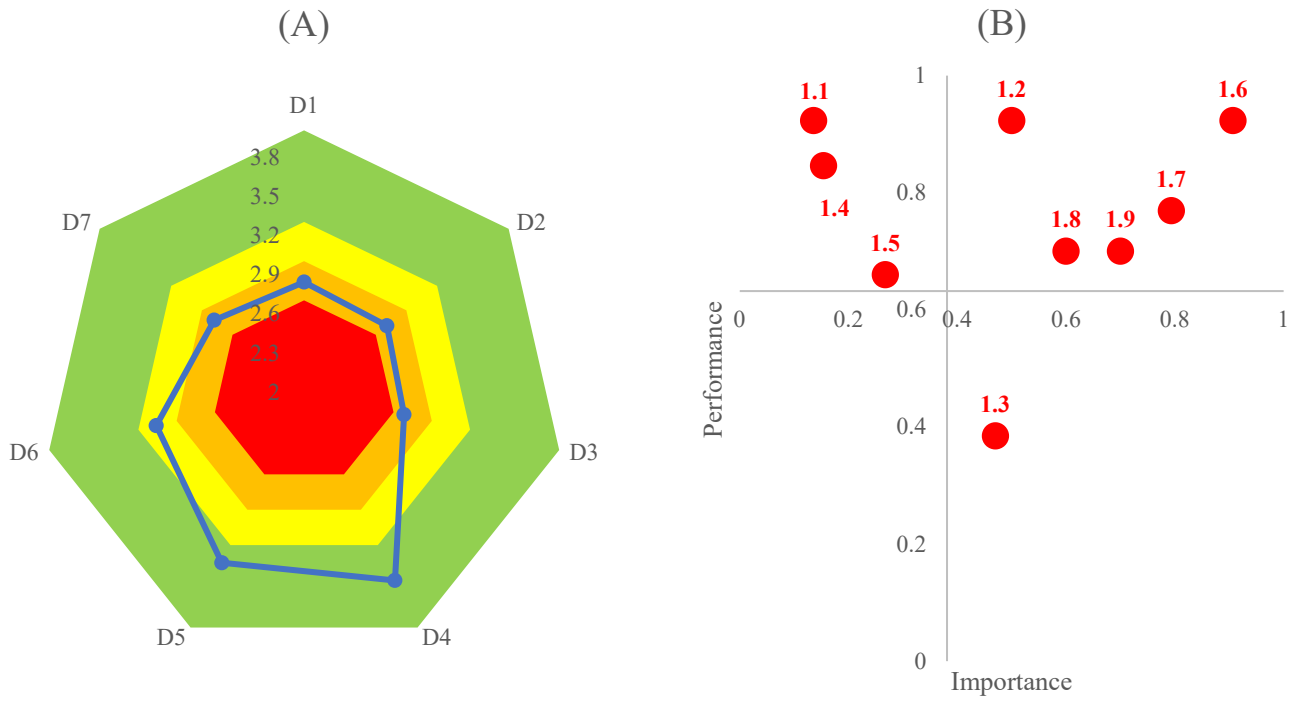
Demographic Information		Participants (n = 296)
Age	20–30	78
	31–40	119
	41–50	72
	51–60	21
	>60	6
Education	Below elementary school	12
	Elementary school	147
	Secondary school	92
	Above secondary school	45
Work Experience	<3	59
	3–5	97
	6–10	78
	11–15	32
	>15	30

4. Results

For each dimension, the average scores and standard deviation (SD) are displayed in Table 4 below. Moreover, the NOSACQ-50 grid is shown in Figure 2A. Additionally, the IPA matrices for each dimension are shown in Figure 2B–H.

Table 4. Descriptive statistics.

