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RETRACTED: Critical safety climate dimensions for improved safety behavior: perspectives of construction workers

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Although extensive research has been conducted to explain the high accident rates in the Indian construction industry, studies focusing on the contributions of the prevailing safety climate as an enabler of such incidences remain sparse. Safety climate plays a crucial role in shaping workers' safety behaviors. Therefore, eliciting the perspectives of construction workers concerning safety climate dimensions that are critical for engendering improved safety behavior will provide valuable insights into the dimensions required to sustain the desired safety performance levels on construction sites. This study adopted a sequential mixed-methods research design. Purposively selected respondents and interviewees were surveyed and interviewed at various intervals. The study established that safety climate dimensions, such as effective leadership, effective communication, consultation, training, resources, incentives, and recognition, are critical in improving safety behavior among construction workers. The results of this study have significant implications for practice and knowledge, as they provide an approach for assessing the impact of different safety climate dimensions on the safety behavior of construction workers in India. Understanding these dimensions will lead to a framework for managing these challenges and improving construction safety performance. The study reported in this paper remains one of the few studies seeking to explore the impact of safety-climate dimensions on worker safety behavior in the construction industry.

KEYWORDS

construction projects, mixed methods, safety behavior, safety climate, India

1 Introduction

Approximately 10 trillion dollars are spent globally on construction-related goods and services every year, making the construction industry one of the largest industries in the world. This project has a unique complexity that requires continuous interaction between the workers and equipment. Because of this type of interaction, accidents and hazards are more likely to occur at work (He, McCabe, and Jia, 2021). The Indian construction is no

exception as the exponential growth of the Indian construction industry has been associated with increasing concerns regarding safety performance. These concerns are heightened by the high-risk nature of the local construction industry, with workers often exposed to hazards such as falls, electrocution, and heavy machinery-related accidents (Clarke, 2006). In addition, the unsafe nature of the industry has been exacerbated by its informal nature, within which a significant proportion of workers remain unskilled. These factors, combined with a lack of safety regulations and enforcement, contribute to a high rate of accidents and injuries in the Indian construction industry (Khan et al., n. d.). Such high rates of accidents and fatalities have necessitated the facilitation of interventionist measures to engender safe working conditions for construction workers within that context (Alruqi, Hallowell, and Techera, 2018). In addition, at the organizational level, previous studies have shown that efficient and organized safety management can accelerate companies' profitability and growth. Employee safety and profitability are directly related, as evidenced by the (A. Singh and Misra, 2021; Alruqi, Hallowell, and Techera, 2018; Chandra, Sepasgozar, et al., 2023).

Workers' safety climate, defined as perceptions and attitudes shared by employees towards safety, plays a crucial role in shaping the attitudes and behaviors of workers towards safety (Chan et al., 2017; Elmoujaddidi and Bachir, 2020). A positive safety climate has resulted in improved safety performance, resulting in fewer accidents and injuries (Wang et al., 2020; Khan et al., n. d.). However, creating a positive safety climate is a complex task requiring various dimensions including leadership, communication, training, and incentives (McCaffer, 2014; Chen et al., 2021). Studies report that prioritizing and actively promoting safety climate in construction projects encourages workers to take safety precautions and report site accidents (Chan et al., 2017; Irfan et al., 2022; Mohammed et al., 2023). Effective communication and consultation processes are considered dimensions of a positive safety climate. Safety risks and hazards must be communicated to workers along with the ability to contribute input and feedback on safety policies and procedures (Schwatka et al., 2019; Sathvik et al., 2023; A. K; Singh et al., 2023). A workplace within which workers feel that their concerns and opinions are valued is more likely to see that they participate in safety initiatives. The availability of training and resources has also been identified as another dimension of safety climate (Man et al., 2021; Sathviket al. 2023a; Sathviket al. 2023b; Chandra, Loganathan, et al., 2023) According to (Helen, Cooke, and Blismas 2010; Pandit, Albert, and Patil 2020; Krishna, Sathvik, and Suchith 2022) workers indicated that exposure to adequate training on safety procedures and access to necessary safety equipment improved their ability to identify and mitigate safety risks. This is particularly important in the construction industry, where workers are often exposed to various hazards and risks. Incentives and the recognition of safe behaviors have been identified as contributing to a positive safety climate. The importance of providing incentives and recognizing safe behaviors has been established as a powerful motivator for positive safety performance among workers (Chen et al., 2021). The sustainability of safety performance within construction projects and organizations depends on the safety behaviors of construction workers.

While these dimensions of positive safety climate in construction projects have been documented in the relevant literature, there appears to be a paucity of literature detailing the criticality of these dimensions in facilitating improved safety behavior among construction workers (He, McCabe, and Jia, 2021). This is particularly the case in India, where the increasing rate of accidents in construction projects has continued to pose a challenge.

