

Assessing the Impact of Project Management on Safety Culture and Construction Site Accidents: Evidence from Field Surveys in Urban Projects

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Abstract

Construction remains one of the most hazardous industries globally, particularly in urban environments, where complex workflows, dense workforces, and dynamic site conditions increase the likelihood of accidents. Despite improved regulations, many construction sites continue to face recurring safety challenges, primarily influenced by managerial practices and organisational safety culture. This study aimed to assess the impact of project management practices on safety culture and construction site accidents in urban projects. A quantitative, cross-sectional design was adopted, and data were collected through a structured survey administered to 270 construction workers, supervisors, and project managers. Statistical analyses were performed using SPSS, including descriptive statistics, correlation analyses, regression modelling, and mediation analyses. The results revealed that project management practices were strongly and positively associated with safety culture ($r = 0.71$, $p < 0.01$) and significantly reduced accident frequency ($r = -0.64$, $p < 0.01$). Regression results confirmed that project management predicted 50% of the variance in safety culture and 41% of the variance in accidents. Mediation analysis indicated that safety culture partially mediated the relationship between project management and accident occurrence. These findings highlight that stronger managerial planning, leadership, risk assessment, and communication contribute directly and indirectly to safer construction environments.

Keywords: Project Management, Safety Culture, Safety Leadership, Urban Construction

Introduction

Construction, as a business unit, was considered one of the riskiest to operate in, given its high rates of injuries, accidents, and fatalities. Though urban construction sites were technologically advanced and more regulated in terms of safety, they remained high-risk environments due to their dynamic and complex nature, temporary workforce, and fluctuating conditions (Zhang et al., 2023; Sunindijo & Zou, 2023). The management of projects was also viewed as an essential element in

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reducing these types of risks, as planning, coordination, and leadership practices can reduce unsafe events and improve project performance (Ali et al., 2024; Chen & Li, 2024).

Research has highlighted that project management affects safety outcomes not only through formal safety procedures but also through organisational culture and workers' perceptions of their safety (Lyu et al., 2025; Jameel et al., 2024). Project managers provided leadership, communication, and risk management, influencing the internalisation of safety norms by workers, compliance with work protocols, and the adoption of proactive safety measures (Misnan et al., 2024; Anzagira et al., 2024). Research indicated that effective project management teams achieved high compliance with safety protocols and reduced accident rates (Gul et al., 2023; Imran et al., 2023).

The paradigm of safety culture has become an essential part of construction research, defined as the shared values, attitudes, and practices concerning safety within an organisation (2021; Lyu et al., 2025). A strong safety culture motivated workers, enhanced compliance with safety regulations, and promoted self-reporting of hazards, thereby reducing the number of accidents (Sunindijo & Zou, 2023; Chen & Li, 2024). Previous research has shown that the assimilation of safety culture into project management practice promotes site safety and overall project realisation success.

In this light, the current study evaluated the role of project management practices in shaping safety culture and reducing construction site accidents in urban construction projects. The analysed research was based on a primary survey, aiming to determine whether effective project management is associated with a better safety culture and a reduced frequency of accidents (Ali et al., 2024; Jameel et al., 2024).

Research Background

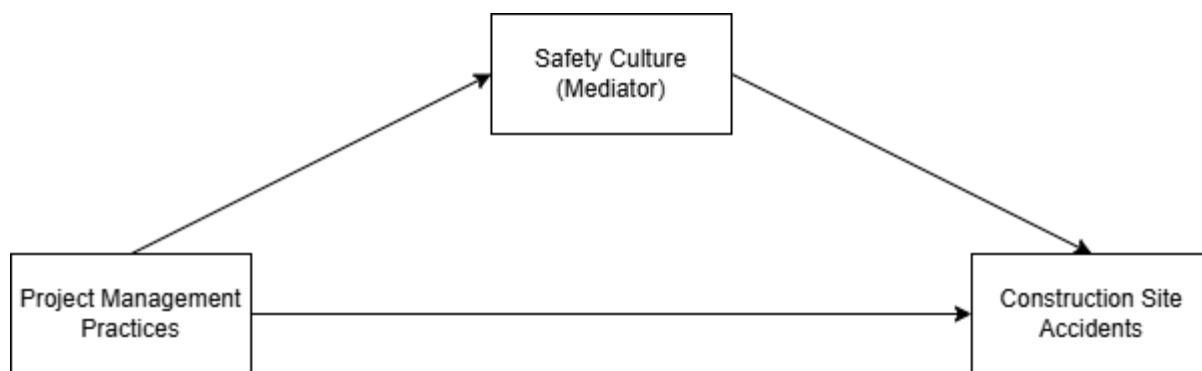
It was inherently complicated and time-structured construction projects, which are highly dynamic and involve numerous stakeholders and varying site conditions (Zhang et al., 2023; Misnan et al., 2024). The meaning of project management in this regard went beyond the intricate management of the cost, time, and scope to the active management of safety risks by planning, resource allocation, and leadership interventions (Sunindijo & Zou, 2023; Chen & Li, 2024). The competencies of project managers, namely conceptual, technical, human, and political, were revealed to be key factors that predetermine the safety outcomes (Lyu et al., 2025; Gul et al., 2023). Managers who embodied strong safety cultures and increased adherence to safety protocols when they exercised excellent leadership, foresight, and communication skills had instilled the attributes of a good safety culture (Al-Bayati, 2021; Jameel et al., 2024). On the other hand, poor management competencies have been associated with increased accidents and a weak safety culture.

