A model of factors influencing safety behaviour and awareness among Vietnamese construction workers

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Abstract:

Ensuring labour safety remains a critical concern within the construction industry, particularly in Vietnam, where workers face various challenges related to awareness and behaviour. This study explores the factors influencing workers' safety behaviour and perception. Key factors were identified through a review of existing literature and consultations with experts. Data were collected via questionnaires distributed to three respondent groups, differentiated by job roles, project stakeholders, and years of experience. The data were analysed using appropriate statistical methods. The findings reveal 23 factors, categorised into three groups: worker characteristics, management capacity, and working conditions. The study found no significant differences in the assessment of these factors' effects on worker safety behaviour across the respondent groups. Using exploratory factor analysis (EFA), these initial factors were consolidated into principal groups, accounting for over 60% of the total variance. Practically, the study provides insights into the content and implications of each factor and group. These findings can assist safety managers in better understanding worker behaviour and attitudes, thereby facilitating the development of appropriate policies.

Keywords: **construction worker, factor model, safety behaviour.**

Classification numbers: **1.3, 2.3**

1. Introduction

The labour force is of paramount importance in the development of the market economy and international economic integration. Prioritising workplace safety and workers' health has significant implications for human resource development, enhances the quality of labour within companies, and fosters a sustainable economy within the Vietnamese construction industry [1]. There have been notable improvements in ensuring labour safety in Vietnam, with increasing awareness and responsibility among organisations and agencies yielding positive results [2]. However, it remains essential to establish robust labour protection measures alongside productive labour activities. Moreover, occupational accident statistics reveal complex patterns in workers' adherence to safety regulations [3].

The construction industry plays a critical role in the national economy but faces significant challenges in ensuring labour safety, characterised by distinct difficulties [2]. Workers in this sector often contend with unpredictable conditions, such as exposure to harsh weather, heavy physical labour, and remote worksite locations [4]. These factors, coupled with the absence of fixed workplaces, contribute to an increased risk of accidents and health hazards, including occupational diseases [1]. Notably, the construction sector accounts for 14% of all labour accidents, attributable to factors such as a lack of emphasis on establishing safe working procedures, inadequate safety solutions by companies, and insufficient or poor-quality safety training for workers [5].

Previous study identified the primary causes of accidents that negatively impact labour productivity in construction [6]. These include low safety awareness among workers, inadequate training, insufficient provision of protective equipment, the use of outdated equipment, and engagement in unsafe practices. Furthermore, another study assessed how management characteristics and methodologies influence workers' safety performance [7].

The above discussion highlights the critical role of construction workers in occupational accidents. However, previous studies have not comprehensively evaluated the factors affecting construction workers' safety behaviour and awareness. It is thus increasingly important to investigate

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workers' behaviour, attitudes, and practices. This study aims to explore the impact of various factors on workers' safety behaviour and examine differences in the assessment of these factors' influence on safety behaviour across respondent groups differentiated by job roles, project stakeholders, and years of experience. The specific research objectives are as follows:

- To identify the factors that impact workers' safety behaviour in the workplace.

- To determine the extent of each factor's impact on workers' safety behaviour.

- To investigate any variations and their significance in assessing each factor's effect on workers' safety behaviour across different respondent groups.

- To develop a model of the principal factors influencing workers' safety behaviour.

- To provide recommendations based on the findings to improve safety behaviour in the workplace.

2. Literature review

2.1. Typical domestic research

Previous study examined the persistently high rate of workplace safety incidents, which result in substantial human and economic losses [8]. The study identified various factors influencing workers' behaviour and adherence to occupational safety measures, with particular emphasis on the pivotal roles of individual employee characteristics and managerial influence. It quantified the time lost due to work-related incidents and highlighted common causes of accidents. These issues underscore the crucial role of labour safety management officials, emphasising the need for clearly defined responsibilities and the importance of fostering a safety-oriented work culture among employees.

Other studies focused on organisational factors, including hygiene practices and occupational safety protocols, such as site organisation, worker selection, and safety training procedures [9]. The study proposed technical measures for the appropriate arrangement of equipment and materials to prevent accidents during construction, with a primary focus on fall prevention and working at heights. These measures were suggested to mitigate the risk of accidents and improve overall site safety.

