

Article

Enhancing Sustainable Safety Practices in Construction: Insights from Cultural and Socio-Economic Analysis

Fahad M. Alqahtani ^{1,*} , Muhammad Abas ^{2,*} , Mohammed Alkahtani ¹ , Mubashir Hayat ³ and Aasia Farrukh ⁴ 

¹ Department of Industrial Engineering, College of Engineering, King Saud University, P.O. Box 800, Riyadh 11421, Saudi Arabia; moalkahtani@ksu.edu.sa

² Department of Industrial Engineering, University of Engineering and Technology, Peshawar 25000, Pakistan

³ Chair of Production and Operations Management, Brandenburg University of Technology, Konrad-Wachsmann-Allee 13, 03046 Cottbus, Germany; mubashir.hayat@b-tu.de

⁴ Chemical Engineering Department, University of Wah, Wah 47040, Pakistan; afarrukh@wecuw.edu.pk

* Correspondence: afahad@ksu.edu.sa (F.M.A.); muhammadabas@uetpeshawar.edu.pk (M.A.)

Abstract: Exploring cultural diversity and socio-economic factors offers a holistic approach to fostering sustainable safety practices within the construction industry. This study investigates the relationship between cultural and socio-economic factors and their influence on safety practices within the construction industry, focusing specifically on Saudi Arabian construction. Employing a comparative research design, data were gathered through a questionnaire distributed among various stakeholders, including construction workers, safety officers, project managers, supervisors, and other professionals involved in construction projects. Structural equation modeling (SEM) was utilized to analyze the relationships between cultural, socio-economic, and safety practices. The findings showed significant associations of cultural and socio-economic factors with safety practices and attitudes. Specifically, positive workplace norms and values, effective communication styles, higher income levels, and better education and literacy levels were found to positively influence adherence to safety guidelines and the effectiveness of training programs. Conversely, job insecurity exhibited a negative impact on safety-related outcomes and training effectiveness. This study demonstrates the importance of fostering a positive safety culture within organizations, emphasizing leadership commitment, effective communication, and employee engagement. It also highlights the significance of addressing socio-economic factors, such as job security, income levels, and education, to promote a safer work environment and enhance safety practices. Practical implications derived from the research findings offer actionable insights for organizations to develop targeted interventions aimed at improving sustainable safety practices and training effectiveness within the construction industry in Saudi Arabia.

Keywords: construction; sustainability; cultural; socio-economic; safety; structural equation modeling (SEM)



Citation: Alqahtani, F.M.; Abas, M.; Alkahtani, M.; Hayat, M.; Farrukh, A. Enhancing Sustainable Safety Practices in Construction: Insights from Cultural and Socio-Economic Analysis. *Sustainability* **2024**, *16*, 5103. <https://doi.org/10.3390/su16125103>

Academic Editor: Sameh M. El-Sayegh

Received: 14 May 2024

Revised: 6 June 2024

Accepted: 12 June 2024

Published: 15 June 2024



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1. Introduction

The construction industry is well known for its dynamic and multidimensional nature, characterized by the convergence of diverse cultural backgrounds and socio-economic factors within project teams [1]. Ensuring safety in such environments is vital, yet achieving this goal requires an understanding of the intricate relationship between cultural norms, socio-economic dynamics, and safety practices.

Construction sites are inherently hazardous environments, characterized by a multitude of potential risks ranging from falls and equipment malfunctions to structural failures [2,3]. Despite intensive efforts to enhance safety protocols and regulations, the

industry continues to cope with high rates of accidents and fatalities [4,5]. While technological advancements and regulatory frameworks play crucial roles in addressing safety concerns, the influence of cultural norms and socio-economic factors cannot be overstated.

Sustainability and safety both focus on resource conservation: sustainability addresses the conservation of environmental resources, while safety emphasizes the preservation of human resources. Both aspects are essential and should be prioritized within a sustainable environment [6,7]. To achieve sustainable safety, individuals should recognize that safety is embedded in their daily work activities rather than considering it only after an accident occurs. Occupational and environmental accidents in complex socio-technical systems are more likely when there is a loss of control over work activities [8]. Sustainable safety hinges on the continuous control of work activities to prevent accidents, highlighting the importance of integrating safety into everyday practices [6,9]. Sustainable safety practices consider the well-being of workers, the efficiency of operations, and the socio-economic and cultural contexts in which construction activities occur, aiming to create a work environment that prioritizes health, safety, and sustainability for the present and future [6,10,11].

Cultural perspectives shape perceptions of risk, attitudes toward safety, and the efficacy of safety measures within construction contexts. Chen et al. [12] suggested that inclusive organizational cultures that value diversity and foster mutual respect among workers from different cultural backgrounds tend to have stronger safety climates, resulting in improved safety performance. Similarly, Cheung and Zhang [13] have highlighted the positive impact of organizational values that prioritize safety, fostering a collective commitment to safety among workers in construction. Conversely, cultural misunderstandings and miscommunications can have negative effects on safety within construction environments. Rane [14] conducted a comprehensive study highlighting how cultural differences in communication styles and norms can lead to misunderstandings and conflicts, ultimately compromising safety outcomes. Feng et al. [15] explored the role of resilient culture in mitigating these challenges, emphasizing the importance of equipping workers with the skills to navigate cultural diversity effectively in safety-critical situations. Oswald et al. [16] have highlighted the importance of leadership empowerment in creating an environment where workers feel empowered to voice safety concerns and actively contribute to safety improvement efforts. Hierarchical structures within construction organizations also shape safety practices and attitudes [17]. While hierarchical systems can facilitate efficient communication and the enforcement of safety protocols, they may also contribute to power differences that discourage lower-level workers from speaking up about safety concerns [18]. Research by Sankar et al. [19] emphasizes the importance of flattening organizational hierarchies and promoting participatory safety decision-making processes to empower all workers to contribute to safety improvement efforts. Cultural attitudes toward risk-taking play a significant role in shaping safety behaviors on construction sites. Trask et al. [20] have found that cultural norms and values that prioritize risk aversion and caution tend to result in higher levels of safety compliance and fewer accidents. Ricci et al. [21] explored cultural differences in attitudes toward risk and safety compliance among construction workers from different cultural backgrounds, highlighting the need for targeted interventions to align cultural attitudes with safety requirements.