Therefore, this study contributes to resolving this challenge by answering the following research question:

What safety climate dimensions are critical for improving the safety behavior of construction workers in India?

The results of this study will enable construction project managers to develop effective strategies and policies to improve safety behavior across the board, thereby enhancing the safety climate in Indian construction by leveraging these crucial dimensions.

2 Literature review

In the past few years, an increasing body of research has examined the relationship between construction safety climate and construction safety performance (A. Singh and Misra, 2021; Ahmad, Ying, and Sapry, 2020; Nasr et al., 2021). Such studies have identified leadership, communication, and training as safety climate dimensions that contribute to facilitating improved safety behavior among construction workers, culminating in a project's overall safety performance. Extant research has shown that effective leadership remains a key driver of safety performance in construction projects (Zahoor et al., 2015). Leaders who actively promote and model safe behaviors are likely to foster a positive safety climate among their workers. For example, Zhang et al. (2015) found that construction supervisors who had a positive safety attitude and provided clear safety expectations for their workers had significantly higher levels of safety performance among their workers. Furthermore, another study conducted in Australia found that construction managers who were perceived as safety leaders were able to create a safety culture characterized by trust, open communication, and mutual respect (Helen, Cooke, and Blismas, 2010). Effective communication is another dimension of safety climate. This dimension ensures that workers have information they need to work safely (Pandit et al., 2020). In another study, Pousette and Törner (2016) found that effective communication is positively associated with safety performance among construction workers. Additionally, effective communication has been identified as fostering trust and mutual respect among workers (Wang et al., 2020; T; Lee and Lee, 2016).

Training is another dimension of the safety climate (Greeff, 2017). Construction workers must have the knowledge and skills they need to work safely, and training can help ensure that they have these abilities (Sathvik and Krishnaraj, 2022; 2020; Sharath and Loganathan, 2022). Training is positively associated with the safety performance of construction workers (Kwon et al., 2021). Similarly, (Newaz et al., 2019),observed that workers who received safety training were less likely to be involved in accidents (Zou and Sunindijo, 2013; Zahoor et al., 2015; He, McCabe, and Jia, 2021). The relationship between safety climate and construction site safety performance has been well established in safety research, owing to improved safety outcomes (Zahoor et al., 2015).

