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Assessment and Prioritization of Contractor Internal Schedule Delay Risks in Phnom Penh High-Rise Building Projects Using Relative Importance Index Method

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Abstract

The rapid expansion of high-rise building projects in Phnom Penh has been accompanied by persistent schedule delays that significantly impact project performance. While external factors are often emphasized, contractor internal risks represent controllable factors requiring systematic assessment and prioritization. This study aims to identify and prioritize contractor internal delay risk factors in high-rise building projects in Phnom Penh through quantitative analysis of expert perceptions. A mixed-methods approach was employed, combining qualitative data collection through structured questionnaires with quantitative analysis using the Relative Importance Index (RII). Data were collected from 97 construction professionals involved in high-rise projects (exceeding 10 floors) in Phnom Penh during 2020–2025. Seventeen internal risk factors were assessed across probability (RII-P) and impact (RII-I) dimensions. Analysis identified three critical risks with Risk Scores ≥ 0.60: Poor Planning and Scheduling (RII-P: 0.81, RII-I: 0.83, Risk Score: 0.68), Cash Flow Problems (RII-P: 0.76, RII-I: 0.83, Risk Score: 0.64), and Ineffective Monitoring and Control (RII-P: 0.79, RII-I: 0.79, Risk Score: 0.62). Fourteen additional risks were classified as Medium Priority (Risk Scores: 0.46–0.56). Managerial and financial factors dominate internal delay risks in Phnom Penh's high-rise construction, suggesting contractors should prioritize planning systems, financial management, and monitoring controls to improve schedule performance. These findings have implications for similar developing construction markets, particularly in Indonesia.

Introduction

The construction industry in Phnom Penh has undergone remarkable transformation over the past decade, characterized by an unprecedented surge in high-rise building developments that have reshaped the urban landscape. This construction boom aligns with Cambodia's broader economic growth trajectory, driven by foreign direct investment, urbanization pressures, and increasing demand for modern residential and commercial facilities (World Bank, 2022). However, this rapid development has exposed systemic challenges in project delivery, particularly concerning schedule performance and timely completion of construction projects (Latif et al., 2023; Husain, 2024; Koya, 2025; Oluwaseum & Mogaka, 2025). Schedule delays in construction projects represent a persistent and costly challenge with far-reaching implications for project stakeholders (Oluwaseum & Mogaka, 2025; Koya, 2025; Alemu &

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Thakur, 2026). Research indicates that delays contribute to significant cost overruns, contractual disputes, opportunity costs, and strained relationships among project participants (Assaf & Al-Hejji, 2006). In high-rise building projects, the complexity is amplified by multiple factors including technical sophistication, intensive resource requirements, extensive subcontractor networks, and challenging site logistics. These characteristics make high-rise projects particularly vulnerable to schedule disruptions, with delays often cascading through interdependent activities and magnifying their impact on overall project performance (Abaza & Kisi, 2024; Michael, 2025; Duale et al., 2025; Haque & Mathur, 2025).

Extensive literature has documented various causes of construction delays across different geographical and sectoral contexts. Previous studies have identified external factors such as adverse weather conditions, regulatory approval processes, utility service disruptions, and material supply chain issues as significant contributors to schedule delays (Sambasivan & Soon, 2007). However, a growing body of research suggests that contractor internal factors those within the direct control or influence of contracting organizations represent equally, if not more, critical sources of delay, particularly in developing country contexts (Doloi et al., 2012; Kaming et al., 1997). These internal factors encompass planning deficiencies, financial management challenges, human resource limitations, equipment mismanagement, and coordination failures among project teams.

The distinction between external and internal risk factors carries important implications for risk management practice (Balaji et al., 2024; Goni et al., 2024; Seyed et al., 2023). While external factors often require adaptive or reactive strategies, internal factors present opportunities for proactive control and systematic improvement (Huang, 2025). This is particularly relevant for contractors operating in emerging construction markets like Cambodia, where organizational capacity and management systems may still be developing alongside rapid industry growth (Cvetković et al., 2024; Swalih et al., 2024; Battaglia et al., 2025). By focusing on controllable internal factors, contractors can implement targeted interventions that yield tangible improvements in schedule performance without relying on external environmental changes (Annamalah et al., 2025; Siamuzwe et al., 2024; Warren et al., 2025).

Despite the acknowledged importance of contractor internal factors, empirical research specifically addressing these risks in the Cambodian construction context remains limited. Existing studies on Southeast Asian construction delays have predominantly focused on more established markets such as Indonesia, Malaysia, Thailand, and Vietnam (Le-Hoai et al., 2008; Kaming et al., 1997). The unique characteristics of Cambodia's construction industry including its rapid growth trajectory, regulatory environment, labor market conditions, and level of technological adoption suggest that risk profiles may differ from those in neighboring countries. This research gap limits evidence-based decision-making for contractors operating in Phnom Penh's high-rise construction sector, potentially leading to inefficient resource allocation and suboptimal risk mitigation strategies.