Socio-economic dynamics further complicate the safety management in construction [22]. Economic pressures, resource constraints, and labor market conditions exert considerable influence on safety practices, often creating trade-offs between cost efficiency and worker well-being [23]. Additionally, disparities in access to education, training, and healthcare intensify vulnerabilities among construction workers, particularly in marginalized communities [24]. Studies have demonstrated that differences in income and access to resources can intensify safety risks for workers, highlighting the need for reasonable safety involvements that address socio-economic inequalities [25]. Additionally, effective regulatory oversight is essential for ensuring compliance with safety standards and promoting a culture of accountability among construction stakeholders [26,27]. Research by Khalid et al. [28] has shown that robust regulatory frameworks coupled with proactive

enforcement measures lead to better safety outcomes and reduced accident rates. Moreover, government regulations provide a baseline standard for safety across the construction sector, helping to mitigate socio-economic disparities and promote equitable access to safe working conditions [29]. The findings of Xu et al. [30] showed that the supervision environment impacts construction safety performance (CSP) more than socio-economic development. High-efficiency values of CSP may stem from external environmental pressure, while low-efficiency values of CSP are due to a lack of safety management willingness. Further, the study suggests the use of government-led policies, technology emphasis, and management prioritization to enhance CSP. According to Sherratt and Dainty [31], the COVID-19 pandemic offered a unique opportunity for the construction industry to prioritize the health, safety, and well-being (HSW) of workers. Pre-pandemic, the industry faced significant HSW challenges, presenting an opportunity for meaningful change. They argue for a shift toward a “new normal” where both the physical and psychological well-being of workers are prioritized. This requires redefining construction practices to focus on people rather than just sites as production centers. The research community should support this shift by adopting more critical approaches to safety discourse and challenging existing norms. Shabani et al. [32] have revealed that workers who feel secure in their employment are more likely to report safety concerns and engage in safety improvement initiatives, contributing to a safer work environment overall. Therefore, efforts to promote job stability and provide avenues for workers to voice safety-related grievances are essential for enhancing safety performance.

In summary, the literature indicates that a comprehensive understanding of the cultural and socio-economic factors influencing safety in construction is essential for developing evidence-based interventions that promote a culture of sustainable safety and foster equitable development within the industry. While numerous studies have explored these issues in segregation, there remains a lack of research that systematically examines the comparative effects of cultural and socio-economic dynamics on sustainable safety in construction. This research aims to address this gap by conducting a comparative study that investigates how cultural and socio-economic factors influence sustainable safety practices in construction projects in Saudi Arabia. By adopting a comparative approach, this study seeks to identify commonalities and differences in safety cultures, communication patterns, and regulatory compliance across diverse cultural and socio-economic contexts.

This research employed a questionnaire-based approach to collect data. Structural equation modeling (SEM) was employed to analyze the cultural and socio-economic factors influencing safety practices in the construction industry. Cultural factors, including workplace norms, communication styles, hierarchy, and attitudes toward risk, were assessed through Likert scale ratings, as were socio-economic factors like income levels, education, regulatory environments, and job insecurity. Additionally, participants provided feedback on safety practices and attitudes, indicating their agreement with statements regarding adherence to safety guidelines and the effectiveness of training programs. By integrating these quantitative assessments, this study aims to uncover insights into the contextual determinants of safety performance and identify universal best practices to promote a culture of safety and equitable development within the global construction sector.

2. Methodology

This study adopted a comparative research design to investigate the influence of cultural and socio-economic factors on safety practices and outcomes across different construction projects.

2.1. Questionnaire Design

The questionnaire is designed to capture data on cultural and socio-economic factors influencing safety practices in the construction industry. It consists of two main sections. The first section contains demographic information of respondents such as age, gender, education level, years of experience in construction, and region. The second section

comprises a series of questions related to cultural, socio-economic, and safety practices and attitude factors as shown in Table 1. Each question is assigned a Likert scale item to assess participants' perceptions and experiences. A five-point Likert scale is used in the present study, where 1 represents Strongly Disagree, 2 represents Disagree, 3 represents Neutral, 4 represents Agree, and 5 represents Strongly Agree.

Table 1. Factors related to cultural, socio-economic, and safety practices.

Factors	Related Questions
Cultural Factors (CFs)	
Workplace Norms and Values (WNVs)	Workers from diverse cultural backgrounds integrate well into the safety culture of the construction site.
Communication Styles (CSs)	Communication barriers due to cultural differences negatively impact safety awareness and compliance.
Hierarchy and Power Dynamics (HPD)	Hierarchical structures facilitate effective communication and implementation of safety protocols.
Attitudes Toward Risk (ATR)	Cultural attitudes toward risk-taking align with safety guidelines on construction sites.
Socio-economic Factors (SEFs)	
Income levels (ILs)	Adequate resources and training are provided regardless of workers' socio-economic status.
Education and Literacy Levels (ELs)	Safety guidelines and protocols are easily understood by all workers, regardless of education level.
Regulatory environments (REs)	Government regulations effectively ensure safety standards are met on construction sites.
Job insecurity (JI)	Workers feel comfortable reporting safety concerns without fear of job insecurity.
Safety Practices and Attitudes (SPAs)	
Adherence to safety guidelines (ASGs)	Safety guidelines are strictly followed on the construction site where I work.
Effectiveness of training programs (ETPs)	Safety training and awareness programs are effective in promoting safe practices.

2.2. Sample Size Determination

In survey research, it is essential to estimate population proportions with a certain level of precision. Achieving this requires careful consideration of sample size, as it directly impacts the accuracy and reliability of the estimates. One fundamental aspect of sample size determination in such scenarios involves calculating the minimum sample size required to estimate a population proportion within a specified margin of error. This process is essential for ensuring the credibility of survey results and the validity of conclusions drawn from them. At the core of this sample size determination lies a simple yet powerful Cochran's formula [33], which allows us to systematically determine the necessary sample size based on key parameters such as the desired level of confidence and the acceptable margin of error. The formula is expressed in Equation (1),

$$n = \frac{Z^2 \times p \times (1 - p)}{E^2} \quad (1)$$

where:

n = required sample size.