T.K. Trang (2017) [10] explored the relationship between safety culture and organisational performance at the Northern power corporation (NPC). By employing a combination of document synthesis, analysis, and questionnaires distributed to NPC employees, the study clarified the concept and content of safety culture and assessed its impact on organisational efficiency. The findings revealed a positive correlation between safety culture and the company's productivity, as improved safety practices contributed to reducing accidents, minimising costs, enhancing employee performance, and increasing company profits. The questionnaire results were categorised into four sections: the current state of safety culture at NPC, its impact on employee efficiency, its influence on NPC's overall effectiveness, and the relationship between employee efficiency and the company's overall performance in relation to safety culture.

B.T. Tung (2016) [11] addressed the issue of poor compliance with labour safety practices at construction sites in Ho Chi Minh City, Vietnam. The study presented a model consisting of four groups of variables associated with inadequate occupational safety practices at these sites. These variables included deficiencies in organisational management, the implementation and inspection of safety measures, irregular maintenance, and a lack of proper labour protection equipment. The study also highlighted insufficient tools and electrical safety measures, as well as a lack of awareness and compliance with safety practices among both management and construction workers. Tung emphasised the urgent need to raise safety awareness among workers to improve compliance with safety protocols.

2.2. Typical abroad research

M. Shin, et al. (2014) [12] investigated the use of System Dynamics to model workers' safety attitudes and behaviours. Their study examined the effects of three conditions aimed at improving safety: first, providing workers with information on safe work behaviours to foster habits conducive to safety, thereby preventing desensitisation to accident risks; second, sharing accident information across job roles to reduce incidents by addressing workers' tendency to overestimate their ability to control risks; and third, increasing workers' concern about accidents, leading to a more accurate assessment of accident likelihood.

D. Fang, et al. (2015) [13] explored the impact of supervisory influence on worker safety behaviour in construction projects, aiming to identify managerial behaviours that affect safety. Supervisors, being the most frequent interactors with construction workers among management levels, were studied in terms of two aspects: coaching and preventive actions, and reactive and supportive actions. A 3-month questionnaire survey conducted in Hong Kong's construction industry was used to gather data.

Results from confirmatory factor analysis and structural equation modelling revealed both direct and indirect effects of supervisory behaviour on worker safety behaviour, with responsive and supportive actions found to have a direct impact.

B.H. Guo, et al. (2016) [14] focused on predicting occupational safety behaviour in the construction industry through the development and testing of an integrated model. Data from 215 construction workers in New Zealand were collected via questionnaire, and eight competing models were tested using structural equation modelling (SEM). The results indicated significant relationships, with management safety commitment positively linked to social support and production pressure. Production pressure emerged as a key factor directly impacting safety behaviour and compliance, while social support also influenced safety behaviour, along with safety knowledge and motivation.

B. Choi, et al. (2017) [15] examined group norms and individual standards of construction workers regarding safe behaviour from a social identity perspective. The study aimed to determine the influence of group norms on workers' standards for safety behaviour and the moderating role of social identity in this relationship. Empirical data were collected from 82 construction workers and nine project managers across three sites and analysed using correlation and regression analyses. The findings highlighted varying levels of social identity among construction workers, associated with different groups (e.g., workgroup, company, project), with social identity moderating the effect of group norms on personal safety standards.

K.P. Cigularov, et al. (2010) [16] investigated the role of error management and communication environments in workplace safety, gathering data from 235 union construction workers employed by 15 contractors across the Midwest and Northwest regions of the United States. The study underscored the importance of positive occupational safety communication and management in improving workplace safety, with the implications discussed for organisational safety research and practice.

S.L. Morrow, et al. (2010) [17] examined the relationship between psychological safety climate dimensions and safety behaviour in the railway industry. The study aimed to confirm the correlation between workers' perceptions of occupational safety psychology and safety behaviour, exploring aspects such as work safety management, colleague influence on safety behaviour, and the impact of pressure on safety compliance.