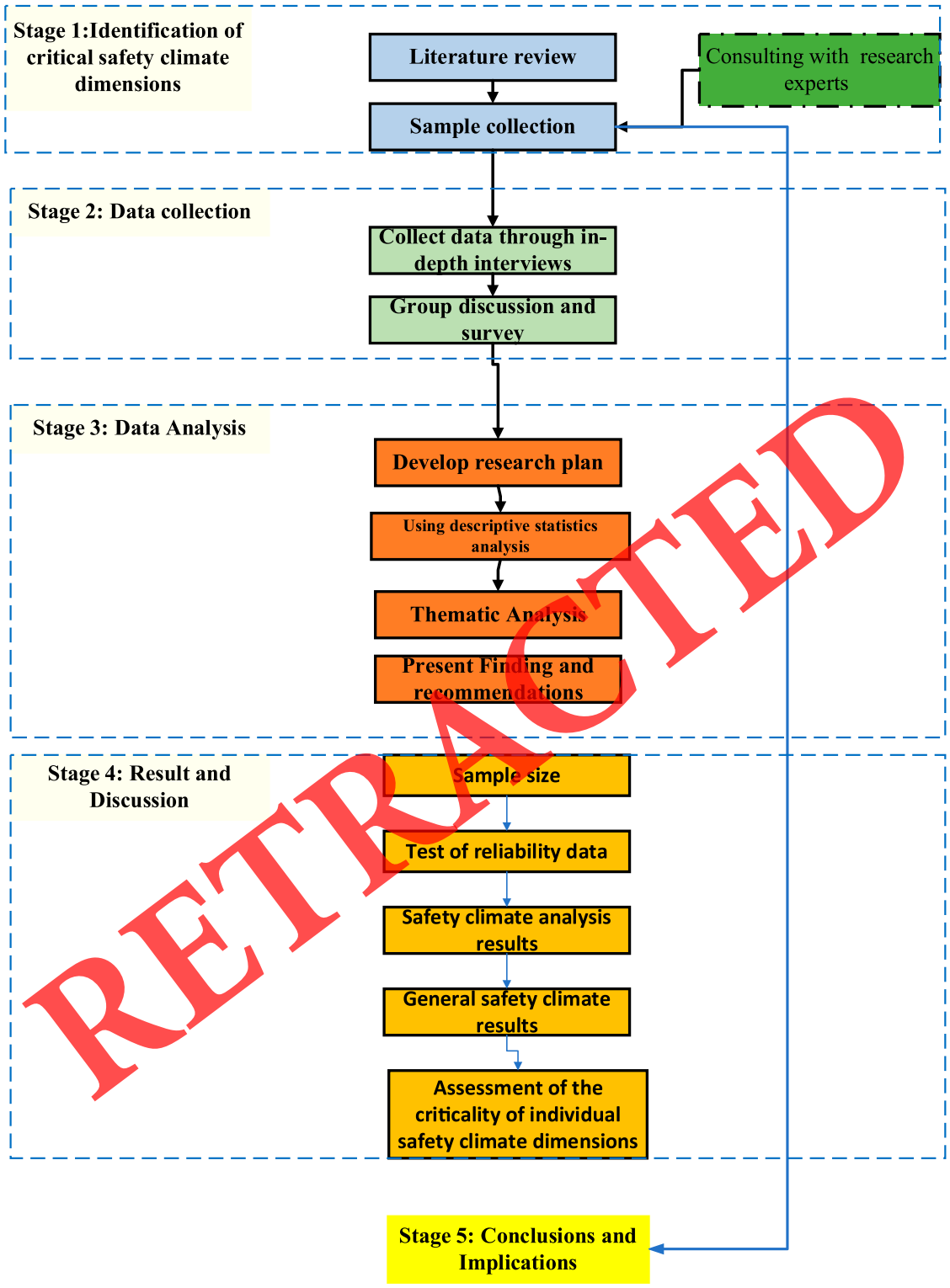

FIGURE 1
Research methodology.

Although most studies on the relationship between safety climate, safety behavior, and safety performance have focused on several countries (Mohammed, Shakor, Sathvik, et al., 2023), a limited number of studies have considered the Indian construction context. In addition, there is a paucity of studies exploring the impact of particular safety climate dimensions on the safety behavior of construction workers has been observed. This leaves a gap in understanding as it concerns how these dimensions

influence the safety behavior of construction workers and, by extension, the sustenance of a positive safety climate and improved safety performance in India's construction industry. This investigation is considered imminent because workers' unsafe behavior has been cited as a major contributing factor to construction accidents (Chan et al., 2017). In addition, the most effective interventions sought to ensure safe behavior at work. Additionally, there is limited research on how different demographic characteristics of construction workers, such as age, gender, and education level, influence their perceptions of the criticality of these dimensions in improving safety performance. This study attempts to fill these gaps by examining the perspectives of Indian construction workers.

3 Research methodology

This study aims to establish safety climate dimensions that are critical in engendering optimal safety behaviors that enable construction workers in India to safely engage in work-related activities. The methodological framework adopted for the data collection and analysis is shown in Figure 1.

A construction project in southern India was used as a case study to obtain data for this study. This project commenced in 2022 and was completed in 2023. Six Likert stations/construction sites were built as part of this project. Five construction sites were surveyed from February 2022 to July 2023. An automated response system called 'Viewpoint' with handheld devices called 'clickers' was used to administer the survey. Participants can respond to the survey using handheld devices like 'clickers.' Users find these devices convenient and easy to use. A minimum amount of technical knowledge or training is required to manage them. A real-time data collection system provides the ability to collect and analyze data immediately. Recording answers from participants instantly eliminates the need for manual data entry and reduces the likelihood of error or data loss. Improved accuracy: This study sought to minimize potential errors associated with manual data collection and transcription by utilizing an automated response system. Using clickers, data can be entered in a standardized manner, which reduces variability and increases data reliability. Participants' engagement and participation can be enhanced when handheld devices such as clickers are used. By design, the system is interactive, encouraging respondents to participate actively in the survey and resulting in more accurate and thoughtful responses. Efficient data management: Data management was simplified using an automated response system. The associated software allows for easy storage, organization, and analysis of the collected data, facilitating a more efficient and accurate interpretation of the data.

An individual sequentially reads the survey questions projected on a screen. The survey was completed by 352 participants. The university's ethics guidelines and principles require voluntary participation and all responses remain anonymous. The survey is divided into two sections. The initial section of the study focused on gathering background information from each respondent, including their age, gender, education level, current position, years of experience in the construction industry, and nature of their employer.

Several minor changes were made to the survey's grammatical structure after the pilot survey was conducted in six construction fields, which effectively translated the survey into English. A second question was added to the cross-validation of the results based on the participant recommendations in the pilot survey. A web-based survey was conducted on the construction of five major projects in the southern region of India, one of the country's most developed regions, and a face-to-face survey was conducted on the construction of five major projects in the northern region shown in Table 1.