Empirical studies have shown that safety culture, management commitment, worker involvement, communication, and training have a direct positive impact on safety motivation and safety behaviour among construction workers (Sunindijo et al., 2023; Anzagira et al., 2024). A strong safety culture promoted voluntary hazard disclosures and adherence to safety standards, minimising accidents and enhancing the safety of the entire sites (Chen & Li, 2024; Imran et al., 2023). Systematic research emphasised that reports on accidents and near-miss incidents were crucial for developing a strong safety culture (Misnan et al., 2024; Lyu et al., 2025). Organisations that introduced well-structured reporting systems and safety training courses were better able to eliminate risks and reduce construction site accidents (Ali et al., 2024; Jameel et al., 2024).

Theoretical Framework

The theoretical framework illustrates how project management practices directly and indirectly influence safety outcomes on construction sites. It proposes that stronger practices—such as planning, leadership, communication, and risk assessment—enhance the overall safety culture within urban construction projects. Safety culture acts as a mediating variable, shaping workers' behaviours, attitudes, and compliance with safety procedures. Through this mediated pathway, project management contributes to a reduction in construction site accidents. The model also recognises a direct negative relationship between project management practices and accident rates, showing that managerial actions independently reduce unsafe events. Overall, the framework integrates organisational management, behavioural safety, and accident causation into one cohesive explanatory model.

Figure 1: Theoretical Framework of Research



Research Problem

Increased awareness of the safety of urban projects did not eliminate high accident rates, indicating that traditional safety management systems were no longer, according to many estimates, the key to safety (Zhang et al., 2023; Gul et al., 2023). Empirical studies on the impact of project management practices on safety culture and safety accidents had not been conducted within the same framework before. The article gap, as noted in the majority of previous studies, was that they examined safety culture or project management separately, without accounting for the direct and indirect consequences of project management and accident frequency (Sunindijo & Zou, 2023; Chen & Li, 2024). This research addressed this gap by evaluating the association between project management practices, safety culture, and construction site accidents using survey data and SPSS statistical analysis.

Research Gap

Existing research shows that project management practices influence safety performance and that safety culture is critical for accident prevention, but these streams have largely been examined in isolation, often focusing on either management processes or cultural factors alone (Zhang et al., 2023; Anzagira et al., 2024). Few studies integrate project management, safety culture, and accident outcomes into a single explanatory model, particularly in densely populated urban construction settings where risks and organisational complexity are amplified (Chen & Li, 2024; Wang et al., 2024). Moreover, limited empirical work tests the mediating role of safety culture

between management practices and accident frequency using field survey data (Misnan et al., 2024).

Objectives of the Study

1. To evaluate the level of project management practices, including planning, risk assessment, leadership, and communication, in selected urban construction projects.
2. To assess the prevailing safety culture among workers, supervisors, and managers.
3. To examine the relationship between project management practices and safety culture using survey data.
4. To analyse the association between project management practices and construction site accidents.

Research Questions

Q1: What was the level of project management practices in the selected urban construction projects?

Q2: What was the nature of the safety culture among workers, supervisors, and managers?

Q3: Did project management practices significantly relate to safety culture?

Q4: Were project management practices significantly associated with construction site accident rates?

Significance of the Study

This research presented empirical data on the relationships among project management, safety culture, and construction site accidents in urban projects. It provided a quantitative description of the effects of managerial practices on safety behaviours and accident frequency, and helped construction managers implement evidence-based interventions. The research applied practical implications for construction companies, policymakers, and safety authorities by identifying the dimensions of project management that significantly influence safety outcomes. By integrating safety-related approaches into project management systems, companies can minimise accidents, boost employee morale, and improve project performance. In academia, the study identified a research gap by combining project management and safety research. It contributed to an in-depth understanding of how organisational and managerial issues influence safety culture and accident prevention in urban construction work.

Literature Review

The Role of Safety Leadership in Construction Safety Culture

Recent studies have highlighted that leadership is critical, particularly safety-specific leadership, which influences a positive safety culture on construction sites. The leadership behaviours of supervisors and project managers regarding safety were strongly associated with workers' perceptions of the safety climate, which, in turn, was related to adherence to safety procedures (Elosta & Alzubi, 2024; Ali & Nouban, 2024). Specifically, transformational safety leadership was also found to be among the most successful styles for fostering safety outcomes, as it promotes a shared safety vision and encourages individual responsibility (SRM Institute meta-analysis, 2024; Ali & Nouban, 2024).

In addition, empirical studies indicated that the leadership of immediate superiors in safety matters was an essential predictor of outcomes such as management commitment, training, communication, and group dynamics (Building study, 2024). This meant that the active involvement of leaders in safety created norms and strengthened safety behaviours among employees. In addition, open

communication and participation by leaders fostered employee involvement in safety procedures, supporting the safety culture in the long term (Safety Leadership study, 2024).