I. Hansez, et al. (2010) [18] explored safety behaviour by examining the effects of job demands, job pressure, and perceived management commitment to safety. Their research highlighted the influence of job demands and resources on safety behaviour, emphasising the impact of work-related stress and the significance of management's perceived commitment to safety.

L. Zhang, et al. (2016) [19] studied the interactive perceptions of construction safety behaviour from workers' perspectives, employing SEM and exploratory factor analysis (EFA) to elucidate the cause-and-effect relationships between factors influencing worker safety. Their findings underscored the positive influence of management- and system-oriented supervision and leadership on construction workers' psychological well-being and safety behaviour.

S. Clarke (2012) [20] explored the effects of pressure factors on construction worker safety behaviour through meta-analysis, examining the relationships between stressors, safety behaviours, and outcomes. The findings revealed that hindering factors negatively impacted safety compliance and outcomes, while certain pressurising factors had a positive influence on safety performance.

I. Mohammadfam, et al. (2017) [21] developed a Bayesian network model to enhance worker safety behaviour based on research conducted in power plant construction projects in Iran. The study identified several factors influencing safety behaviour, including management commitment, a supportive environment, the safety management system, employee participation, safety knowledge, attitude, motivation, resource allocation, and work pressure.

R.M. Choudhry (2014) [22] investigated construction site safety based on workers' behaviour, proposing a management method to improve occupational safety. The approach involved supervisors recognising and praising safe behaviours, engaging observers in discussions with workers, distributing training materials, providing feedback to management, and displaying safety performance charts. The study demonstrated significant improvements in safety performance across various categories, highlighting the effectiveness of the proposed approach in enhancing workplace safety.

2.3. Research gaps

Previous studies have provided valuable insights into the factors affecting construction workers' safety behaviour, significantly improving project stakeholders' understanding of workplace safety. However, most of these studies focus on individual-level factors, such as attitudes, beliefs, and perceptions, while there is a paucity of research into broader contextual factors, including organisational culture, project demands, and societal influences. Furthermore, existing research predominantly examines top-down safety management approaches, with limited attention given to the role of worker involvement in safety decision-making processes. Additionally, psychosocial factors, such as job stress, job satisfaction, and social support, which can profoundly influence safety behaviour, have not been extensively studied. Consequently, there is currently no comprehensive model that evaluates the impact of these broader contextual and psychosocial factors on construction workers' safety behaviour.

2.4. Summary and description of influential factors

Twenty-one factors were identified through a comprehensive literature review. Additionally, interviews with three experts were conducted for two main purposes: first, to evaluate the factors identified from the literature, and second, to solicit additional factors based on their practical experience. The results indicated unanimous agreement among the experts on the twenty-one factors from the literature, and they collectively proposed eleven additional factors. Table 1 summarises the thirty-two potential factors influencing construction workers' safety behaviour and awareness. These factors are categorised into three clusters: worker-related, management capacity-related, and working conditions-related aspects.

Factor A2 "Experience": Experience is crucial for construction workers. Those with extensive project involvement and training are well-versed in labour safety regulations. Experienced workers, having encountered various construction scenarios, possess a deeper understanding of how subjective judgments, lack of awareness, and inexperience can compromise safety. In team environments, experienced workers play a pivotal role, often staying with companies long-term and receiving further training to enhance their skills. Their accumulated experience gives them a heightened awareness of behaviours impacting workplace safety.

Factor A6 "Tenure with the company": Tenure is vital in evaluating workers' adherence to safety principles and regulations. Human resources departments assess employees who consistently demonstrate exemplary compliance and safety practices. Additionally, competitive wages and incentive packages contribute to workers' material and psychological well-being, fostering long-term commitment to the company.

Table 1. Factors affecting construction worker's safety behaviour and awareness.