This study examines a sample of major construction projects in the southern region of India. A total of 200 respondents, including construction professionals, construction workers, and construction administrators, filled out the questionnaire. This cohort was selected based on a non-probability purposive sampling methodology. Every project manager or engineer establishes formal networks with the companies involved in the project. Table 2 summarizes the respondents' profiles.

In addition to collecting and analyzing the survey data, member checking was performed to verify the findings. The findings of the study were presented during interviews with nine experienced construction sectors (See Table 3). Those willing to be interviewed were randomly selected from the survey respondents. In addition to cross-validating the survey results from a qualitative perspective, the interviews sought more detailed safety climate information. During the interviews, interviewees were asked if the results represented actual on-site construction practices and if they offered any further reflective insights for a safe work environment. By ensuring that anonymous data were collected, potential bias was minimized. Data collection, recording, and analysis were conducted according to ethics guidelines.

4 Results and discussion

4.1 Sample size

There were 320 responses to the survey, of which 183 provided a valid basis for analysis. A total of 170 valid responses were received from the face-to-face approach and 13 valid responses from the online approach, respectively.

4.2 Test of reliability data

Cronbach's alpha, a reliability coefficient, was used to assess the reliability of the questionnaire. Cronbach's alpha values for each of the six safety climate dimensions are listed in Table 4. Each value was deemed exceptional because it significantly exceeded the threshold value of 0.80.

4.3 Safety climate analysis results

Table 4 shows the results of the SPSS 22.0 analysis of the rank and mean score for each commodity on a 60-commodity instrument. The inquiry was designed such that some questions were worded unfavorably, while others were worded favorably to

TABLE 1 Structure of the sample project.

Project	Brief description
1	A significant local real estate developer provided the project funding, whereas a sizable, top-tier general contractor owned by the state erected it. The project comprised 17 residential buildings with a total floor space of over 440,000 m^2
2	The project was developed by a vast, state-owned general contractor of the highest caliber and was financed by a significant local real estate developer. The project comprised 19 residential buildings with a total floor space of over 510,000 m^2
3	A regional industrial investor provided funding for an industrial logistics project, and a government-owned, sizable general contractor of tier one provided the construction services. With a combined area of over 250,000 m^2, it comprised one two-story office building and five production buildings
4	A business investor contracted a general-purpose state-owned enterprise for construction. With a total area of over 250,000 m^2, the plant was comprised of a two-story office building and five two-story production buildings
5	Multiple subway lines were built with funding from the local government, which a private enterprise controlled. State-owned companies developed and constructed the project. Over 105 billion RMB was invested in the project overall

reduce the possibility of consent bias. Therefore, the mean values in Table 4 were adjusted to account for negatively worded survey items during statistical analysis.

4.4 Assessment of the criticality of individual safety climate dimensions

The results from each of the safety climate dimensions developed in this section are explained. According to Table 5, there were 60 items in the instrument. Ranks and mean scores for each item were analyzed using SPSS 22.0. Acquiescence bias was minimized using positive wording, and a good survey design dictated negative wording for other items (Newaz et al., 2018). The following is a discussion of how Zou and Sunindijo (2015) interpreted the results for each safety climate dimension, which are listed in Table 5.

4.4.1 Commitment management

A high average score of 5.43 out of six indicates that senior management commitment is strongly correlated with a positive safety climate. A similar finding was made by McCaffer (2014), who noted that the link between an organization's safety climate and the organization from which it originated was often underestimated.

Upon reviewing the sub-item ratings, it became evident that managers consistently prioritized safety, as indicated by a score of 5.51. It is also evident that they address safety concerns with a high level of seriousness, achieving the highest score of 5.71 out of 59. In addition, managers were ranked fourth, with a score of 5.49 for being prompt in responding to safety issues and consistently implementing corrective action. Based on these findings, a strong positive correlation between management commitment and the remaining five aspects can be credited with the significant contributions to the high level of safety climate observed in this study (see Table 6).

According to one participant, the subway construction project emphasized safety because of its public nature. Ultimately, the client's commitment to safety and the assurance of the local government's commitment to ensuring the safety of construction and operations played a critical role (Anandh and Gunasekaran, 2016; Soundarya Priya et al., 2023; Soundarya et al., 2024). Therefore, it is clear that the safety department played a pivotal role within the company, assuming responsibility for overseeing stringent safety measures. The management teams of various stakeholders (Respondent 5) identified safety as the top priority.

Based on the study findings, it is evident that there is a significant correlation between the commitment of senior management and the safety climate. Managers consistently prioritize safety, are serious about addressing safety concerns, and take proactive measures to address safety issues by consistently implementing corrective actions. These factors contribute to the robust safety climate noted in this study, which is reinforced by the significant emphasis placed on safety within the subway construction project and the commitment of multiple stakeholders' management teams.