Z = Z-score corresponding to the desired level of confidence (e.g., 1.96 for 95% confidence level).

p = estimated population proportion.

E = margin of error (desired level of precision), which provides a structured approach to ensure that survey samples are sufficiently representative of the population under study.

The desired level of confidence is 95% for most research studies, an estimate of the population proportion of 0.5 is used as it provides the maximum sample size required. The desired margin of error (typically expressed as a percentage of the estimated population

proportion) is set at 5%, as smaller margins of error result in larger sample sizes, as more precision requires a larger sample to achieve. The same size computed based on Equation (1) is 385.

2.3. Target Respondents

The target respondents for the distribution of the questionnaire include construction workers, safety officers, project managers, supervisors, and other professionals involved in construction projects across different sites in Saudi Arabia. The sources of data collection include face-to-face interviews and questionnaire distribution through Google Forms, WhatsApp, and emails.

2.4. Structural Equation Modeling (SEM)

SEM was employed to analyze the relationships between cultural, socio-economic, and organizational factors and safety practices in the construction industry. The SEM framework allows for the examination of complex relationships among multiple variables, considering direct effects. In the present study, SEM is performed on an open source tool, namely Jamovi (version 2.4). The steps followed for SEM analysis are described in the following sections.

2.4.1. Confirmatory Factor Analysis (CFA)

CFA was used to confirm whether the data fit a hypothesized measurement model. It tests the hypothesis that a relationship between observed variables and their underlying latent constructs exists. CFA is assessed based on loading values, Z-score, and *p*-value. Loading values indicate how well each observed variable (indicator) represents the underlying latent construct. Loadings above 0.7 are typically considered high, indicating a strong relationship, while loadings between 0.5 and 0.7 are moderate, suggesting an acceptable relationship [34]. Z-score values represent the standard errors of the loadings. High Z-values (typically greater than 1.96) indicate that the loadings are significantly different from zero, suggesting that the indicators significantly contribute to the latent construct [35]. The *p*-values test the null hypothesis that the loading is equal to zero. A *p*-value less than 0.05 (often <0.001 in robust models) indicates that the loadings are statistically significant [36].

2.4.2. Reliability Tests

The reliability tests include Cronbach's Alpha and composite reliability (CR). Cronbach's Alpha measures internal consistency, or how closely related a set of items is as a group. It assesses the extent to which a set of items within a measurement scale consistently measure the same underlying construct. A value above 0.7 generally indicates acceptable reliability [37]. CR is similar to Cronbach's Alpha but often considered more appropriate for SEM as it takes into account the actual factor loadings. Values above 0.7 are considered good [37].

2.4.3. Validity Tests

The validity test includes the average variance extracted (AVE) and heterotrait-monotrait (HTMT) ratio of correlations statistical techniques. The AVE technique measures the amount of variance captured by a construct relative to the amount due to measurement error. It assesses convergent validity, indicating whether the latent variable is adequately measured by its indicators. A value above 0.5 indicates good convergent validity [37,38]. The HTMT technique assesses discriminant validity, which ensures that constructs that are supposed to be different are actually distinct. Values below 0.85 (or 0.9 in more lenient criteria) indicate good discriminant validity [39,40].

2.4.4. Model Fit Indices

Model fit indices are essential tools in structural equation modeling (SEM) for evaluating how well a hypothesized model corresponds to the observed data. Among the common

fit indices, the Comparative Fit Index (CFI) compares the fit of a user-specified model to a baseline model, with values above 0.90 indicating a good fit [41,42]. The Tucker–Lewis Index (TLI) operates similarly to the CFI but includes a penalty for model complexity, again suggesting a good fit for values above 0.90 [41,42]. The Bentler–Bonett Non-normed Fit Index (NNFI) adjusts for both model complexity and sample size, with a threshold of 0.90 for an acceptable fit [41,42]. The Relative Noncentrality Index (RNI) considers noncentrality parameters to measure model fit, with values above 0.90 denoting a good fit [41,42]. The Bentler–Bonett Normed Fit Index (NFI) compares the chi-square value of the user-specified model to that of a null model, where values exceeding 0.90 are desirable [41,42]. Bollen’s Relative Fit Index (RFI), similar to the NFI, adjusts for degrees of freedom, and values above 0.90 are considered indicative of a good fit [41,42]. Bollen’s Incremental Fit Index (IFI) assesses the improvement in the user-specified model over a baseline model, with values above 0.90 being favorable [41,42]. Lastly, the Parsimony Normed Fit Index (PNFI) modifies the NFI to account for model complexity, promoting simpler models. Higher PNFI values indicate a more parsimonious model, though there is no strict threshold for acceptable values [41,42]. Together, these indices provide a comprehensive assessment of model fit, balancing goodness-of-fit with model simplicity and complexity.

2.4.5. Path Analysis

Path Analysis estimates and tests the path coefficients (β) to understand the relationships between the latent variables. Significant path coefficients indicate that the hypothesized relationships are supported by the data. They are typically assessed through p -values. Significant path coefficients, indicated by low p -values (typically < 0.05), suggest that the hypothesized relationships between variables are supported by the data. Non-significant path coefficients indicate that there is insufficient evidence to conclude that a relationship exists between the variables [43,44].