Dimension	Mean	SD
D1	2.84	0.8802
D2	2.81	0.2602
D3	2.78	0.881
D4	3.6	0.7076
D5	3.45	1.1321
D6	3.16	0.7329
D7	2.88	0.7463



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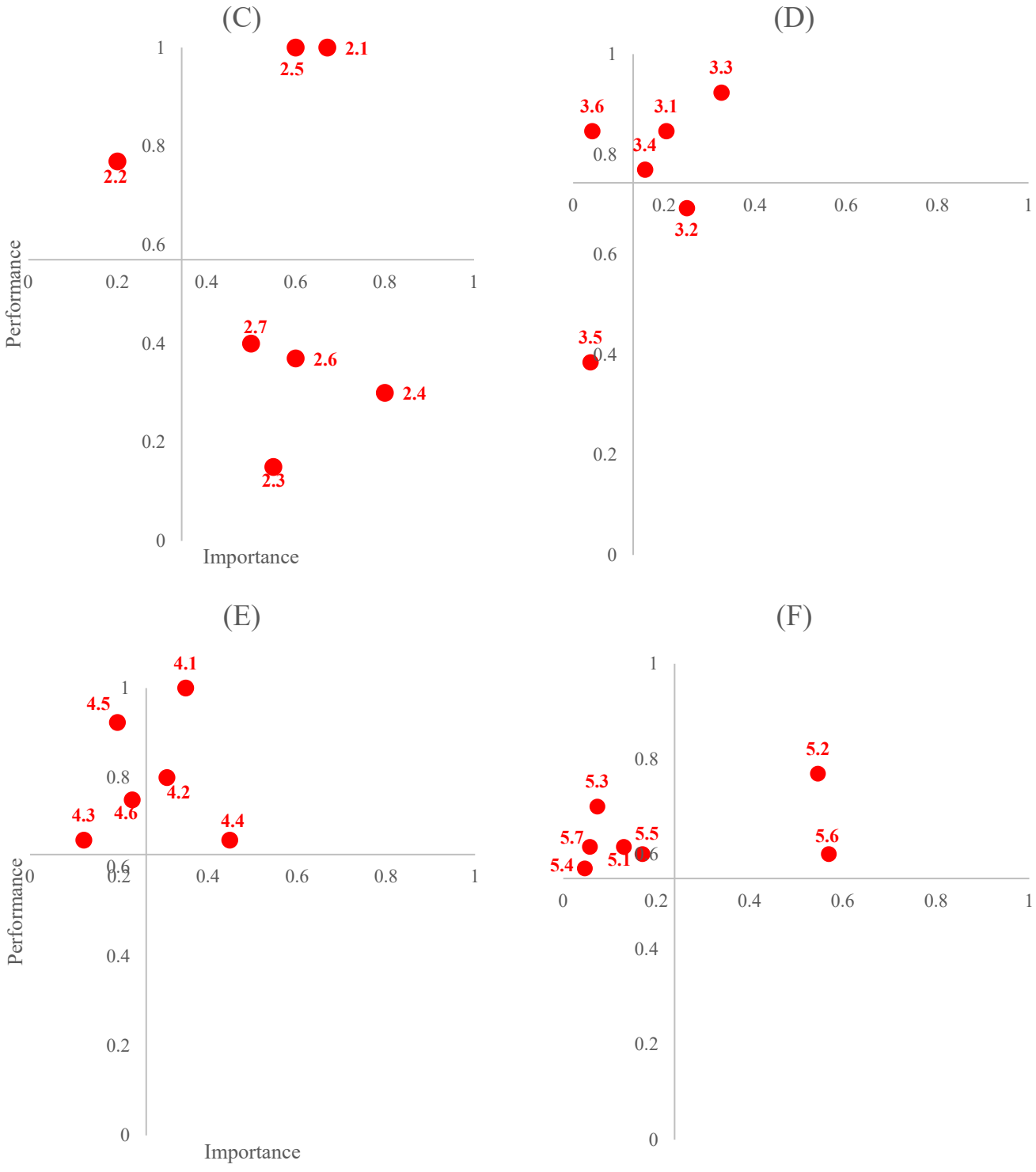