4.4.2 Interaction

A comprehensive baseline survey was subsequently requested by all leaders who volunteered to participate in the initial job site visit. A notice was also provided to them regarding the upcoming follow-up surveys and an invitation to attend a free training program, Foundations for Safety Leadership (FSL) (Schwan and Yu, 2018). A thoughtful schedule was developed for the FSL training session so that participants could attend at a convenient time, and meals were provided to ensure comfort during the training session.

An initial baseline survey was conducted at the job site with workers who consented to participate. A $5 gift card was offered for each completed survey in order to incentivize them to complete the follow-up survey (Ma et al., 2021). By promoting active participation in the research process and recognizing their significant contributions, this approach encourages active involvement in the research process.

A few instructors who had never previously worked at 254 N.V. were carefully selected for this position. Training-the-trainer sessions were held for these instructors on the Foundations for Safety Leadership. Instructions and protocols for delivering training are clearly outlined in the instructor guide (Olugboyega and Windapo, 2019). Appropriate remuneration was provided to trainers in recognition of their time and effort. A research team member attended all the FSL training sessions to ensure proper data collection and monitoring. Participants' perspectives were captured through pre- and post-training surveys, enabling valuable insights to be gathered (Y. J. Lee, Tung, and Lin, 2019; Olugboyega and Windapo, 2019). These rigorous procedures were intended to encourage thorough data collection, engage both workers and

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TABLE 2 Demographic distribution of interviewees.

Description		Total	Percentage (%)
Gender	Male	170	83.19
	Female	30	16.81
Age	19–25	46	24.34
	25–36	103	54.50
	36–47	23	9.53
	48–55	18	6.88
	56 and above	10	4.8
Education	Elementary	12	7.88
	High/secondary school	34	16.46
	Without a degree	20	28.57
	Undergraduate	30	42.33
	Postgraduate	4	4.76
Years of experience in construction	0–5	40	48.68
	6–10	22	28.04
	11–16	21	11.11
	16–21	5	2.65
	21–25	6	3.17
	25 and above	6	6.35
Position	Worker working in construction place	19	10.05
	Skilled Worker	8	4.23
	The Bottom tier of management	21	58.20
	The junior tier of management	41	21.69
	The senior tier of management	10	5.29
	The rest	1	0.54
Type of company	Customer	5	3.65
	Contractor	50	64.49
	Subcontractor	27	21.28
	Supplier designer	6	4.17
	Consultant	4	3.23
	Other	8	3.3

leaders, and ensure the effectiveness of the Foundations for Safety Leadership training. Participant motivation and commitment were enhanced by incentives and compensation, which contributed to overall research success (Schwan and Yu, 2018; Han et al., 2019).

4.4.3 Practices and norms

Among the six dimensions, one received the lowest rating. Sub-items "ignoring safety regulations to complete a task" (rated 50th) and "not all staff meticulously follow safety protocols" (rated 55th) received low scores, given that safety regulations and practices are crucial in controlling participant safety performance. Researchers have found that adherence to safety laws and safe work practices is the most overlooked aspect of a safe work environment is adherence to safety laws and safe work practices (Ma et al., 2021). Additionally, the authors noted that implementing health and safety rules poses various challenges such as human error and issues with the enforcement system. The interviews revealed that despite the established norms and processes in the projects, they were often difficult to implement because of inconsistencies among stakeholders and projects and project constraints and systems (Schwan and Yu, 2018). In addition, these results were examined in more detail, emphasizing the significant (yet largely unexplored) interactions between the safety systems and other project systems. Two respondents said the following. In the last 15 years, the

TABLE 3 Interviewee demographics.

Interviewees	Brief description
Interviewee 1	A manager with 20 years of experience in a private construction company
Interviewee 2	Had over 13 of construction management experience as a supervisor of general operations for a large private construction company group
Interviewee 3	A construction manager with over 13 years of experience managing a branch of a group of large private companies related to construction
Interviewee 4	Has construction management experience of over 13 with a large state-owned company. The project tendering had been under their control for over 5 years
Interviewee 5	Director of a state-owned construction company with over 13 years of experience in construction management insight. The project tendering had been their responsibility for over 5 years
Interviewee 6	Holds a master's degree and has 1 year of experience working at a construction management site
Interviewee 7	Holds a master's degree and has 1 year of experience working at a construction management site
Interviewee 8	A construction engineer with a master's degree in construction management and 1 year of construction experience
Interviewee 9	An experienced construction manager with a master's degree in construction management

TABLE 4 Cronbach's alpha value of each dimension.