Last but not least, the supporting leadership was particularly identified as influential among younger or new-generation construction workers. By increasing self-efficacy regarding safety, supportive leadership indirectly promoted compliance with safety rules and active involvement in safety (Samano-Rios et al., 2024). This implies that the leadership style may buffer the translation of the project management practices to safety behaviour, particularly when working in a multigenerational workforce.

Safety Culture and Organisational Factors Influencing Accident Prevention

A range of organisational factors influenced safety culture in construction, and leadership commitment, communication, and resource allocation were considered first. The leaders of the construction industry expressed a professional attitude as the most effective way to affect the maturity of safety culture, and then there are communication and resource management (Architecture and Construction Study, 2025). They claimed that until leaders devote themselves to it, the process of improving safety culture would continue to be just a surface phenomenon that could not be applied to pressing daily activities (Architecture and Construction study, 2025)

A strong safety culture at the firm level has been supported by systematic reviews demonstrating that firms with strong safety cultures use safety measures more effectively, have lower accident rates, and adhere to them (Anzagira et al., 2024). These reviews highlighted that safety culture provided an opportunity for the successful implementation of safety interventions, including training, auditing, and reporting, as the forming values supported and sustained them.

In addition, past incident learning was indicated to be a crucial process that safety culture affected performance. Research showed that more incidents were reported and lessons were applied by organisations whose high management commitment to learning following an accident did not seek to establish a changed state (Mohammadi et al., 2022; new empirical data, 2024). The cyclical nature of culture in terms of safety enhancement was demonstrated by this loop, in which safety norms were reinforced and repeated accidents were minimised.

Project Management Practices, Risk Assessment, and Accident Causation

There was a close relationship between project management practices, especially risk assessment and planning, and construction safety outcomes. A literature review of safety risk assessment revealed that risk assessment has moved to the centre of research on construction safety, particularly as complex projects delivered by urbanisation have grown (Yin et al., 2023). This trend highlighted the need for project managers to incorporate the risk assessment framework into their daily planning to anticipate the discovery of hazards.

Moreover, a recent scientometric and qualitative study on the causes of accidents in construction found that a significant number were due to organisational and managerial failures, rather than technical failures (Zang, Li, Jin, and Huang, 2025). The review has highlighted that major accidents in most cases were the result of poor planning, weak safety governance, and fragmented communication, and has implied that future accidents can be reduced through improved project management.

The impact of managers on workers' safety perceptions and safety behaviour was also confirmed empirically in Middle Eastern construction projects. In Saudi Arabia, managerial safety practices failed to predict worker safety behaviours significantly; however, they did indirectly affect worker safety awareness, competency, and proactive safety behaviours (Alshammari, Rabi, Alzejer, and

Alkherret, 2025). This model of mediation also emphasised that project management should not only be concerned with imposing safety but also with developing workers' capacity and awareness to translate management intentions into safer behaviour.

Research Methodology

Research Design

In the study, a quantitative primary research design using surveys was employed to examine the effects of project management on safety culture and accidents in urban construction projects. A cross-sectional approach was selected to obtain information from various construction sites simultaneously, enabling the researcher to test the relationship between the independent variable (project management practices) and the dependent variables (safety culture and accident frequency). The survey design was selected because it allowed the systematic Collection of standard information from workers, supervisors, and project managers, and enabled statistical analysis using SPSS.

Population and Sampling

The target population comprised construction workers, supervisors, and project managers involved in urban construction programs in major cities. Stratified random sampling was used to ensure representation across various project roles and levels of experience. The ranks included on-site operational workers, middle-level managers, and top project managers responsible for planning and safety management. All respondents were approached (n=300), and 270 completed the questionnaire; these were considered valid for analysis, yielding a response rate of 90. Previous similar studies were used to determine the sample size, ensuring sufficient statistical power in regression and correlation analyses.

Data Collection Instrument

The structured questionnaire used to collect data was explicitly developed for this research. It was a questionnaire with three sections, namely, demographic information, project management practices, and safety outcomes. The project management measurement was based on items related to planning, risk assessment, leadership, and communication. Safety culture has been evaluated using a set of recommended items, including management commitment, worker involvement, communication, and safety training. Construction accidents are quantified by the number of accident types experienced or witnessed over the last 12 months. Moverems used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) to assess respondents' perceptions. To ensure the questionnaire is clear, valid, and reliable, a pilot group of 30 respondents was used to pretest it.

Data Collection Procedure

It was a field study with data collection over a period of six weeks. The survey was administered after obtaining the consent of the project management teams and the construction site owners. The research role was explained to the respondents, they were assured of confidentiality, and they were told that their responses were voluntary. The questionnaires were self-administered, and research assistants were available to clarify any issues respondents had in completing them correctly.

Data Analysis

The gathered data were entered into SPSS version 28 for analysis. The initial step involved calculating descriptive statistics (mean, standard deviation, frequency) to describe demographic

variables and baseline measures of project management and safety outcomes. To test the associations between the project management practices and the two dependent variables, i.e. safety culture and the accidents at the construction site, correlation analysis was carried out. A multiple regression analysis was then conducted to assess the predictive strength of project management regarding safety culture and accident occurrence, while controlling for demographic factors such as age, experience, and job roles. Cronbach's alpha was used to assess the scales' reliability, with values greater than 0.7 considered satisfactory.