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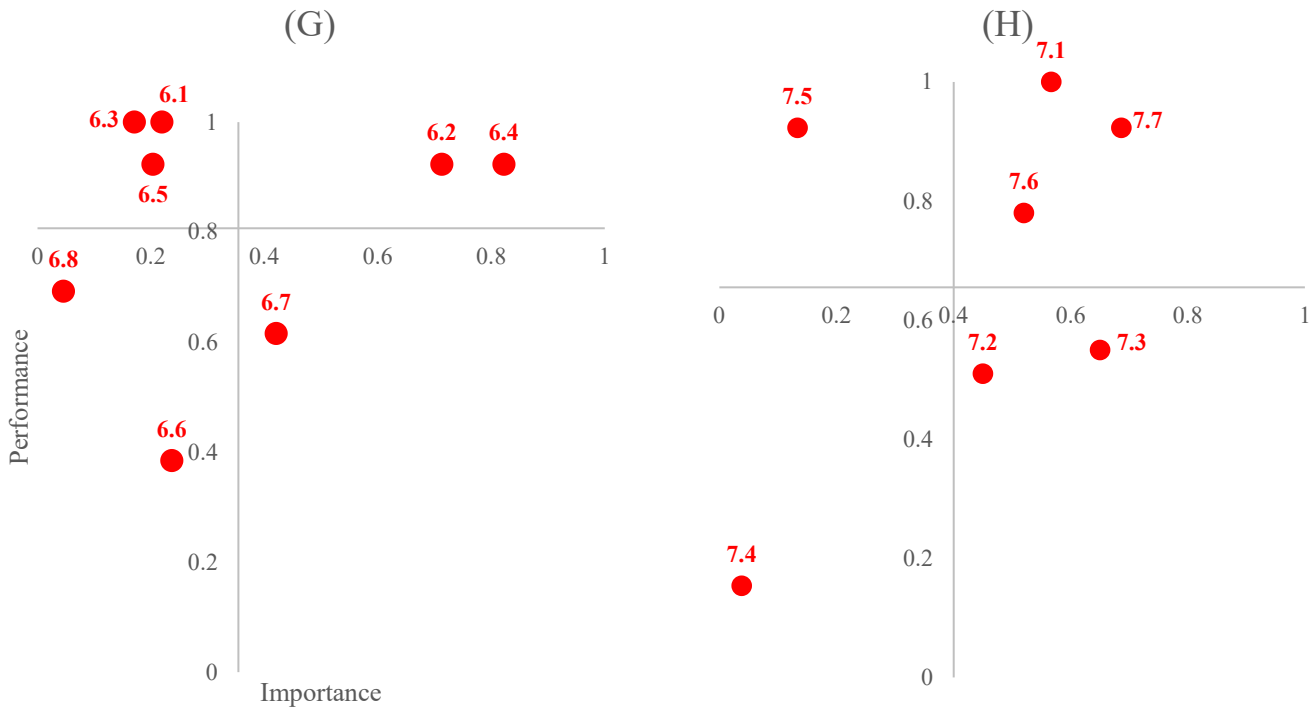

Figure 2. (**A**) The average score of each dimension. The green zone denotes a good level of safety allowing maintaining development. The yellow zone indicates that the dimension is at a fairly good level with a minor need of improvement. The orange zone means that the dimension is at a fairly low level with need of improvement. The red zone means that the dimension is at a low level with a major need of improvement. The IPA quadrants of (**B**) D1: Management's Safety Priority and Abilities, (**C**) D2: Management Safety Empowerment, (**D**) D3: Management Safety Justice. The IPA quadrants of (**E**) D4: Employees' Safety Commitment, (**F**) D5: Workers' Priority for Safety and Risk Rejection, (**G**) D6: Communication, Learning, and Trust among Peers, and (**H**) D7: Workers' Trust in the Effectiveness of Safety Systems.

5. Model Validation

According to Kines et al., in three consecutive pilot studies, the prototype survey was applied in the construction sector in all five Nordic countries. Structured equation modeling (SQM) and Rasch analysis were used to assess instrument reliability [16,51]. The results of the pilot tests confirmed the questionnaire's reliability and validity. The NOSACQ-50 was discovered to be a reliable technique for assessing safety climate, as well as a valid predictor of safety motivation, self-rated safety behavior, and perceived safety level [16]. Moreover, due to its validity and reliability, the NOSACQ-50 questionnaire was applied in many industries to assess SC, including the construction industry [22,23], oil and gas exploration [24,25], medical care [26], and firefighting [28].

To evaluate the reliability of the results in the conducted study, Cronbach's alpha was used. The global Cronbach's alpha value across the seven dimensions was 0.77, and individually was between 0.71 and 0.86, as shown in Table 5, which represents good reliability [52].

Table 5. Cronbach's alpha values for each dimension as a reliability measure.