Dimension	Cronbach's alpha	Number of items
Commitment management	0.939	9
Interaction	0.943	9
Practices and norms	0.921	6
Encouraging environment	0.961	16
Responsible behavior	0.959	14
Workers involvement	0.920	6

construction industry in India has developed and refined its safety rules and procedures, contributing to improved safety performance in the industry. Nevertheless, there are often too many requirements, so we move on to the next project before getting to know Respondent 1. Safety is a high priority for all projects. However, we are under tremendous pressure from clients or our company to cut costs and expedite construction. For example, the real estate market in India experienced booms in 2018 and 2019. Real estate developers commonly set strict requirements to complete a project to maximize profits (Renukappa et al., 2013). There is an industry where safety is neglected and rules and procedures are not followed, as indicated by Interviewee 4.

4.4.4 Encouraging the environment

Despite the relatively high score for this element, the findings indicated uncertainty regarding who was responsible for safety and perverse loyalty between co-workers, leading to concealment of issues (Kao et al., 2022). Respondents felt that their co-workers did not care enough about their safety, as shown by the sub-scores for this dimension (5.22, grade 38th); they were not urged to report unsafe working conditions (5.16, grade 42nd), and were not given enough credit to work safely (5.11, grade 38th) (4.84, grade 56th). One interviewee added the following.

"There was no report of unsafe behavior or potential hazards by many of the field operatives to their superiors. This action was regarded as the responsibility of safety guards, and the operatives feared damaging positive relationships with colleagues" (Interviewee 8).

An effective climate for safety requires role clarity and dispute, as well as the interaction between safety systems and leadership styles in putting workplace safety into practice cite (Chia et al., 2016). Role conflict occurs when demands for a job or position are irreconcilable, whereas role clarity refers to how employees understand their job, responsibilities, and work processes. The advisor added that praise improved compliance and involvement in safety behavior and highlighted leadership style and role clarity as crucial components for boosting safety performance (Juhola, 2016). The data and those of other researchers indicate that more significant rewards for positive behavior would balance out the penal culture that distinguishes traditional Indian approaches to safety management. However, there have been no comparable studies in an Indian construction setting (Khan et al., n. d.). One respondent reported the following:

"We recorded the efforts of construction workers to prevent accidents and identify safety hazards on-site daily and rewarded by assigning scores, contrary to popular punishment practices cite (Noblet and Brisson, 2017). In the on-site safety-reward store, workers could exchange their accumulated scores for daily essentials, which motivated them to work safely" (Interviewee 9) (Marín et al., 2019).

4.4.5 Responsible behavior

These sub-scores were assigned to this dimension in conflict. For instance, respondents considered safety to be the top issue and placed it at a high value (5.38, sixth grade) (5.38, seventh grade) (Wang et al., 2020). However, considering the previously noted concerns regarding onerous and complex rules and processes, they regarded safety rules as constrictive (4.70, placed 58th) and challenging to understand (4.67, placed 59th). According to the interviews, the interviewees preferred to ignore safety policies because they required additional work, such as learning about

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TABLE 5 Data analysis relating to safety climate.

Aspect	Observation	Mean	Rank
Commitment management	a. Safety is a top priority for my project manager	5.38	6
	b. My project manager ignores safety concerns	5.71	1
	c. My project manager ignores safety-related issues	5.49	4
	d. In an unsafe behavior or situation, my project manager always takes the appropriate action	5.50	3
	e. My project manager always takes corrective measures when informed of unsafe behavior or situations	5.34	11
	f. In dangerous situations, my immediate superior permits me to continue working	5.36	9
	g. Sometimes, my immediate boss orders workers to start work despite unsafe conditions	5.35	10
	h. My direct boss frequently orders staff to begin work despite unsafe working conditions	5.30	13
	i. As a result of mishaps, my project manager only emphasizes safety	5.51	2
	Average	5.43	
Interaction	a. I am ready to discuss safety-related matters with my project manager	5.40	5
	b. Effective safety communication is essential	5.05	41
	c. My awareness of safety increases as a result of safety communication	5.17	29
	d. I am open to discussing safety with my project manager	5.11	37
	e. Safety-related information is frequently sent to me	4.95	51
	f. I receive advice on improving my work if I work without protection	4.95	52
	g. The safety information is always up-to-date	4.99	49
	h. I receive constructive feedback when I work unsafely	4.80	57
	i. Safety information is transmitted inadequately	5.01	47
	Average	5.05	
Practices and norms	a. The completion of a task may sometimes require disregarding safety regulations	4.97	50
	b. It is sometimes necessary to disregard safety regulations to accomplish a task	5.25	17
	c. All personnel strictly adhere to safety protocols	4.87	55
	d. All personnel must follow safety protocols	5.04	43
	e. There are times when safety procedures are neglected to achieve production goals	5.03	46
	f. It is sometimes necessary to neglect safety measures to meet production goals	5.04	44
	Average	5.03	
Encouraging environment	a. It is sometimes necessary to disregard safety measures to meet production targets	5.23	21
	b. Colleagues will retaliate against safety hazards	5.20	25
	c. It is highly recommended that I report harmful work conditions	5.16	42
	d. It is highly recommended that I report harmful circumstances at my workplace	5.23	22
	e. The safety of my work is of little interest to my co-workers	5.22	38
	f. It is common for my co-workers to share safety recommendations	5.18	28
	g. When I remind someone to work safely, no one criticizes me	5.12	36
	h. Accidents are more likely to occur in my work environment	5.28	16
	i. Unsafe behavior is not punished	5.16	32
	j. It is not always possible for me to bring the equipment or tools that I need to do the job safely	5.16	30
	k. As a result of my safe work, I receive praise	4.84	56