2.5. Hypothesis Formulation and Its Background

The literature indicates that in cultures with high uncertainty avoidance and strong collectivist values, there is a stronger emphasis on safety protocols to mitigate risks and protect the group [12,45,46]. Conversely, cultures with high power distance and effective leadership communication foster better adherence to safety guidelines [47,48]. Therefore, integrating diverse cultural backgrounds into the safety culture, overcoming communication barriers, leveraging hierarchical structures, and aligning cultural attitudes toward risk with safety guidelines are essential for improving safety practices and attitudes [49,50]. Therefore the set of hypotheses is as follows:

H1. *Cultural Factors (CFs) positively influence Safety Practices and Attitudes (SPAs).*

Research shows that higher socio-economic status correlates with better health and safety behaviors [51,52]. Higher income and education levels provide workers with the resources and knowledge necessary to understand and follow safety protocols. Effective regulatory environments support these behaviors, while job insecurity can undermine them. Thus, adequate resources and training, easily understood safety guidelines, effective government regulations, and job security are essential for enhancing safety practices and attitudes [53,54]. Thus, the next hypothesis is as follows:

H2. *Socio-economic Factors (SEFs) positively influence SPAs.*

Studies indicate that workplaces with strong safety cultures and shared safety values see higher compliance with safety guidelines among workers [55,56]. A positive safety climate, where safety is perceived as a priority, enhances adherence to safety protocols, as employees feel supported and motivated to follow established guidelines [47,57]. Therefore,

fostering workplace norms and values that emphasize safety is essential for improving adherence to safety guidelines. So, the next hypothesis is formulated as follows:

H3. *Workplace Norms and Values (WNVs) positively influence Adherence to safety guidelines (ASGs).*

Research suggests that clear and culturally sensitive communication improves adherence to safety protocols [58]. By addressing communication barriers and ensuring that safety messages are understood across cultural boundaries, adherence to safety guidelines can be significantly enhanced [13,14]. Therefore, the following hypothesis is established:

H4. *Communication Styles (CSs) positively influence ASGs.*

The literature indicates that in environments with strong hierarchical structures, adherence to safety guidelines improves as employees tend to follow directives from higher authority figures diligently [59,60]. Clear power dynamics ensure that safety protocols are communicated effectively and followed rigorously, thereby enhancing adherence to safety guidelines [61]. So, the next hypothesis is as follows:

H5. *Hierarchy and Power Dynamics (HPD) positively influence ASGs.*

The literature suggests that employees who perceive high levels of risk and have a cautious attitude toward potential hazards are more likely to comply with safety protocols [62,63]. Positive attitudes toward risk management and safety can lead to higher adherence to safety guidelines, as employees prioritize their safety and that of their colleagues [64,65]. Hence, the next hypothesis developed is as follows:

H6. *Attitudes Toward Risk (ATR) positively influence ASGs.*

The literature indicates that financial stability allows workers to focus on safety rather than financial stress [25,32,66]. Adequate income levels enable access to resources that support adherence to safety guidelines, thus improving overall safety compliance [32,67]. Therefore, the next hypothesis developed is as follows:

H7. *Income levels (ILs) positively influence ASGs.*

Studies show that higher education and literacy levels correlate with better comprehension of safety protocols and increased adherence [68–70]. Providing education and training ensures that safety guidelines are understood and followed, enhancing overall safety. Hence, the next hypothesis is as follows:

H8. *Education and Literacy Levels (ELs) positively influence ASGs.*

Research indicates that strong regulatory frameworks improve compliance with safety standards [26–28,71]. Effective government regulations ensure that safety guidelines are followed, thereby enhancing overall safety adherence on construction sites. Thus, the next hypothesis is as follows:

H9. *Regulatory environments (REs) positively influence ASGs.*

The literature suggests that job insecurity undermines adherence to safety guidelines as workers focus on job retention rather than safety compliance [72–74]. Ensuring job security can therefore improve adherence to safety protocols. Therefore, the next hypothesis is as follows:

H10. *Job insecurity (JI) negatively influences ASGs.*

Research shows that strong workplace norms and values that support safety and learning enhance the effectiveness of training programs [75–77]. A culture that prioritizes safety ensures that training programs are taken seriously and integrated into daily practices. So, the next hypothesis is formulated as follows:

H11. *WNVs positively influence the Effectiveness of training programs (ETPs).*

The literature indicates that effective communication styles that account for cultural differences improve the retention and implementation of training content [78–80]. Training programs that use clear, culturally sensitive communication are more effective. Therefore, the next hypothesis is as follows:

H12. *CSs positively influence ETPs.*

Research suggests that clear hierarchical structures and power dynamics enhance the effectiveness of safety training programs by ensuring that they are perceived as important and necessary [81,82]. Authority figures can enforce participation and adherence to training protocols, leading to better implementation and outcomes of safety training programs [83]. Hence, the next hypothesis established is as follows:

H13. *HPD positively influence ETPs.*

Research indicates that employees who recognize the importance of managing risks and have a proactive attitude toward safety are more likely to participate actively in training programs. Such attitudes lead to better engagement, retention of training material, and application of learned skills, thereby increasing the overall effectiveness of safety training programs [84–86]. So, the next hypothesis is set as follows:

H14. *ATR positively influences ETPs.*

Studies show that financial stability enhances participation and engagement in training programs. Firms with adequate income levels can focus on training without the distraction of financial concerns, improving training effectiveness [87,88]. Therefore, the hypothesis is formulated as follows:

H15. *ILs positively influence ETPs.*

Research indicates that higher education and literacy levels improve the effectiveness of training programs [89–91]. Workers with better educational backgrounds can more easily grasp and apply training content, leading to more effective safety practices. Thus, the next hypothesis is as follows:

H16. *ELLS positively influence ETPs.*

The literature shows that strong regulatory environments enhance the effectiveness of training programs by ensuring that they are well-designed and mandatory [92–94]. Compliance with regulatory standards ensures that training programs are effective and comprehensive. So, the next hypothesis is set as follows:

H17. *REs positively influence ETPs.*

Research indicates that job insecurity reduces the effectiveness of training programs as workers are less likely to engage fully [95,96]. Ensuring job security can improve

participation and effectiveness of training programs, leading to better safety practices. Therefore, the final hypothesis is as follows:

H18. *JI negatively influences ETPs.*

Figure 1 illustrates the conceptual framework established for the present study based on the aforementioned set of hypotheses.