Dimension	D1	D2	D3	D4	D5	D6	D7
Cronbach's alpha	0.77	0.86	0.8	0.72	0.71	0.73	0.75

In order to test the validity of the proposed model, Pearson's correlation was calculated. In each dimension, the correlation between each aspect, i.e., question, and the overall satisfaction of that dimension was calculated. As shown in Table 6, the aspects that were

located in quartiles 1 and 4, which indicate the highest priorities to the management, had the strongest correlation, i.e., effect, on the workers' satisfaction in each SC dimension $\rho \geq 0.7$ [53].

Table 6. The correlation between each attribute and the overall satisfaction in each dimension of the questionnaire.

D1		D2		D3		D4		D5		D6		D7	
Q1.1	0.721	Q2.1	0.771	Q3.1	0.805	Q4.1	0.700	Q5.1	0.17	Q6.1	0.22	Q7.1	0.756
Q1.2	0.181	Q2.2	0.716	Q3.2	0.025	Q4.2	0.850	Q5.2	0.846	Q6.2	0.713	Q7.2	0.849
Q1.3	0.498	Q2.3	0.134	Q3.3	0.726	Q4.3	0.121	Q5.3	0.073	Q6.3	0.171	Q7.3	0.787
Q1.4	0.154	Q2.4	0.810	Q3.4	0.851	Q4.4	0.800	Q5.4	0.046	Q6.4	0.822	Q7.4	0.038
Q1.5	0.268	Q2.5	0.671	Q3.5	0.038	Q4.5	0.196	Q5.5	0.216	Q6.5	0.204	Q7.5	0.133
Q1.6	0.907	Q2.6	0.890	Q3.6	0.042	Q4.6	0.23	Q5.6	0.910	Q6.6	0.237	Q7.6	0.337
Q1.7	0.794	Q2.7	0.708					Q5.7	0.057	Q6.7	0.878	Q7.7	0.810
Q1.8	0.869									Q6.8	0.046		
Q1.9	0.813												

6. Discussion

The concept of SC has been introduced in several studies in an effort to identify the direction of safety levels at workplaces such as the construction sector, since it is considered a high-risk sector with high rates of injuries and fatal occurrences [54]. Numerous studies have shown the importance of the SC in predicting the rate of safety accidents at sites [55–57]. Therefore, building a positive SC is acknowledged as a key method for efficiently managing safety at construction sites. Each safety climate aspect that is improved can raise the level of the SC. This study aimed to apply the NOSACQ-50 to construction workers, dissect in detail the main strengths and weaknesses of each dimension in the survey using the IPA method, and suggest strategies for improving the SC.

The average score of dimension 1, which measures how the workers assess management safety ability and priority, was 2.84, which indicates a need for improvement. Organizations should try to establish and maintain a safe environment by ensuring that workplace safety is recognized as a high priority and appreciated at all levels of the workforce. This is because the SC is crucial in integrating safety motivation with safety behavior to improve safety outcomes. According to question 1.1, workers rated the management prioritization of the safety aspect as high performance. Such a rating can be seen also in question 1.4 and 1.5, which assesses the managers and supervisors in their commitments to safety rules. Safety management commitment describes how highly they value safety and how well they handle safety-related issues. Workers emphasized the critical role of management and the anticipated top-down direction of the perceived safety culture on construction sites for a better SC. According to Basahel et al., senior management in the construction sector has a significant effect on the safety climate from the perspective of construction site employees [58]. Moreover, in question 1.2, workers stated that the management clearly communicates the safety regulations to everyone at the field. It was obvious over there that the management were delivering the safety information through different means, such as posters, lectures, and videos. Additionally, question 1.6, 1.7, 1.8, and 1.9 showed that workers were satisfied with the corrective actions taken by the management to prevent risks and solve safety issues. According to question 1.3, one of the weaknesses of the management performance was in not judging workers on safety issues strictly enough. After discussion with the supervisors, they stated they did not emphasize the causes of accidents but rather the accident report and who was responsible for the accident. This may contradict management safety performance, since the workers who were involved in accidents were not warned and judged. The reason behind that warning is to teach how to deal with and prevent risk.