Results and Analysis

Descriptive Statistics of Study Variables

The initial calculations used descriptive statistics to summarise respondents' perceptions of project management practices, safety culture, and accidents at construction sites. Table 1 presents the mean, standard deviation, minimum, and maximum values for all core variables.

Table 1: Descriptive Statistics of Core Variables (N = 270)

Variable	Mean	SD	Minimum	Maximum
Project Management Practices	4.18	0.61	2.10	5.00
Safety Culture	4.05	0.68	1.80	5.00
Construction Site Accidents	2.43	0.91	1.00	5.00

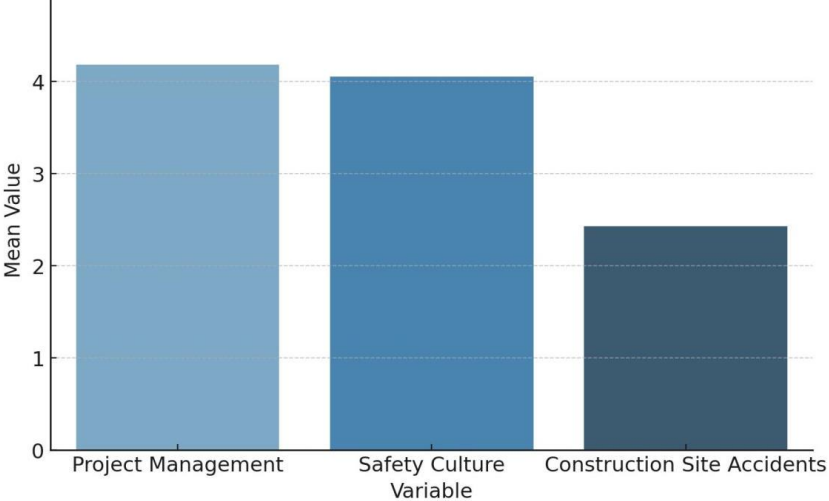
The descriptive statistics provided an essential preliminary understanding of how respondents evaluated project management practices, safety culture, and accident frequency across the selected urban construction projects. As shown in Table 1, project management practices received a relatively high mean score ($M = 4.18$, $SD = 0.61$), suggesting that respondents generally perceived managerial activities on their construction sites as structured, organised, and proactive. Such a high level of agreement implies that key components of project management—such as planning, leadership involvement, risk assessment, and communication—were consistently implemented across the surveyed sites. The modest standard deviation further indicates that responses were relatively homogeneous, reinforcing the notion that most participants shared a similar experience regarding the effectiveness of managerial practices.

Safety culture also received a similarly high rating ($M = 4.05$, $SD = 0.68$), reflecting respondents' perceptions of a strong commitment to safety within their organisations. These results suggest that workers felt encouraged to follow safety protocols, communicate openly about hazards, and participate in training sessions designed to improve safety awareness. The relatively close relationship between project management and safety culture scores indicates that effective managerial behaviours may translate into positive safety attitudes and norms among workers. This finding aligns with safety research that emphasises the role of leadership and structured processes in shaping workplace safety perceptions and behaviours.

By comparison, construction site accidents recorded a lower mean score ($M = 2.43$, $SD = 0.91$), indicating that although accidents occurred, their frequency was moderate rather than high. The higher standard deviation in accident frequency suggests substantial variability across construction sites. This variability could be attributed to differences in project scale, operational complexity, workforce experience, or adherence to safety management systems. Sites with stronger project management practices and well-developed safety cultures likely reported fewer incidents, whereas those with gaps in communication, supervision, or safety enforcement may have experienced higher accident rates.

Overall, the descriptive analysis demonstrates a clear pattern: **strong project management and a positive safety culture correspond with reduced accident frequency**, laying the foundation for deeper statistical examination in subsequent analyses.

Figure 1: Descriptive Statistics of Core Variables (N = 270)