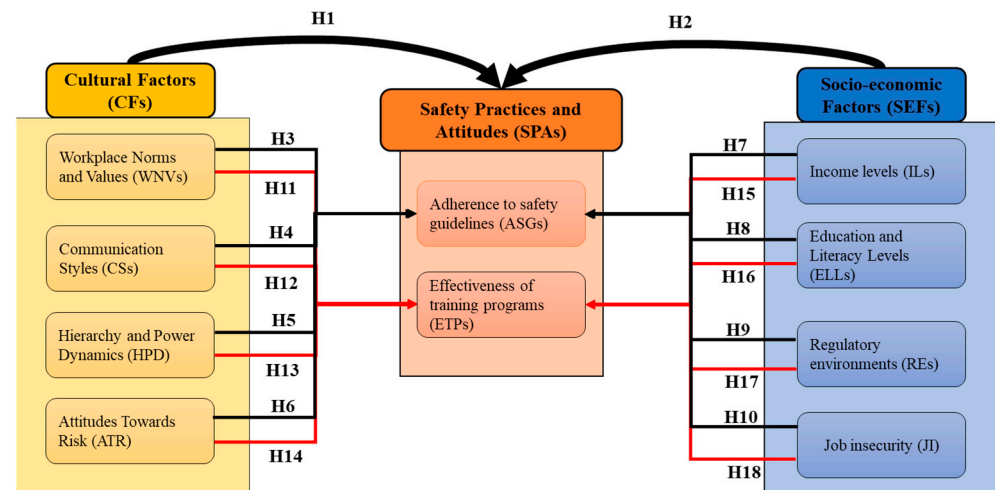


Figure 1. Conceptual framework.

3. Results

3.1. Received Responses

A total of 810 questionnaires were distributed, and 669 responses were received. Thus, a response rate of 84% was achieved. The average response rate is above 50%, which is adequate for surveys. Figure 2 shows the response rate from individuals across different roles within the construction industry. Safety officers represent the largest proportion of received responses, comprising 27% of the total, indicating a significant interest and involvement from this critical segment responsible for ensuring safety standards on construction sites. Following safety officers, project managers constitute 16% of the responses, highlighting their substantial contribution to the survey. As key decision-makers managing project execution, their perspectives play a crucial role in shaping safety policies and practices within construction projects. Construction workers, comprising 20% of the responses, represent a substantial portion of the participant pool. Their experience and firsthand knowledge of on-site conditions provide valuable insights into the practical implementation of safety protocols. Supervisors, with 20% of the responses, also offer important perspectives as individuals responsible for overseeing day-to-day operations on construction sites. Their insights into the challenges and opportunities for safety enforcement contribute to a comprehensive understanding of safety dynamics. Lastly, other professionals, accounting for 17% of responses, represent a diverse group contributing to the research. Their inclusion ensures a broad spectrum of perspectives, enriching the data with varied insights and experiences from different roles within the construction industry. The distribution of responses across these roles reflects a well-rounded representation of stakeholders within the construction sector, providing a comprehensive basis for analyzing safety practices and attitudes across different professional domains.

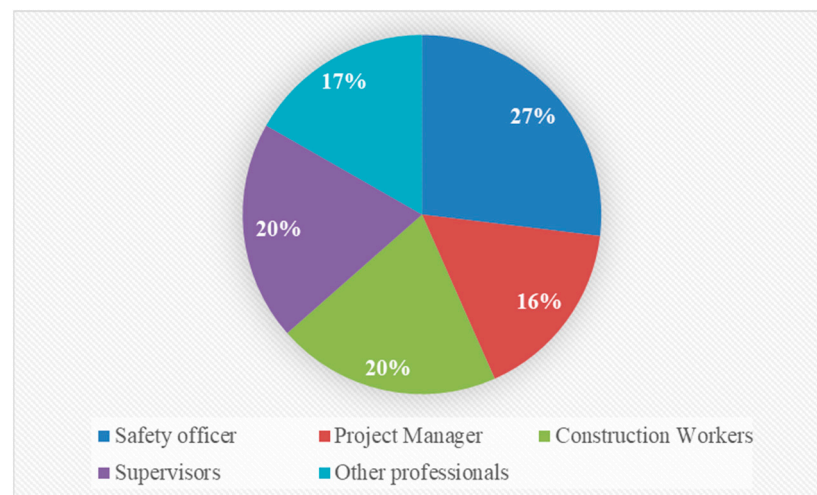


Figure 2. Percentage of received responses.

3.2. Structural Equation Modeling

3.2.1. Confirmatory Factor Analysis (CFA)

The results of the CFA indicate strong support for the reliability and validity of the measurement model as shown in Table 2. Examination of the indicator loadings reveals robust associations between the indicators and their corresponding latent variables. The indicator WNVs, with a loading of 0.527, Z-value of 8.25, and a p -value < 0.001 , shows a moderate loading on the CFs latent variable, suggesting it moderately reflects this construct. The indicator CSs has a high loading of 0.873, with a Z-value of 26.97 and a p -value < 0.001 , indicating a strong reflection of the CFs construct, highlighting its significant role in shaping organizational culture. Additionally, the indicator HPD, with a loading of 0.621, Z-value of 12.43, and a p -value < 0.001 , demonstrates a moderate-to-high loading, indicating a good reflection of the CFs construct. Similarly, the indicator ATR, which has a loading of 0.626, a Z-value of 12.54, and a p -value < 0.001 , also reflects the CFs construct well, showing a moderate-to-high loading. In a nutshell, these indicators significantly contribute to the measurement of CFs, with CSs being the most robust indicator.

Table 2. Confirmatory factor analysis, reliability, and convergent analysis.

Latent Variable	Indicator	Loading	Z	p -Value	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
CFs	WNVs	0.527	8.25	<0.001	0.85	0.82	0.57
	CSs	0.873	26.97	<0.001			
	HPD	0.621	12.43	<0.001			
	ATR	0.626	12.54	<0.001			
SEFs	ILs	0.585	8.73	<0.001	0.91	0.88	0.65
	ELs	0.556	8.44	<0.001			
	REs	0.579	8.65	<0.001			
	Jl	0.595	9.81	<0.001			
SPAs	ASGs	0.846	16.68	<0.001	0.89	0.88	0.58
	ETPs	0.513	8.09	<0.001			

The CFs results for the latent variable SEFs reveal that all indicators have moderate loadings on this construct. The indicator ILs, with a loading of 0.585, a Z-value of 8.73, and a p -value < 0.001 , demonstrates a moderate reflection of the SEFs latent variable. Similarly, the indicator ELs, which has a loading of 0.556, a Z-value of 8.44, and a p -value < 0.001 , also reflects the SEFs construct moderately. The indicator REs, with a loading of 0.579, a Z-value of 8.65, and a p -value < 0.001 , shows a moderate loading, suggesting a good

reflection of the SEFs construct. Lastly, the indicator JI, having a loading of 0.595, a Z-value of 9.81, and a p -value < 0.001 , indicates a good reflection of the SEFs. In summary, these indicators moderately contribute to the measurement of SEFs, confirming their significance in representing this latent variable.