In dimension 2, which measures how the workers perceive management safety empowerment, the average score was 2.81, which means that it requires an improvement. One

of the strengths can be seen in question 2.1, which assesses management competence in designing safety rules. Almost all the managers and supervisors had strong experience in occupational safety over there. Supervisors play an important role in creating a safe environment by encouraging workers to communicate about safety, which improves workers' safety compliance and behaviors [58]. A positive SC and sustaining high levels of safety communication can have synergistic advantages among the workers [59]. Management–worker communication on safety is crucial in enhancing safety performance [60–63]. This demonstrates the importance of top management promoting employees' perceptions of the SC. This may be achieved by providing specialist safety guidance and supervision by assigning qualified safety personnel for construction sites for auditing and inspection. Supervisors have a substantially higher view of the SC compared to the workers [22,64]. They play an important role in giving workers the required safety assistance through continual engagement, such as teaching how to execute activities properly and ensuring that incentives are offered to meet safety objectives on the job. The major weakness in dimension 2 was that the companies were not considering worker input in safety decisions. This weakness may result in workers disobeying safety rules and regulations. Therefore, managers and supervisors should always ask the workers for their suggestions regarding safety aspects, since they are the only people facing hazards. Moreover, the workers considered their input in safety decisions as important to them since they were the ones working on the front line and facing daily risks, as seen in question 2.3 in Figure 2C.

The average score of dimension 3 was 2.783, which implies a need of enhancement in that dimension. This dimension evaluates worker perception of management safety justice. Workers were satisfied with management safety justice, since during accidents the management listened to all workers involved in an accident to search for the causes without blaming others, and dealt with all workers fairly, which confirms the competence of the companies, as shown earlier in dimensions 1 and 2. However, the major weakness in this dimension was that the workers did not report near-miss accidents. Nevertheless, according to Hawkins et al., preventing near-miss accidents may indeed prevent major risk in the future [65]. The main role and function of accident reporting is to identify them so they can be investigated and prevent recurrence. Some of the more serious accidents must be reported to the enforcing authority. Workers should be encouraged to report all accidents to their line managers and supervisors. Unfortunately, many near-miss incidents go unreported. Research has shown that an accident leading to an injury is often preceded by many near-miss incidents and that, had these near misses been reported and investigated, the injury could have been prevented [65]. Moreover, managers should monitor near-miss incidents in order to identify any trends that may lead to a serious accident.

In dimension 4, which assesses how far the workers are committed to safety regulations, the average score was 3.6, which indicates that the management should maintain their current efforts. It is obvious in Figure 2E that the participants rated all aspects as high performance. The results indicated that workers were sharing the responsibility to create a high level of safety environment at their workplaces for each other. Employees' safety practices may be influenced by their coworkers because they typically function in teams or small groups [38]. As a result, coworkers' safety awareness and safety behaviors may be affected. Positive safety behaviors among coworkers can serve as a motivation for others to follow safety protocols, and vice versa.

The average score of dimension 5, which shows how workers prioritize safety during their work, was 3.45. This value indicates that the management should maintain their current efforts. All aspects in this dimension were rated as high performance, as shown in Figure 2F. Workers stated that minor accidents were indicators of safety issues, which confirms the importance of reporting near-miss accidents as mentioned earlier [66]. Moreover, workers refused risk behaviors even for the sake of work. Such an act may result from the management's policy, in which they prohibit taking risks even if the schedule is tight, as seen in question 1.5. Additionally, 71% percent of the workers stated that their work was

risky. Therefore, the management should enhance all safety precautions, such as training, PPE, and maintenance.

The average score of dimension 6, which measures how workers communicate and trust each other in safety aspects, was 3.16, which is fairly good with a minor need for enhancement in that dimension. When a risk is detected, workers listen to each other because they trust each other's competence, as shown in dimension 4. However, workers do not discuss and talk about safety aspects when a risk occurs, since the management does not allow their input in safety regulations, as shown in question 6.6, 6.7, and 6.8. The reason behind not listening to the workers might be that the management believes that the workers do not have a sufficient educational level, since 85% of workers are educated to high school level or less. Another explanation might be because most workers in the construction sector come from various nations, and they regard communication as a big barrier because most workers do not speak the same language as the supervisors. The absence of worker suggestions in establishing safety rules may prevent the management from discovering hidden risks and taking the corrective actions. Therefore, there should be periodic meeting sessions in multiple languages to motivate worker participation in establishing safety rules and reporting unsafe conditions. Also, employees' participation involves reporting incidents and potentially hazardous circumstances on construction sites. Some construction workers might be afraid of reprisals if they report dangerous conditions or possible hazards [67]. A study found that the connection between the SC and safety outcomes might be affected by communication [68]. Additionally, communication technology systems can help to improve safety communication at various levels [69]. A pilot research study that explored the use of communication technology systems in the form of a mobile application found that dangerous behaviors were reduced by 90%.