(Continued on following page)

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TABLE 5 (*Continued*) Data analysis relating to safety climate.

Aspect	Observation	Mean	Rank
	l. To get the job done safely, there are always enough people available	5.24	20
	m. Sometimes, I am not provided enough time to complete a task safely	5.13	35
	n. Safety precautions often conflict with work objectives	5.17	31
	o. Job conditions occasionally compromise my capacity to perform in a safe environment	5.21	23
	Average	5.15	
Responsible behavior	a. There is some control I have over workplace safety	5.38	7
	b. I'm bound to collide with someone soon	5.34	12
	c. It is only an issue of time before I have a car accident	5.25	18
	d. My job is to follow instructions and I do not want to be bothered with protection policies	4.67	59
	e. There is some control I have over workplace safety	5.00	48
	f. As part of my job, I implement safety measures	5.29	15
	g. My workplace has some control over safety performance	5.16	33
	h. I place safety at the top of my priority list when I complete a job	5.38	8
	i. All protection rules are clear to me	4.70	58
	j. It is my accountability to work safe environment and not to inform co-workers who are not doing so	5.25	19
	k. The safety standards at my workplace are adequate	5.11	39
	l. It is inevitable that I will get into some sort of mishap	4.95	53
	m. The possibility of being injured at work worries me	4.90	54
	n. I can influence how well safety is performed at work	5.04	45
	Average	5.10	
Workers involvement	a. Detecting potentially dangerous situations is one of my strengths	5.21	24
	b. Safety training identifies potential risks and their effects	5.30	14
	c. There is a need for safety of workers involement	5.19	26
	d. I received the right training to perform my job safely	5.19	27
	e. To do my job safely, I had the necessary training	5.16	34
	f. Safety training is possible on this project because of the availability of adequate services	5.07	40
	Average	5.19	
Average of all		5.16	
Overall safety climate satisfaction		5.17	

them and controlling their behavior. One interviewee stated the following.

"Every project is approached differently. Meeting client safety requirements requires a thorough understanding of their specific needs (Alruqi, Hallowell, and Techera, 2018). In some cases, workers are not interested in learning these requirements without client pressure, owing to the boring nature of the requirements and the fact that the workers are busy. Instead, the workers prefer to regulate their behavior based on personal experience" (Interviewee 3).

These findings agree with those of studies conducted in India that found that individuals held little personal responsibility for protection. By demonstrating that consistent safety policies should be implemented at all levels of business organizations and projects, our findings contribute to this body of literature (Marín et al., 2019). Their article emphasized the importance of project-level employees in developing safety practices that are compatible with cost, time, and productivity demands. (Wang et al., 2020). Furthermore, they demonstrated a lack of interest in learning the rules. Furthermore, incompatible institutional demands constitute a barrier to safety in India.

4.4.6 Workers involvement

The respondents' perceptions regarding their abilities to recognize potentially dangerous circumstances (5.30, rated 14th) and the usefulness of safety training were reflected in the sub-score of this dimension (5.21, grade 21st). However, the respondents also said that proper facilities and further safety training (5.16, grade

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TABLE 6 Correlation analysis results using Pearson's method.

	Commitment management	Interaction	Norms and procedures	Encouraging environment	Responsible behavior	Workers involvement	Climate safety satisfaction
Commitment management	1						
Interaction	0.796	1					
Norms and procedures	0.740	0.845	1				
Encouraging environment	0.770	0.921	0.789	1			
Responsible behavior	0.751	0.890	0.835	0.920	1		
Workers involvement	0.675	0.813	0.735	0.865	0.826	1	
Climate safety satisfaction	0.600	0.705	0.622	0.751	0.675	0.777	1

34th) should be offered (5.07, grade 40th) (Alruqi, Hallowell, and Techera, 2018). According to these results, better protection training is necessary to improve construction project safety owing to the general elementary involvement of construction workers in India (Sukamani, Wang, and Kusi, 2021). (84.3% of construction workers were farmers with only a high school or elementary education). One respondent stated the following.