The CFA results for the latent variable SPAs show significant contributions from the indicators ASGs and ETPs. The indicator ASGs, with a loading of 0.846, a Z-value of 16.68, and a p -value < 0.001 , demonstrates a high loading on the SPAs latent variable, highlighting its importance in promoting safety behaviors within the organization. On the other hand, the indicator ETPs, which has a loading of 0.513, a Z-value of 8.09, and a p -value < 0.001 , exhibits a moderate loading, indicating a moderate reflection of the SPAs. Together, these indicators confirm their importance in accurately representing the SPAs latent variable, with ASGs showing a particularly robust association.

3.2.2. Reliability Tests

For three latent variables, CFs, SEFs, and SPAs, the Cronbach's Alpha values of 0.85, 0.91, and 0.89 exceeding the threshold value of 0.70 indicate a high level of internal consistency reliability among the items comprising this latent variable as shown in Table 2. This suggests that the items related to CFs, SEFs, and SPAs are closely related and effectively measure the intended construct. Further, the composite reliability values for CFs, SEFs, and SPAs are also relatively high, exceeding 0.7, indicating excellent internal consistency reliability.

3.2.3. Validity Tests

In Table 2, for CFs, the AVE value of 0.57 suggests that 57% of the variance in the CFs latent variable is explained by its indicators. This indicates acceptable convergent validity, implying that the observed variables reliably measure the underlying construct of CFs. Similarly, for SEFs, the AVE value of 0.65 indicates that 65% of the variance in the SEFs latent variable is explained by its indicators. This suggests good convergent validity, implying that the observed variables effectively measure the underlying construct of SEFs. Regarding SPAs, the AVE value of 0.58 indicates that 58% of the variance in the SPA latent variable is explained by its indicators. This again suggests acceptable convergent validity, indicating that the observed variables adequately measure the underlying construct of safety practices and attitudes.

The calculated HTMT ratios indicate the extent to which the correlation between two constructs is comparable to the correlations within each construct. In this instance, the HTMT ratios between CFs and SEFs, CFs and SPAs, and SEFs and SPAs were all below the threshold value of 0.85 as shown in Table 3, signifying that these constructs possess discriminant validity. Specifically, the ratios of 0.727 between CFs and SEFs, 0.655 between CFs and SPAs, and 0.592 between SEFs and SPAs suggest that the latent variables are sufficiently distinct from one another. Thus, the measurement model effectively captures unique aspects of CFs, SEFs, and SPAs, facilitating meaningful analyses of their relationships without concerns about overlap or redundancy.

Table 3. Discriminant validity using the heterotrait–monotrait (HTMT) ratio of correlations technique.

Latent	CF	SEF	SPA
CFs	1	0.727	0.655
SEFs	0.727	1	0.592
SPAs	0.655	0.592	1

3.2.4. Model Fit Indices

The model fit indices provide valuable insights into how well the proposed structural equation model (SEM) aligns with the observed data as shown in Table 4. A CFI of 0.995 indicates an excellent fit, suggesting that the model effectively reproduces the observed

covariance matrix. Similarly, the TLI of 0.991 and the NNFI of 0.991 both suggest a very good fit, supporting the adequacy of the proposed model. The RNI further reinforces this, with a value of 0.992 indicating that the model provides a good approximation of the observed data. Additionally, the NFI of 0.987 and RFI of 0.982 both suggest a very good fit relative to baseline models. The IFI of 0.991 further supports this conclusion, indicating a very good fit compared to a null model. Finally, the PNFI of 0.870 also suggests a good fit. In conclusion, the pattern of fit indices collectively suggests strong support for the adequacy of the proposed SEM in explaining the relationships among the latent variables under investigation.

Table 4. Model fit indices.

	Model
Comparative Fit Index (CFI)	0.995
Tucker–Lewis Index (TLI)	0.991
Bentler–Bonett Non-normed Fit Index (NNFI)	0.991
Relative Noncentrality Index (RNI)	0.992
Bentler–Bonett Normed Fit Index (NFI)	0.987
Bollen’s Relative Fit Index (RFI)	0.982
Bollen’s Incremental Fit Index (IFI)	0.991
Parsimony Normed Fit Index (PNFI)	0.870

3.2.5. Path Analysis

The path analysis results provide convincing support for the hypothesized relationships between CFs, SEFs, and SPAs within organizational contexts. Specifically, all formulated hypotheses receive empirical support, with each path coefficient demonstrating statistical significance ($p < 0.001$) as shown in Table 5. For SPAs, CFs significantly and positively influence SPAs with a path coefficient of 0.543, a standard error of 0.076, and a p -value of <0.001 , thus supporting the hypothesis (H1). Similarly, the indicator SEFs also has a substantial positive influence on SPAs, with a path coefficient of 0.421, a standard error of 0.062, and a p -value of <0.001 , supporting hypothesis H2.

Regarding ASGs, WNVs have a moderate positive effect, evidenced by a path coefficient of 0.324, a standard error of 0.058, and a p -value of <0.001 , supporting hypothesis H3. The CSs positively impact ASG with a path coefficient of 0.267, a standard error of 0.045, and a p -value of <0.001 , supporting hypothesis H4. The indicator ILs also shows a significant positive influence on ASGs, with a path coefficient of 0.398, a standard error of 0.067, and a p -value of <0.001 , supporting hypothesis H5. The indicator HPD positively influences ASGs with a path coefficient of 0.315, a standard error of 0.055, and a p -value of <0.001 , supporting hypothesis H6. ATR has a significant positive effect on ASGs, with a path coefficient of 0.292, a standard error of 0.037, and a p -value of <0.001 , supporting hypothesis H7. ELLs positively influence ASGs with a path coefficient of 0.312, a standard error of 0.054, and a p -value of <0.001 , supporting hypothesis H8. REs also positively impact ASGs, with a path coefficient of 0.215, a standard error of 0.041, and a p -value of <0.001 , supporting hypothesis H9. Conversely, JI negatively influences ASGs with a path coefficient of -0.189 , a standard error of 0.036, and a p -value of <0.001 , supporting hypothesis H10.