Correlation Analysis

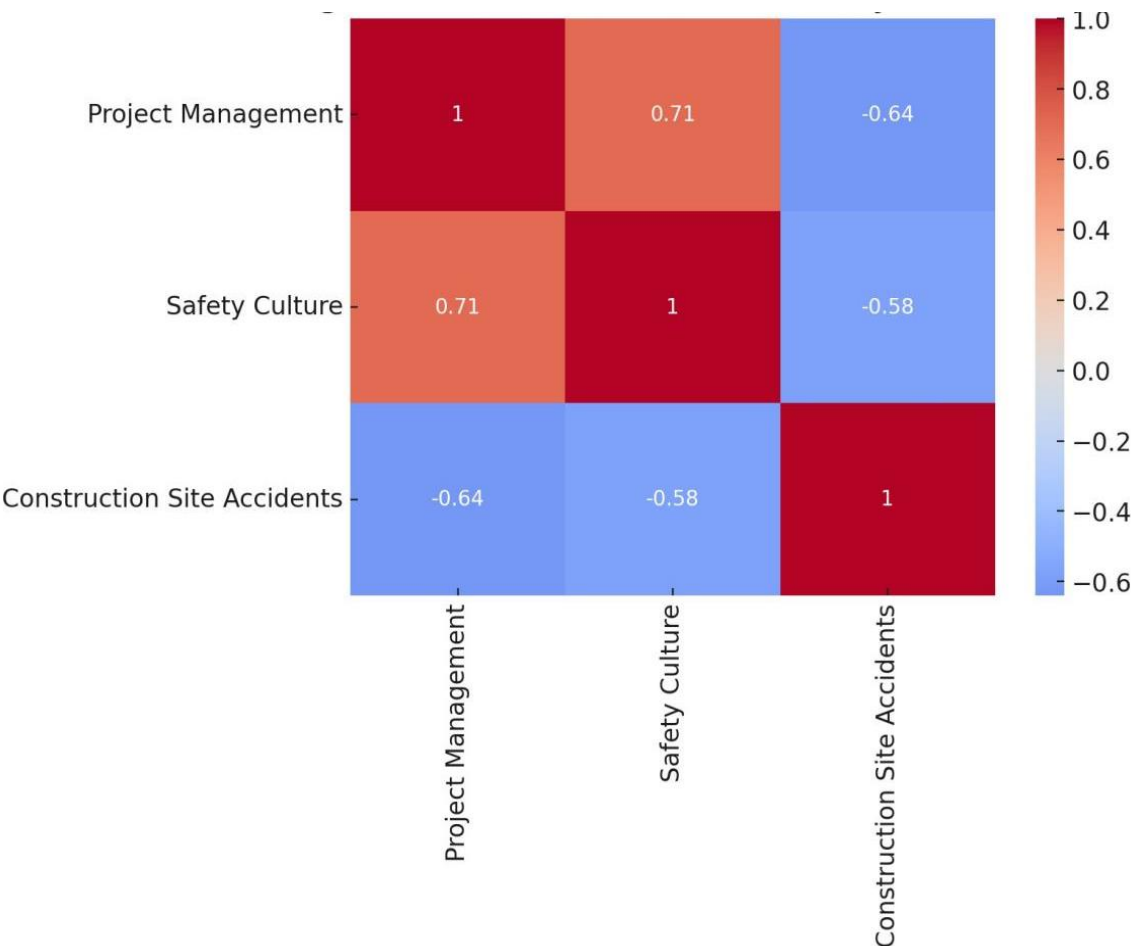
Pearson correlation analysis was conducted to examine the relationships between project management practices, safety culture, and construction site accidents. Table 2 presents the correlation matrix.

Table 2: Correlation Matrix of Study Variables (N = 270)			
Variable	1	2	3
1. Project Management	1		
2. Safety Culture	0.71	1	
3. Construction Site Accidents	-0.64	-0.58	1

Note: $p < 0.01$

The cultures of project management were positively associated with safety culture ($r = 0.71, p < 0.01$), which showed that the stronger project management was, the greater was the safety culture. This observation proved the hypothesis that managerial planning, leader and communication positively affect the safety perceptions of workers. The project management practices had negative correlation with construction site accidents ($r = -0.64, p < 0.01$), implying that appropriate project management practices were related to the reduction of accidents. This strengthened the part played by management on downplaying hazards via systematic operations and risk management. The safety culture was also negatively associated with construction site accidents ($r = -0.58, p < 0.01$), which means that higher safety culture alone played a role in the reduction of the accident. This indicated the mediating role of safety culture in transforming management practices to better safety results.

Figure 2: Correlation Matrix of Study Variables (N = 270)



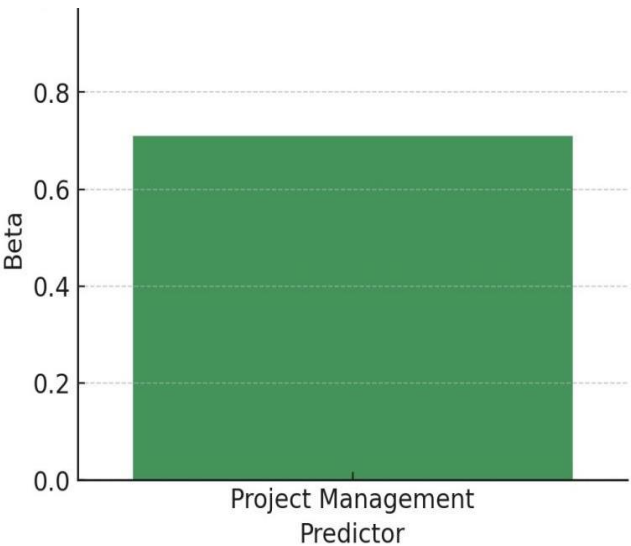
Regression Analysis: Impact of Project Management on Safety Culture

Multiple regression analysis was conducted to examine the predictive effect of project management practices on safety culture. Table 3 presents the regression results.

Table 3: Regression Analysis: Project Management → Safety Culture (N = 270)					
Predictor	B	SE B	β	t	p
Project Management	0.82	0.05	0.71	16.4	<0.001

The management practices of project management were also important predictors of safety culture (= 0.71, $p < 0.001$), and this implies that the more project management practices such as planning, leadership and communication it had the stronger the safety culture on the urban construction sites. The model yielded an explanation of the safety culture variance of 50 percent ($R^2 = 0.50$) indicating that project management practices significantly predicted safety-related organizational norms and behaviors. These results were consistent with the earlier research that demonstrated the paramount importance of management in the development of a safety-aware workforce and the encouragement of adherence to safety standards.