Group	Factors	References
A. Workers themselves-related		
A1	Age	[23]
A2	Experience	Proposed by experts
A3	Health status during work	[23]
A4	Marital status	[24]
A5	Education level	[11]
A6	Tenure with the company	Proposed by experts
A7	Gender	[24]
A8	Knowledge of labour safety	[11, 12, 21, 24]
A9	Trust in management effectiveness	Proposed by experts
A10	Smoking or alcohol consumption habits	Proposed by experts
A11	History of violating labour safety regulations	[11]
A12	Level of risk tolerance	Proposed by experts
B. Management capacity-related		
B1	Sanctions for labour safety violations	[18-20]
B2	Failure to enforce working and rest hours strictly	Proposed by experts
B3	Awareness of labour safety supervision and management	[9]
B4	Manager's experience	[19]
B5	Regular inspection of labour safety conditions and risks on construction sites	[10, 14]
B6	Absence of commitment to occupational safety in construction sites	[9, 10]
B7	Policy for safety activities	[21, 22]
B8	Lack of strict supervision of tool usage	[14, 17]
B9	Unreasonable worker arrangement	[13]
B10	Inefficient labour safety training programs	[9, 10, 13, 22, 25]
C. Working conditions-related		
C1	Lack of innovation in safety and construction techniques	[9-11]
C2	Challenging construction site conditions	Proposed by experts
C3	Polluted environment (dust, noise, toxic gases)	Proposed by experts
C4	Unfavourable organization of construction sites	[9]
C5	Absence of signs, instructions, rules on safety techniques, and protective equipment for workers	[14, 17]
C6	Poor quality of safety equipment	[26]
C7	Failure to meet workers' daily needs and personal hygiene	Proposed by experts
C8	Negative working conditions	[14, 19, 21]
C9	Natural disasters and epidemics	Proposed by experts
C10	Extreme weather conditions	Proposed by experts

Factor A9 "Trust in management effectiveness": Worker trust in management's ability to enforce safety regulations directly influences compliance rates. Disagreement with safety regulations, such as the necessity of safety straps and helmets when working at heights, can arise from perceived inconvenience on construction sites, affecting workers' adherence to safety protocols.

Factor A10 "Smoking or alcohol consumption habits": Workers who frequently use stimulants, cigarettes, or alcohol experience deteriorating health and decreased alertness over time, which impacts their awareness during construction work. For example, habitual alcohol consumption after work hours can lead to liver and kidney health issues, physical exhaustion, and insufficient sleep, subsequently affecting mental acuity the following morning. This lack of alertness can hinder adherence to safety regulations. A worker driven by a smoking habit may disregard safety protocols to satisfy personal needs, creating potential hazards such as careless cigarette disposal, which poses significant risks of fire, explosion, and other occupational safety concerns.

Factor A12 "Level of risk tolerance": Risk tolerance significantly influences workers' awareness and adherence to occupational safety protocols. When employees understand the potential hazards of workplace accidents, they are more inclined to follow safety guidelines strictly. For instance, when working at heights, using protective belts and safety locks is essential to reduce the risk of falls and fatalities. Recognising these risks compels workers to prioritise safety measures to protect themselves, their families, and mitigate the financial burdens associated with accidents. This study underscores the importance of risk awareness and acceptance in promoting occupational safety.

Factor B2 "Failure to enforce working and rest hours strictly": Companies that fail to enforce regulations on working hours, rest breaks, and internal procedures often exhibit negligence towards labour safety regulations, significantly reducing overall compliance levels.

Factor C2 "Challenging construction site conditions": High-altitude and confined construction sites can impede workers' movements, leading to frustration and decreased awareness of safety behaviours.

Factor C3 "Polluted environment (dust, noise, and toxic gases)": A polluted work environment negatively affects workers' physical and mental well-being, which in turn impacts their compliance with safety regulations. For example, inadequate control of dust and toxic gas emissions during construction projects can cause respiratory issues, diminishing workers' health and cognitive function, thus impairing their ability to follow safety protocols. Similarly, prolonged exposure to loud machinery noises can disrupt concentration and awareness, compromising safety behaviour.

Factor C7 "Failure to meet workers' daily needs and personal hygiene": Failing to meet workers' basic needs, such as access to personal hygiene and adequate accommodation, can lead to health issues and dissatisfaction, which in turn affect their psychological state and adherence to safety protocols. For instance, unsanitary living conditions and insufficient access to clean water in construction camps can compromise workers' health and well-being, leading to psychological distress and reducing their commitment to safety behaviours.