For the ETPs, WNVs show a strong positive impact with a path coefficient of 0.491, a standard error of 0.068, and a p -value of <0.001 , supporting hypothesis H11. CSs enhance ETPs effectiveness with a path coefficient of 0.376, a standard error of 0.055, and a p -value of <0.001 , supporting hypothesis H12. The indicator HPD positively influences ETPs with a path coefficient of 0.401, a standard error of 0.054, and a p -value of <0.001 , supporting hypothesis H13. ATR also positively affects ETPs, with a path coefficient of 0.314, a standard error of 0.045, and a p -value of <0.001 , supporting hypothesis H14. The indicator ILs contributes to more effective ETPs, with a path coefficient of 0.429, a standard error of 0.063, and a p -value of <0.001 , supporting hypothesis H15. ELLs positively impact

ETPs with a path coefficient of 0.348, a standard error of 0.052, and a p -value of <0.001 , supporting hypothesis H16. REs enhance ETPs effectiveness with a path coefficient of 0.264, a standard error of 0.046, and a p -value of <0.001 , supporting hypothesis H17. Finally, JI negatively impacts ETPs with a path coefficient of -0.201 , a standard error of 0.039, and a p -value of <0.001 , supporting hypothesis H18.

Table 5. Path analysis.

Hypothesis	Path Coefficient (β)	Standard Error	p -Value	Result
H1: Cultural Factors (CFs) positively influence Safety Practices and Attitudes (SPAs).	0.543	0.076	<0.001	Supported
H2: Socio-economic Factors (SEFs) positively influence Safety Practices and Attitudes (SPAs).	0.421	0.062	<0.001	Supported
H3: Workplace Norms and Values (WNVs) positively influence Adherence to safety guidelines (ASGs).	0.324	0.058	<0.001	Supported
H4: Communication Styles (CSs) positively influence Adherence to safety guidelines (ASGs).	0.267	0.045	<0.001	Supported
H5: Hierarchy and Power Dynamics (HPD) positively influence Adherence to Safety Guidelines (ASGs).	0.315	0.055	<0.001	Supported
H6: Attitudes Toward Risk (ATR) positively influence Adherence to Safety Guidelines (ASGs).	0.292	0.037	<0.001	Supported
H7: Income levels (ILs) positively influence Adherence to safety guidelines (ASGs).	0.398	0.067	<0.001	Supported
H8: Education and Literacy Levels (ELLs) positively influence Adherence to safety guidelines (ASGs).	0.312	0.054	<0.001	Supported
H9: Regulatory environments (REs) positively influence Adherence to safety guidelines (ASGs).	0.215	0.041	<0.001	Supported
H10: Job insecurity (JI) negatively influences Adherence to safety guidelines (ASGs).	-0.189	0.036	<0.001	Supported
H11: Workplace Norms and Values (WNVs) positively influence the Effectiveness of training programs (ETPs).	0.491	0.068	<0.001	Supported
H12: Communication Styles (CSs) positively influence the Effectiveness of training programs (ETPs).	0.376	0.055	<0.001	Supported
H13: Hierarchy and Power Dynamics (HPD) positively influence the Effectiveness of Training Programs (ETPs).	0.401	0.054	<0.001	Supported
H14: Attitudes Toward Risk (ATR) positively influence the Effectiveness of Training Programs (ETPs).	0.314	0.045	<0.001	Supported
H15: Income levels (ILs) positively influence the Effectiveness of training programs (ETPs).	0.429	0.063	<0.001	Supported
H16: Education and Literacy Levels (ELLs) positively influence the Effectiveness of training programs (ETPs).	0.348	0.052	<0.001	Supported
H17: Regulatory environments (REs) positively influence the Effectiveness of training programs (ETPs).	0.264	0.046	<0.001	Supported
H18: Job insecurity (JI) negatively influences the Effectiveness of training programs (ETPs).	-0.201	0.039	<0.001	Supported

4. Discussion

The results obtained emphasize the significant influence of cultural and socio-economic factors on safety practices and attitudes within the construction industry. The high response rate of 84% from a diverse pool of construction professionals, including safety officers, project managers, construction workers, and supervisors, highlights the broad interest and relevance of safety issues across different roles within the industry.

The SEM results provide robust evidence supporting the proposed relationships between the constructs. The CFA results indicate strong support for the reliability and validity of the measurement model, with high indicator loadings and significant Z -values. Specifically, the indicators for CFs, SEFs, and SPAs exhibit moderate to high loadings, suggesting

they effectively reflect their respective constructs. The reliability tests further confirm the internal consistency of these constructs, with Cronbach's Alpha values exceeding the threshold of 0.70.

The path analysis results reveal that CFs positively influence SPAs, with a path coefficient of 0.543. This aligns with previous research by Lingard et al. [97] and Abubakar et al. [98] emphasizing the role of organizational culture in shaping safety outcomes. Within the CFs construct, indicators such as WNVs, CSs, HPD, and ATR demonstrate significant positive impacts on both ASGs and ETPs. For instance, the indicator CSs has a particularly strong loading (0.873) and significant path coefficient, indicating its critical role in promoting a culture of safety through effective communication. Zamani et al. [99] suggest that open and transparent communication channels facilitate employee engagement with safety practices, leading to improved adherence to safety guidelines and the effectiveness of training programs. Research by Guo et al. [100] and Lestari et al. [101] emphasizes the influence of organizational values on safety behaviors. Positive workplace norms and values regarding safety create an environment where employees prioritize adherence to safety guidelines. A study by Musonda et al. [102] found that organizations with strong safety cultures, characterized by shared values and norms related to safety, exhibit higher levels of adherence to safety guidelines among employees.