In dimension 7, which assesses workers' trust in the safety systems at their companies, the average score was 2.879, which means that it needs improvement. According to the questionnaire, respondents stated that the participation of safety managers, safety checks, and training were important aspects in their daily activities. These aspects are beneficial for both workers and the management as they reduce injuries and in turn reduce costs. The findings underline the crucial role of first-level supervisors in acting as a conduit for communicating corporate safety goals to the workforce [57]. However, despite the high importance of these elements, safety checkups, and training were rated as low performance according to the IPA. One explanation of this result could be that the management trust their workers and they do not conduct checkup rounds. Moreover, the language barrier might prevent the workers from making the most of training sessions, and that could be the reason for the insufficient training. A study conducted by Yi et al. found that some construction employees did not receive enough official safety training, which was related to a poor SC and safety outcome [70]. In the construction business, safety training improves the level of the SC and its related aspects [71]. Safety training may enhance employees' safety behaviors, and effective safety training programs can transform workers' risky behaviors [72]. It was found that, following effective safety training, the scores of several SC elements such as management commitment, safety communication, employee engagement in safety, safety regulation, and rule breaking rose significantly. Safety training has an influence on SC dimensions, and the SC has an effect on workers' perceptions of workplace safety [73]. Additionally, respondents stated that specifying clear safety goals is very important to them because it shows how committed the companies are to safety. Moreover, it shows the competence of the management in terms of occupational safety.

7. Conclusions

In the construction sector, the SC has been extensively investigated in safety-related research. However, none of the previous studies has analyzed what happened internally inside each dimension of the SC questionnaire. Therefore, to mitigate this gap, the goal of the study was to integrate the IPA technique with the NOSACQ-50 questionnaire to analyze in detail the strengths and weaknesses of each dimension in the survey, and propose

appropriate strategies based on the IPA results. This study will assist organizations with a new SC assessment technique that will help them to assess their safety level. Moreover, for construction companies, the results of the current study will help them to apply the recommended strategies to solve their weaknesses and improve the overall SC at their sites, in turn improving safety performance. In conclusion, the main strategies that will improve the score in each dimension are as follows: In dimension 1, management should have strict judgement in safety-related issues in order to find the causes of risks without blaming the workers. In dimensions 2 and 6, management should have periodic reports, or meetings with their workers, in order to discuss safety-related issues and to allow for their opinions in creating rules and regulations. In dimension 3, managers should emphasize the reporting of near-miss accidents to prevent the occurrence of major accidents in the future. In dimensions 4 and 5, the average scores were greater than 3.3, which indicates that management should maintain their efforts. In dimension 7, the companies should focus on safety checkups, and training sessions. Safety checkups allow management to discover the risks and hazards that their workers are facing. Moreover, they give workers the impression that management is concerned with safety-related issues. Training sessions should be frequently provided for workers with respect to their language to ensure that they gain the full benefit of the training. Moreover, training session should be conducted before each project to explain to workers the risks and hazards they may face and what corrective actions should be applied to solve the safety-related issues. It is worth mentioning the limitations of the study. Firstly, only field workers participated in the study; office workers or supervisors were not included, and they might perceive the SC differently compared to the field workers. Therefore, future studies might apply the proposed method to measure and compare the SC between different levels of the workforce, and to determine exactly what the differences in each dimension of the SC are. The second limitation is that the assessment of SC using the NOSACQ-50 survey was conducted subjectively. However, including objective assessment, such as the number of injuries or incidents, might avoid personal opinions and bias. In addition, future research might implement the proposed methodology in a comparative analysis between the current and improved SC of a certain sector. Moreover, a regression model might be developed for each dimension in the NOSACQ-50 questionnaire to determine the significant safety aspects affecting and predicting the overall SC.

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