Factor C9 "Natural disasters and epidemics": Natural disasters and epidemics contribute to health concerns and negative outlooks, reducing workers' concentration and awareness of safety protocols. For example, during the COVID-19 pandemic, restrictions on movement and uncertainties about personal safety negatively impacted workers' mental health, leading to decreased vigilance in implementing safety measures on construction sites.

Factor C10 "Extreme weather conditions": Adverse weather conditions, such as intense sunlight or thunderstorms, can negatively impact workers' health, morale, and compliance with safety regulations. For example, prolonged exposure to intense sunlight may cause dizziness and fatigue, prompting workers to overlook safety measures.

3. Methodology

Selecting an appropriate methodology is essential for addressing research problems effectively. This study employed a structured questionnaire and expert surveys to collect data. A five-point Likert scale was used, ranging from 1, representing "no," to 5, representing "extremely." The questionnaire comprised two sections. The first section collected the personal information of the respondents, while the second section evaluated the impact of the thirty-two factors (as listed in Table 1) on workers' safety behaviour.

This approach leveraged the expertise and insights of qualified professionals in construction management. The purpose was to gather scientific data, record feedback, and evaluate factors, which served as the basis for refining the research problem. Survey participants were selected from project stakeholders, including investors, consultants, and contractors, all of whom possess extensive work experience and hold senior positions. The surveys were conducted from March to May 2023.

A previous study provided the following formula for determining an appropriate sample size [27]:

$$N = \frac{(Z \times S_X)^2}{E^2} \quad (1)$$

where N: sample size; S_x: standard error of the samples; E: reliability of the samples; Z: value obtained from the normal distribution.

In this study, with an error range of E≤10% and a confidence level of 90%, the minimum required number of samples is 96.

The literature review provided the theoretical foundation for the research problem and synthesised information from previous studies. The research hypotheses were as follows:

• The null hypothesis: H_0=There are no differences in assessing the effect of the proposed factors on worker safety behaviour between respondent groups in terms of working conditions, project stakeholders, and experience years.

• The alternative hypothesis: H_A=There are differences in assessing the effect of the proposed factors on worker safety behaviour between respondent groups in terms of working conditions, project stakeholders, and experience years.

Processing and analysing research data is a crucial step in any scientific study. This involves several key stages: (1) identifying the research problem; (2) collecting, processing, and analysing data; and (3) reporting the analysis results. Clearly defining the research problem facilitates faster and more accurate data collection. At the heart of data analysis lies statistical inference, which entails extrapolating understanding from a random sample to comprehend the entire population, a process known as inductive inference. Data must undergo analysis via statistical tests to ensure the reliability of the conclusions drawn. Initially, data are raw; through analytical processing, they transform into information and eventually knowledge, which is the ultimate goal of all research endeavours.

In this study, survey data was cleaned and coded using Excel. They were then analysed using SPSS software by descriptive analysis, reliability testing using Cronbach's alpha (α>0.7), hypothesis testing using analysis of variance (ANOVA), and exploratory factor analysis (EFA).

4. Results and discussion

4.1. Respondent's characteristics

Table 2 presents the statistics regarding 320 participants involved in the mass survey. This survey aimed to include a diverse range of respondents with characteristics relevant to the research topic.

Table 2. Descriptive statistics of survey respondents.

Type	Characteristics	Frequency	%
Work positions	1. Managers	63	19.7
	2. Site engineers	192	60.0
	3. Others	65	20.3
Project stakeholders	1. Investors	52	16.2
	2. Supervisors	79	24.7
	3. Contractors	150	46.9
	4. Others	39	12.2
Experience years	1. Less than 3	68	21.2
	2. Between 3-5	111	34.7
	3. Between 5-10	87	27.2
	4. Greater than 10	54	16.9

Regarding work positions, the primary survey participants included 63 managers (project managers, site managers, and team managers), representing 19.7% of the total; 192 site engineers, accounting for 60%; and 65 others (foremen and board of directors), representing 20.3%. Among the respondents, construction contractors formed the largest group, with 150 individuals making up 46.9% of the participants, followed by supervision consultants (79 individuals, 24.7%), investors (52 individuals, 16.2%), and others (state agencies and management consultants) (39 individuals, 12.2%). Most survey participants (78.7%) had three or more years of experience in the construction industry. These results demonstrate that the characteristics of the respondents were appropriate to address the research questions effectively.