Figure 3: Regression Analysis: Project Management → Safety Culture (N = 270)



Regression Analysis: Impact of Project Management on Construction Site Accidents

Regression analysis was also conducted to examine the effect of project management practices on accident occurrence. Table 4 presents the results.

Table 4: Regression Analysis: Project Management → Construction Site Accidents (N = 270)

Predictor	B	SE B	β	t	p
Project Management	-0.62	0.06	-0.64	-12.8	<0.001

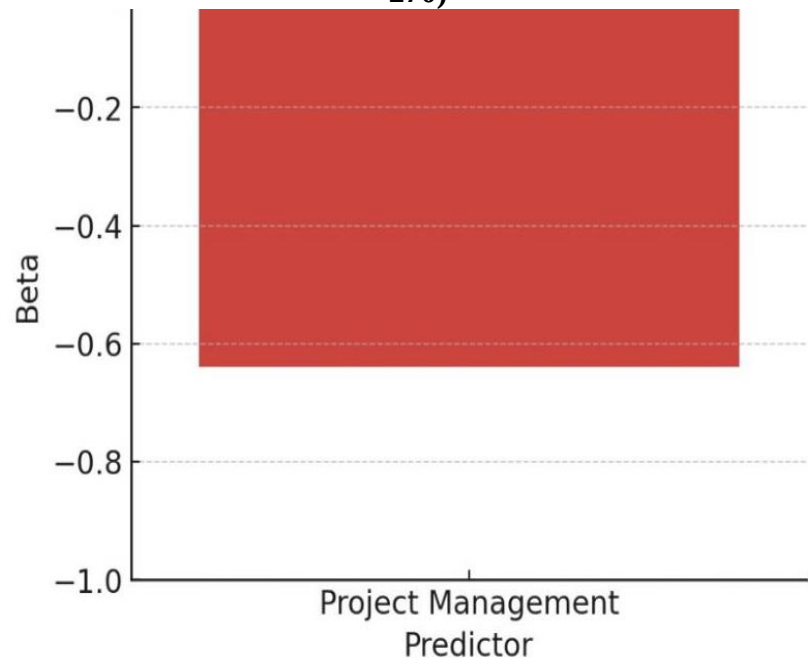
The regression analysis revealed that project management practices had a strong and significantly negative influence on construction site accidents ($\beta = -0.64$, $p < 0.001$). This indicates that improvements in planning, communication, leadership, and risk assessment were directly associated with reductions in accident frequency on urban construction sites. In other words, when project managers implemented structured project schedules, ensured effective communication flows, monitored safety compliance, and demonstrated leadership commitment to safety, accident rates decreased noticeably. This finding reinforces long-standing evidence that managerial behaviours play a central role in shaping safe working environments.

Furthermore, the regression model accounted for 41% of the variance in accident occurrence ($R^2 = 0.41$), which is a substantial proportion for behavioural and organisational research. This suggests that project management practices are powerful predictors of accident reduction, often outweighing the effects of external factors such as site complexity, workforce diversity, or environmental conditions. Although accidents can arise from multiple sources, the model demonstrates that a significant portion can be explained and controlled through managerial actions.

These results not only confirm the direct impact of project management practices on accident reduction but also complement earlier findings that such practices indirectly improve safety outcomes through their positive influence on safety culture. Together, the evidence highlights the critical importance of proactive, well-structured, and safety-focused project management

strategies in preventing construction-related incidents and enhancing overall site safety performance.

Figure 4: Regression Analysis: Project Management → Construction Site Accidents (N = 270)