This study addresses this gap by conducting a systematic assessment and prioritization of contractor internal schedule delay risks in high-rise building projects in Phnom Penh (Vahedi et al., 2024; Nwal et al., 2024; Min et al., 2025). The research employs the Relative Importance Index (RII) method a well-established technique in construction management research to quantify expert perceptions and establish risk priorities based on both probability of occurrence and impact on schedule performance (Frimpong et al., 2003; Yap, 2023; El Khatib, 2025;). By applying this methodological approach in the specific context of Phnom Penh's high-rise construction sector, this study contributes to both academic knowledge and

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practical risk management in developing construction markets (He, 2024; Saeed, 2025; Cubillos et al., 2024).

The specific objectives of this research are threefold: first, to identify key contractor internal risk factors contributing to schedule delays in Phnom Penh high-rise building projects; second, to prioritize these risk factors based on their perceived importance among construction professionals; and third, to derive practical recommendations for risk mitigation that can enhance schedule performance in similar developing construction markets, with particular relevance to the Indonesian context given the academic affiliation of the researchers.

The findings of this study have significant implications for construction practice and project management in developing economies. By identifying and prioritizing the most critical internal delay risks, contractors can allocate limited resources more effectively, develop targeted risk mitigation strategies, and improve overall project delivery performance. Furthermore, the methodological approach demonstrated in this research provides a replicable framework for risk assessment in other emerging construction markets facing similar challenges.

Methods

This study employed a mixed-methods research design that integrated qualitative data collection with quantitative analysis techniques. The methodological approach was structured into three sequential phases: (1) risk identification and instrument development, (2) data collection through expert survey, and (3) quantitative analysis using the Relative Importance Index (RII) method. This integrated approach allowed for comprehensive assessment of contractor internal delay risks while maintaining methodological rigor appropriate for construction management research.

Risk Identification and Instrument Development

The risk identification process commenced with an extensive review of construction delay literature, with particular emphasis on studies conducted in Southeast Asian developing markets (Assaf & Al-Hejji, 2006; Sambasivan & Soon, 2007). This literature review identified 47 potential delay factors from previous research across various construction contexts. Through iterative content analysis and synthesis, these factors were refined and consolidated to focus specifically on contractor internal risks those within the direct control or influence of contracting organizations.

The refined risk factors were organized into a structured Risk Breakdown Structure (RBS) comprising 17 distinct internal risk variables (Tadayon et al., 2012). These factors were systematically categorized into six thematic groups to facilitate comprehensive assessment: (1) Planning and Management (encompassing scheduling, monitoring, and coordination aspects), (2) Financial Resources (addressing cash flow, working capital, and payment issues), (3) Human Resources (covering workforce skills, productivity, and supervision), (4) Contractor Management (including site management, communication, and decision-making), (5) Subcontractor and Supply Chain (addressing coordination, performance, and integration challenges), and (6) Equipment and Logistics (covering availability, maintenance, and utilization aspects).

A structured questionnaire was developed to operationalize the risk assessment. The instrument utilized a 5-point Likert scale to measure two critical dimensions for each risk factor: probability of occurrence (ranging from 1 = very unlikely to 5 = very likely) and impact on project schedule (ranging from 1 = very low impact to 5 = very high impact). This dual

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assessment approach aligns with established risk management frameworks that consider both likelihood and consequences in risk evaluation (Zavadskas et al., 2010).

Instrument validity was established through multiple approaches. Content validity was assessed through expert review by three construction management academics with research experience in Southeast Asian construction and two senior project managers with over 15 years of practical experience in Cambodian construction projects (Famiyeh et al., 2017). These experts evaluated the relevance, clarity, and comprehensiveness of the questionnaire items, resulting in minor refinements to improve contextual appropriateness. A pilot test was conducted with 10 construction professionals not included in the final sample to assess instrument reliability and identify potential issues with question interpretation or response patterns.

Sampling and Data Collection

The target population for this study comprised construction professionals actively involved in high-rise building projects (defined as structures exceeding 10 floors) in Phnom Penh during the period 2020–2025. The sampling frame included professionals in key roles influencing project schedule performance: project managers, site engineers, planning engineers, construction managers, and quantity surveyors. Both local Cambodian contractors and international firms operating in Phnom Penh were included to capture diverse perspectives and experiences.

Sample size determination followed established practices for construction management survey research. The Slovin formula was applied to determine minimum sample requirements:

$$n = \frac{N}{1 + N(e)^2}, e$$

Where N represents the estimated population of qualified professionals (approximately 250 based on construction industry associations and professional networks), e is the margin of error (set at 10% for exploratory research), yielding a minimum sample size of 71 respondents. The target was set at 120 to account for potential non-response, with actual data collection yielding 97 valid responses representing an 80.8% response rate. This sample size exceeds minimum requirements and provides adequate statistical power for the intended analyses (Kaliba et al., 2009).

Purposive sampling techniques were employed to ensure respondents possessed relevant experience with high-rise construction projects in Phnom Penh. Inclusion criteria required minimum professional experience of three years in construction and direct involvement in at least one high-rise project completed or ongoing during the study period. Data collection was conducted through both online survey platforms and in-person distribution to accommodate respondent preferences and maximize participation rates.