4.2. Reliability test

The results of the Cronbach's alpha (α) analysis are shown in Table 3. The analysis indicates that all factors have α coefficients greater than 0.7. However, nine factors were excluded due to having a total variable correlation coefficient of less than 0.3. The excluded variables are A1, A2, A4, A6, and A7 from the worker-related group, B2 and B6 from the management capacity group, and C7 and C8 from the working conditions group.

Table 3. The coefficients of Cronbach's alpha.

Group	α
Workers themselves	0.786
Management capacity	0.848
Working conditions	0.828

4.3. Hypothesis test

An ANOVA test was conducted to examine the differences in the assessment of respondent groups regarding the effect of the proposed factors on construction workers' safety behaviours. The test results show that for most factors, the significance value is greater than 0.05, indicating that the null hypothesis is accepted. However, in nine cases, the null hypothesis was rejected due to significance values lower than 0.05. These cases include A10 (sig.=0.040), B10 (sig.=0.033), C2 (sig.=0.017), and C10 (sig.=0.011) for the working position group; A3 (sig.=0.001), A10 (sig.=0.019), B3 (sig.=0.015), B7 (sig.=0.001), B9 (sig.=0.048) for the project stakeholder group; and B8 (sig.=0.035) for the experience year group.

Table 4. The post hoc test results for working position groups.

Respondent	Subsets for A10		Subsets for B10		Subsets for C2		Subsets for C10	
	1	*2*	*1*	*2*	*1*	*2*	*1*	*2*
Managers	3.077	-	3.127	-	3.349	-	3.175	-
Site engineers	3.343	3.343	3.464	3.464	3.600	3.600	-	3.599
Others	-	3.556	-	3.662	-	3.776	-	3.677
Sig.	0.244	0.410	0.135	0.497	0.267	0.520	1.000	0.883

Table 5. The post hoc test results for project stakeholder groups.

Respondent	Subsets for A3		Subsets for A10		Subsets for B3		Subsets for B7		Subsets for B9
	1	*2*	*1*	*2*	*1*	*2*	*1*	*2*	*1*
Investors	2.942	-	3.115	3.115	3.462	3.462	3.269	3.269	3.481
Supervisors	3.304	3.304	-	3.494	3.101	-	3.165	-	3.266
Contractors	-	3.633	3.420	3.420	3.560	3.560	-	3.693	3.693
Others	3.154	3.154	2.949	-	-	3.667	-	3.667	3.564
Sig.	0.220	0.054	0.065	0.194	0.102	0.735	0.943	0.104	0.134

Table 6. The post hoc test results for experience year groups.

Respondent	Subsets for B8
	1
Less than 3	3.441
Between 3-5	3.667
Between 5-10	3.287
Greater than 10	3.259
Sig.	0.082

Since respondents assessed these nine cases differently, a post hoc Tukey HSD test was conducted to examine the significant differences within each homogeneous subset. The results of the Tukey HSD test are presented in Tables 4, 5, and 6. These results indicate that all significance values exceed 0.05. However, differences were observed in only a few factors between the two subsets of respondent groups. Therefore, there is a relative consensus among the respondents' assessments for each factor, allowing the data to be used for further analysis.

4.4. Exploratory factor analysis (EFA)

Given the excellent reliability and differentiation test results, an EFA was conducted. Table 7 presents the analysis of factors influencing awareness and implementation of occupational safety. The Kaiser-Meyer-Olkin (KMO) measure is 0.879, exceeding the acceptable threshold of 0.5, and the Bartlett test yields a significance level of less than 0.05. Furthermore, the factor loading coefficients exceed 0.5, the extracted variance index is 4.480 (>1), and the total extracted variance is 60.007% (>50%). These results confirm that the scales and variables used to measure factors influencing awareness and implementation of occupational safety are suitable within the EFA model.

Table 7. Condition check results of exploratory factor analysis.