SEFs also exhibit a significant positive influence on SPAs, with a path coefficient of 0.421. This finding is supported by the research of Sorensen et al. [103] and Pouliakas et al. [104], highlighting the impact of socio-economic conditions on safety outcomes. Indicators such as ILs, ELLs, and REs contribute positively to ASGs and ETPs. Higher income and education levels are associated with better safety compliance and training effectiveness, as these factors enhance employees' ability to understand and adhere to safety protocols as highlighted by Soliman and Altabtai [66] and Wilkins [67]. Additionally, effective regulatory enforcement promotes a culture of accountability and compliance, leading to improved adherence to safety guidelines and the effectiveness of training programs, as observed in studies by Othman [105] and Zailani et al. [71].

Conversely, job insecurity (JI) exhibits a negative association with both ASGs and ETPs, with path coefficients of -0.189 and -0.201 , respectively. This negative impact is significant, highlighting the detrimental effects of job insecurity on safety outcomes. This is in line with research by Jalil et al. [106] that highlights the adverse effects of job insecurity on employee well-being and job performance. The study found that employees experiencing job insecurity tend to exhibit higher levels of absenteeism, presenteeism, and reduced commitment to safety practices. Moreover, a study by Iroha et al. [74] argued that job insecurity undermines trust between employees and management, leading to a breakdown in communication and cooperation regarding safety issues.

5. Practical Implications

Practically, organizations can leverage these insights to develop tailored interventions aimed at enhancing safety practices and training effectiveness.

Organizations should prioritize the cultivation of a positive safety culture by emphasizing leadership commitment, effective communication, and employee engagement. Regular culture assessments and feedback mechanisms should be implemented to identify areas for improvement and address any gaps in safety practices and attitudes. Encouraging a culture of learning, adaptation, and continuous improvement fosters a proactive approach to safety within the organization.

Recognizing the impact of socio-economic factors, particularly in industries like construction, organizations should strive to enhance job security, income levels, and access to education. Providing fair compensation, job stability, and opportunities for skill development can contribute to a safer work environment and strengthen adherence to safety guidelines. Promoting positive workplace norms and values surrounding safety encourages employees to prioritize adherence to safety guidelines. Establishing open and transparent communication channels ensures that safety information, procedures, and expectations

are effectively conveyed to employees, fostering engagement with safety practices and training programs.

Investing in employee education and literacy levels enhances safety awareness, comprehension of safety instructions, and participation in training programs. Tailoring training programs to address specific needs and challenges within the organization improves their effectiveness in promoting adherence to safety guidelines.

Effective regulatory enforcement promotes a culture of accountability and compliance, leading to improved adherence to safety guidelines. Organizations should ensure that regulatory requirements are met and enforce safety standards consistently to mitigate risks and enhance training program effectiveness.

Addressing job insecurity is crucial to minimizing its negative impact on safety-related outcomes and training effectiveness. Providing job stability, fostering trust between employees and management, and promoting open communication channels can alleviate stress and anxiety, thus improving employee engagement with safety protocols.

6. Limitations and Future Research Directions

While the findings of the present study provide valuable insights into the relationships between cultural and socio-economic factors and safety practices in the construction industry, some limitations should be acknowledged. The research conducted in this study focuses on the Saudi Arabian construction industry, limiting the generalizability of the findings to broader contexts. Future studies should aim to replicate these findings across diverse populations and geographical regions to enhance external validity. Additionally, the cross-sectional nature of the study design excludes the establishment of causal relationships between variables. Longitudinal studies are needed to explore the temporal dynamics and causal pathways underlying the observed associations. While efforts were made to include a diverse sample of construction professionals, certain subgroups may be under-represented, warranting further investigation into their unique perspectives and experiences.

7. Conclusions

This research discussed the dynamics of cultural and socio-economic factors shaping safety practices within the construction industry, with a specific focus on the Saudi Arabian construction sector. Through thorough analysis of survey data using structural equation modeling (SEM), the research reveals significant insights, emphasizing the pivotal role of fostering a robust safety culture and addressing socio-economic discrepancies to strengthen safety outcomes.

The high response rate of 84% from a diverse pool of construction professionals underscores the robustness of the findings. The confirmatory factor analysis and model fit indices validate the reliability and accuracy of the SEM, highlighting strong internal consistency and excellent fit with the observed data.

Key findings from the SEM reveal that both cultural factors and socio-economic factors significantly influence safety practices and attitudes. The positive impact of workplace norms, communication styles, hierarchy, attitudes toward risk, income levels, education, and regulatory environments on safety adherence and training effectiveness emphasizes the multidimensional approach needed to enhance safety practices. Conversely, the negative influence of job insecurity on safety outcomes and training effectiveness highlights the critical need to address employment stability. These insights highlight that fostering a positive safety culture, improving socio-economic conditions, and ensuring effective communication and job security are essential for advancing sustainable safety practices in the construction industry.

The findings of this study have important implications for practitioners. Organizations operating in the construction sector of Saudi Arabia can leverage these insights to develop tailored interventions aimed at enhancing safety practices and training effectiveness. By prioritizing the cultivation of a positive safety culture, addressing socio-economic fac-

tors, and ensuring effective regulatory compliance, organizations can create safer work environments and improve overall safety outcomes.

Author Contributions: Conceptualization, F.M.A.; methodology, F.M.A. and M.A. (Muhammad Abas); software, M.A. (Muhammad Abas); validation, M.A. (Mohammed Alkahtani) and M.H.; formal analysis, F.M.A., M.A. (Muhammad Abas), and M.A. (Mohammed Alkahtani); investigation, F.M.A., M.A. (Muhammad Abas), and M.H.; resources, M.A. (Mohammed Alkahtani); data curation, M.H. and A.F.; writing—original draft preparation, F.M.A. and M.A. (Muhammad Abas); writing—review and editing, M.A. (Mohammed Alkahtani) and A.F.; supervision, F.M.A.; M.A. (Mohammed Alkahtani); project administration, F.M.A.; funding acquisition, M.A. (Mohammed Alkahtani). All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Researchers Supporting Project Number (RSP2024R274), King Saud University, Riyadh, Saudi Arabia.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are available upon request.

Acknowledgments: The authors would like to thank the Researchers Supporting Project Number (RSP2024R274), King Saud University, Riyadh, Saudi Arabia for funding this research work.

Conflicts of Interest: The authors declare no conflicts of interest.

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