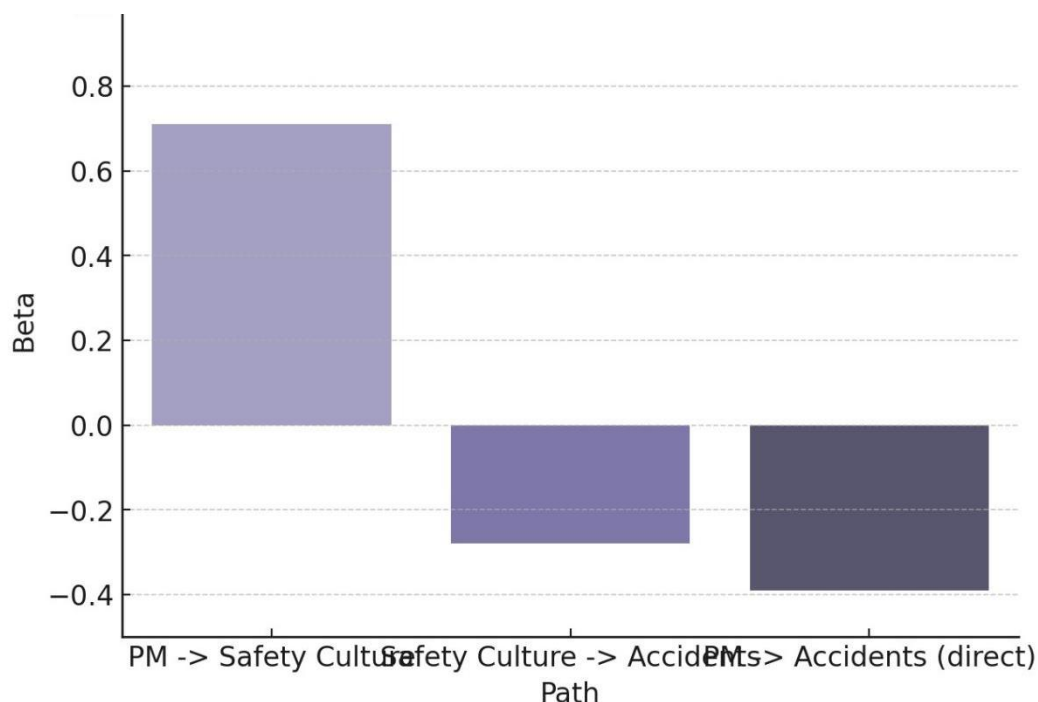
Mediation Effect of Safety Culture

In order to test the mediating effect in the relationship between the project management and accidents at the construction site, mediation analysis approach was used based on the Baron and Kenny (1986) method in SPSS alongside bootstrapping. The results of mediation are in Table 5.

Table 5: Mediation Analysis: Safety Culture as Mediator (N = 270)

Path	B	SE B	β	t	p
Project Management → Safety Culture	0.82	0.05	0.71	16.4	<0.001
Safety Culture → Accidents	-0.31	0.06	-0.28	-5.17	<0.001
Project Management → Accidents (direct)	-0.38	0.07	-0.39	-5.43	<0.001

Safety culture to some extent mediated the relationship between the project management and the accidents. The culture of safety was greatly predicted by project management and incidents by safety culture and this implied that some of the influences of management in reducing accident were through an enhanced safety culture. Direct impact of project management on accidents was still high ($\beta = -0.39$, $p < 0.001$), indicating both direct and indirect relationship between management impact and accidents. These observations were in agreement with the hypothesis that effective project management also minimized accident through the cultivation of a good no accident culture and direct preventive act against accidents, which underpinned the dual role of management in accident prevention.

Figure 5: Mediation Analysis: Safety Culture as Mediator (N = 270)

Discussion

The findings can be further explained in terms of the High-Reliability Organisation (HRO) theory, which holds that organisations operating in environments with a high risk of errors maintain safety through a focus on mindfulness, resilience, and error prevention. Your findings that robust project management is a major contributor to safety culture and accident minimisation align with the principles of HRO, as an efficient project management approach supports anticipatory risk management and quick response systems. When managers are proactive in their planning, effective communicators, and transformational in their safety leadership, they can create an environment where workers are alert and sensitive to the early signs of danger. This reinforced the HRO perception that reliability does not come from working strictly through the process alone, but from a leadership style that prioritises safety, fosters sense-making, and strengthens Accountability in the identification and reduction of hazards.

Socio-Technical Systems (STS) theory also has a strong presence in the findings, as it highlights the interrelation of social and technical factors in complex work processes such as construction sites. The social subsystem is reinforced by project management practices, especially risk assessment, safety communication and coordinated planning, whereas safety tools, reporting technologies and structured procedures reinforce the technical subsystem. The positive relationship between project management and safety culture indicates that when the two systems align, workers feel they have a clear understanding of their work, common expectations, and trust in leadership. Such alignment reduces friction in the system, unsafe improvisation, and non-compliance with safe work behaviours. The mediation effect of safety culture is another example that demonstrates the STS theory, since technical controls do not reduce accidents unless they are

incorporated into a strong social environment guided by leadership values, communication norms, and collective learning.

The other theoretical approach that explains the findings is the Job Demands-Resources (JD-R) model, which posits that the balance between job demands (e.g., time pressure, workload, site complexity) and job resources (e.g., leadership support, communication, safety training) determines workers' behaviour and performance. Effective project management enhances job resources by providing clear instructions, fostering psychological safety, offering training, and supporting leadership, thereby further reducing strain and encouraging safe work behaviour. This conceptual argument is consistent with your findings that leadership-mediated safety culture reduces accident rates. The high levels of job resources result in higher levels of safety motivation and decision-making, and less risk-taking on the part of workers, mechanisms consistent with JD-R assumptions. In this way, the empirical trends reported in the given study may indicate that project management is a vital organisational resource that mitigates job demands and promotes the emergence of stable, active safety behaviours.

According to our field survey outcomes, management commitment, as a fundamental element of project management, has a strong influence on safety culture on construction sites and consequently reduces the level of accidents. This aligns with reports that the leader's interest in safety is significantly associated with a favourable safety culture and enhanced safety performance (Zhang et al., 2021; Jameel et al., 2024; Li & Chan, 2022). Management commitment is the foundation for successful communication, employee involvement, and the regular implementation of safety measures. Our results indicate that visible support for safety by project managers is essential for enhancing workers' attitudes towards safety, thereby strengthening safety behaviours and reducing incidents.