Variance extraction breakpoint	Total variance extracted	Kaiser-Meyer-Olkin coefficient	Sig.
4.789	20.823		
4.533	40.530	0.879	0.000
4.480	60.007		

4.5. Discussion on each grouped factor

The rotated matrix results reveal that the factors influencing awareness and implementation of occupational safety are categorised into three distinct groups, and no new concepts emerged during the analysis, indicating consistency with the research data (Table 8).

Factor C1 demonstrates the highest loading factor of 0.892 among the working conditions-related factors, indicating a strong influence on the variables. Conversely, C9 shows the lowest loading factor of 0.581, suggesting a less pronounced impact. In the context of occupational safety performance among construction workers, the absence of innovation in safety techniques and construction methods (C1) has a more direct influence than factors related to natural disasters and diseases, such as C9, which are relatively infrequent occurrences.

Table 8. Factor loading through Varimax rotation.

Factor	Loading		
	Component 1 'Working conditions'	*Component 2 'Management capacity'*	*Component 3 'Workers themselves'*
C1	0.892		
C2	0.892		
C3	0.770		
C4	0.769		
C5	0.768		
C6	0.740		
C10	0.591		
C9	0.581		
B5		0.806	
B1		0.790	
B3		0.775	
B4		0.771	
B9		0.715	
B8		0.701	
B10		0.651	
B7		0.649	
A12			0.861
A11			0.835
A10			0.808
A9			0.761
A8			0.757
A5			0.752
A3			0.727

Factor C10, relating to geographical conditions, reflects a specific climate with two distinct seasons and relatively comfortable conditions for construction workers accustomed to the local climate. Factors C3, C4, C5, and C6 have an average loading coefficient of approximately 0.7, indicating a notable influence, though not as pronounced as C1 and C2. These factors, which are frequently encountered on construction sites, include hazardous noise and dust, which persist due to asynchronous urbanisation and incomplete infrastructure development.

Factor B5, with the highest loading coefficient of 0.806 within the organisational work-related factors, highlights the importance of managing occupational safety through regular inspections and hazard identification. Effective safety management requires consistent monitoring and discipline to address unsafe practices, particularly during elevated work tasks.

Factors B10 and B7, concerning "Policy for safety activities" and "Occupational safety training programmes," receive relatively lower ratings, which can be attributed to varying reward structures across companies and irregularity in the organisation of safety training programmes.

Loading coefficients ranging from 0.790 to 0.701 are considered appropriate for the remaining factors related to organisational work safety management capacity. In the employee-related factors group, A10, A11, and A12 exhibit the highest loading coefficients, indicating poor discipline, stimulant consumption, and risk tolerance among workers. Factors with lower loadings, such as A3, A5, A8, and A9, reflect workers' education levels, trust in management, and their impact on safety compliance.

5. Conclusions and recommendations

Construction workers operate in environments heavily influenced by working conditions, many of which pose significant risks to their health and safety. Without proper preventive measures, these conditions can lead to accidents on construction sites. Presently, the issue of occupational accidents on such sites remains complex, largely due to workers' behaviour and awareness regarding compliance with labour safety laws. Therefore, there is an urgent need for solutions to address these challenges and enhance the safety performance of construction workers.

This study provides a comprehensive overview of occupational safety and examines the factors impacting construction workers' awareness and compliance with safety protocols. The study identifies 23 factors categorised into three groups: worker-related factors (7 factors), organisational safety management factors (8 factors), and working conditions-related factors (8 factors). These factors are deemed influential in shaping construction workers' safety awareness and practices in projects. Based on the ANOVA test, the study found that most respondents assessed the effect of each factor on workers' safety behaviour similarly, with only a few cases showing significant differences at the 0.05 level. Additionally, based on the EFA, the extracted factor model accounts for over 60% of the original factors' variance, indicating that the model is highly representative.

Furthermore, the study delves into the role and significance of these identified factors within the context of the Vietnamese construction industry. This analysis serves as a crucial foundation for proposing recommendations and strategies to enhance the effectiveness of safety measures among construction workers. However, the study acknowledges certain limitations, including subjectivity among survey participants, the need for further validation of factor grouping, and the explanation for eliminating variables due to systematic factors. Additionally, the study notes that some total variable correlations require further explanation, which necessitates additional scrutiny. Future research can address these shortcomings to advance the field.

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COMPETING INTERESTS

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