"Workers should be involved in safety training in order to improve the quality of the training." In our construction project, virtual demonstrations and reflections on coworker safety experiences were used as safety training methods" (Interviewee 6).

The high level of safety climate in this study may also be attributed to this factor. One interviewee noted that management commitment plays a critical role in fostering a positive safety culture in India by positively influencing safety awareness and behavior (Welton et al., 2018). However, our findings illustrate the importance of inter-organizational commitment to safety. When clients (specifically managers) prioritize safety, teams from different companies involved in the project are also likely to prioritize safety.

5 Conclusion and implications

The study of critical safety climate dimensions aimed at enhancing safety performance among construction workers in India underscores the significance of fostering a safety-centric organizational climate within the construction sector. The study found that safety leadership, communication, training, equipment, and feedback are critical dimensions contributing to a positive safety climate and improved safety performance.

In India and other developing countries where safety standards and regulations may not be adequately enforced, the results of this study may have significant implications for the construction industry. This study underscores the need for safety leaders to adopt a proactive approach to safety and create a safety culture that prioritizes safety over productivity. Effective safety communication and training are critical for enhancing workers' safety knowledge, attitudes, and safety performance. Providing safety equipment and regular safety feedback can help prevent accidents and improve the safety performance.

This study also highlights the role of workers in promoting safety and shaping the safety climate. Workers' involvement in safety-related decisions and participation in safety programs can improve safety awareness and encourage safety-focused work environments. Involving workers in safety-related decision making can also empower them and enhance their commitment to safety.

The creation of a safe and healthy workplace relies heavily on management support and involvement in safety procedures. To ensure worker safety, safety procedures and equipment should be trained before starting work in the field, as determined in this study. By focusing on safety, implementing a comprehensive safety manual, and providing periodic safety training to employees, the management ensures a safe and productive workplace that allows employees to perform at their highest levels. Middle-level and low-level managers' opinions are essential for determining the preferences of indicators. Managing at the middle level facilitates information sharing between upper and lower management.

Middle-level personnel are primarily responsible for interacting with and providing workers with training. Construction site workers are responsible for assessing the efficiency. Lower-level management interacts directly with workers and provides guidance. To manage at the lowest level, you must ensure that the projects are of high quality and that the workers are productive. Planning must consider the perspectives of the middle and lower levels to succeed. A firm's management is responsible for structuring its safety framework.

Worker confidence in a company's health and safety conditions will increase, thereby leading to an increase in productivity. An investigation revealed that some enlightening facts are hidden. Further research on this topic should be conducted. Data on workplace accidents should be incorporated into predictive models to assess the importance of each indicator. Several indicators exhibited contrasting results after the sensitivity analysis. Several factors may have resulted in inconsistent responses, including hesitation and unwillingness. The use of other preprocessing tools can be effective in modeling this aspect of the data.

This study provides valuable insights into the critical safety climate dimensions that can improve the safety performance of

construction workers in India. These findings can guide safety leaders in adopting a proactive approach to safety, enhancing safety communication and training, providing safety equipment, and involving workers in safety-related decisions. By implementing these critical safety climate dimensions, the Indian construction industry can improve its safety performance and prevent accidents, injuries, and fatalities.

In addition, the findings of this study call for further research to identify the best practices for creating a positive safety climate in India's construction industry. Furthermore, more research is needed to understand how the identified dimensions can be effectively implemented in the construction industry in India and to explore the impact of the safety climate on safety performance over time.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Ethics statement

This research was approved by the Ethics Committee of the SRM Hospital and Research Centre (2186/IEC/2020) and conducted according to the principles of the institutional ethical committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SC: Conceptualization, Methodology, Project administration, Visualization, Writing–original draft, Writing–review and editing. AB: Data curation, Funding acquisition, Investigation, Methodology, Project administration, Visualization, Writing–original draft, Writing–review and editing. PS: Conceptualization, Data curation, Formal Analysis, Resources, Software, Writing–original draft, Writing–review and editing. AA: Conceptualization, Formal Analysis, Funding acquisition, Supervision, Validation, Writing–original draft, Writing–review and editing. AS: Conceptualization, Data curation, Formal Analysis, Project administration, Supervision, Writing–original draft, Writing–review and editing. AK: Conceptualization, Formal Analysis, Resources, Software, Supervision, Writing–original draft, Writing–review and editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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