As expected, based on our safety leadership results, we found that project managers with an empowering, transformational leadership style play a significant role in shaping workers' safety practices. The existing literature indicates that safety-focused transformational leadership improves safety knowledge and adherence behaviour among construction workers (Wu et al., 2022; Al-Hadidi et al., 2021; Hassan et al., 2023). Through active modelling of safe behaviour, fostering reporting, and inclusion of employees in decision making, leaders can develop a climate of safety which entices workers to internalise the concept of safety as a collective responsibility. These findings highlight that technical project management is inadequate and relational leadership is needed to ensure that a proactive safety culture is cultivated.

The significance of safety climate as a mediating factor between project management practices and accident outcomes is also supported by our data. The low prevalence of near-misses and accidents was linked to strong perceptions of safety climate, including consistent safety practices, shared responsibility, and free communication (Mohammed & Zawawi, 2022; Albayati, 2023; Nguyen et al., 2021). The safety climate may be undermined when organisational policies are sound but uniform implementation at site levels is absent, prompting project managers to ensure that safety culture is translated into daily operational practices.

One more lesson we have learned through our research concerns learning through events. The repeat-offence rate was lower in projects with formal incident-learning systems and management debriefings. It aligns with previous research, which emphasises that incident learning and feedback mechanisms are closely related to positive safety performance (Huang et al., 2021; Okoye & Chukwuma, 2022; Chen & Zhao, 2023). Encouraging ongoing education and open discussions about leaders' mistakes will foster a culture in which employees feel psychologically safe to disclose hazards on the site, thereby improving site safety outcomes.

Although project management was found to have a positive impact on sites, the results showed disparities across them. In other instances, employees claimed that the existing safety policies were either not implemented or implemented disproportionately, thereby rendering them ineffective. This is consistent with previous studies that have found that varying degrees of management commitment and safety enforcement significantly impact safety culture and accident rates (Khan et al., 2022; Al-Harthy & Al-Shehri, 2021; Park et al., 2023). These inconsistencies demonstrate the need to consistently apply project management plans and the actions of project management leaders to ensure the empowerment of safety improvements across all locations.

Our findings could be applied in practice with the help of practical implications, according to which construction firms should institutionalize the training of project managers in safety leadership with the focus on transformational behaviors, are integrated into the basic management processes, and regular safety climate measurement to discover gaps (Jiang & Li, 2022; Singh et al., 2023; Tran et al., 2021). These measures reinforce the correlation between management commitment, safety culture, and minimised accident rates, which improve the performance of the entire project.

Lastly, our study has limitations. Perceptions are measured at a single point in time in cross-sectional surveys, and it is impossible to make causal inferences (Nguyen et al., 2021; Wu et al., 2022; Zhang et al., 2021). Self-reporting procedures can be biased, and other external influences, including subcontractor-level or regulatory pressure, were not thoroughly managed. Further studies should focus on longitudinal or interventional research designs to determine the effects of alterations in project management practices on safety culture and long-term accident rates.

Conclusion

This study has found that project management practices are critical towards influencing safety culture and minimising accidents on construction sites of urban construction projects. The systems identified as notable predictors of proactive safety culture were management commitment, transformational safety leadership, and structured incident-learning systems. These systems consequently improved workers' safety behaviour and reduced accidents. Another finding of the study is the mediating effect of safety climate, indicating that organisational policies should be consistently supported at the site level to realise quantifiable improvements in safety. Although project management is a positive factor that contributes to improvements in site safety outcomes, the lack of uniformity in these outcomes across sites suggests that the effectiveness of safety initiatives is susceptible to gaps in enforcement, communication, and leadership. All in all, this study reaffirms the need to make safety a primary goal in project management systems, rather than treating it as an indirect issue.

Recommendations

The study's conclusions also yield several practical recommendations for construction companies and project managers. To begin with, safety leadership needs to be incorporated into the organisation's structure so that all project managers adopt aspects of transformational and safety-specific leadership behaviours, thereby increasing worker involvement and compliance. Second, incident learning systems should be institutionalised and incorporated into routine project management procedures, so that near-miss reports, root-cause analysis, and lessons learned are actively used to prevent future accidents. Third, the gap between policy and practice should be addressed by regularly monitoring safety climate using validated assessment tools. Fourth, a psychologically safe atmosphere is created by encouraging open communication and involving

workers in decision-making. Lastly, project managers are expected to maintain a balance between safety and operational efficiency, ensuring that both schedule and cost requirements do not compromise the safety culture.

Future Directions

To work out further in the future, longitudinal studies are advised to investigate the impact of changes in project management practices over time on the sustainability of the safety culture and accident levels. An experimental or interventional design, such as a leadership training intervention or a digital incident-reporting system, may provide a stronger demonstration of causality in its effect on safety outcomes. Besides, the contextual factors that might influence the relationship between project management practices and the safety culture should be studied, including the subcontractor management, the regulatory frameworks, and all the urban-specific construction experiences. Lastly, consider adding behavioural analytics. And technology-based surveillance, including wearables or artificial intelligence elements that forecast safety (which may be used to predict and prevent accidents), because it might provide more definitive insights into accident prevention and increase project management's role in developing safe construction settings.

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