Ethical considerations were carefully addressed throughout the research process. All participants received informed consent information explaining the study purpose, data usage, confidentiality protections, and voluntary participation principles. Data anonymity was maintained through coding procedures that separated identifying information from substantive responses. Institutional research ethics guidelines were followed throughout the study design and implementation.

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Data Analysis

Quantitative analysis of the collected data employed the Relative Importance Index (RII) method, a well-established technique in construction management research for prioritizing risk factors based on expert perceptions (Frimpong et al., 2003). The RII was calculated separately for two dimensions: probability of occurrence (RII_p) and impact on schedule (RII_i), using the following formula:

$$RII_P = \frac{\sum W_P}{A_P \times N}$$

$$RII_I = \frac{\sum W_I}{A_I \times N}$$

Where:

$\sum W_P$	=	total weighted score for probability
$\sum W_I$	=	total weighted score for impact
$A_P = 5$	=	highest possible probability rating
$A_I = 5$	=	highest possible impact
$N = 97$	=	number of respondents

The combined Risk Score ($\boldsymbol{RS}$) for each factor was computed as the product of probability and impact indices:

$$\text{Risk Score} = RII_P \times RII_I$$

This multiplicative approach provides an integrated measure of each risk factor's overall significance, appropriately weighting factors that score highly on both dimensions (Memon et al., 2013). The resulting Risk Scores range from 0 to 1, with higher values indicating greater perceived importance.

Risk factors were ranked based on their calculated Risk Scores and categorized into three priority levels following established thresholds in construction risk assessment literature:

High Priority: $RS \geq 0.60$

Medium Priority: $0.40 \leq RS < 0.60$

Low Priority: $RS < 0.40$

Additional statistical analyses were conducted to ensure robustness of findings. Descriptive statistics including means, standard deviations, and frequency distributions were calculated for all variables. Reliability analysis using Cronbach's alpha assessed internal consistency of the measurement scales. Cross-tabulation analyses explored potential variations in risk perceptions based on respondent characteristics such as professional role, years of experience, and type of employing organization (local vs. international contractor).

Results and Discussion

Respondent Demographics and Characteristics

The demographic profile of respondents revealed a sample with substantial experience and relevant involvement in Phnom Penh high-rise construction. As presented in Table 1, the majority of respondents (42.3%) possessed more than 10 years of construction experience, with an additional 38.1% having 5–10 years of experience. This distribution indicates that

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assessments were provided by professionals with considerable industry exposure and contextual understanding.

Table 1. Demographic Characteristics of Respondents (N=97

Characteristic	Category	Frequency	Percentage
Professional Experience	>10 years	41	42.3%
	5–10 years	37	38.1%
	3–5 years	19	19.6%
Primary Role	Project Manager	34	35.1%
	Site Engineer	28	28.9%
	Planning Engineer	20	20.6%
	Other Managerial	15	15.4%
Organization Type	Local Contractor	58	59.8%
	International Contractor	39	40.2%
Highest Project Involvement	>5 high-rise projects	32	33.0%
	3–5 high-rise projects	45	46.4%
	1–2 high-rise projects	20	20.6%

Source: Field Survey Data Analysis, 2025

Regarding professional roles, project managers constituted the largest group (35.1%), followed by site engineers (28.9%) and planning engineers (20.6%). This distribution ensures representation from key decision-making positions responsible for schedule management. In terms of organizational affiliation, 59.8% of respondents worked for local Cambodian contractors while 40.2% were employed by international firms, providing balanced perspectives from different organizational contexts.

Relative Importance Index Analysis Results

The RII analysis produced clear prioritization of the 17 contractor internal risk factors, with substantial variation in perceived importance across different factors. Table 2 presents the complete ranking based on combined Risk Scores, which integrate assessments of both probability and impact dimensions.

Table 2. Complete Ranking of Contractor Internal Delay Risks Based on RII Analysis

Ranking	Sub-Category	Risk Factor (Variable)	RII (P)	RII (I)	Risk Score	Risk Level
1	Project Planning & Management	Poor planning and scheduling	0.81	0.83	0.68	High
2	Financial & Resources	Cash flow problems	0.76	0.83	0.64	High
3	Project Planning & Management	Ineffective monitoring and control	0.79	0.79	0.62	High
4	Subcontractor & Supply Chain	Delay in subcontractor works	0.75	0.75	0.56	Medium
5	Project Planning & Management	Inadequate project management practices	0.74	0.74	0.55	Medium
6	Human Resources	Low productivity	0.74	0.74	0.54	Medium

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7	Human Resources	Shortage of skilled labor	0.73	0.74	0.54	Medium
8	Subcontractor & Supply Chain	Poor coordination with subcontractors	0.72	0.72	0.52	Medium
9	Financial & Resources	Resource misallocation	0.72	0.72	0.52	Medium
10	Contractor Management	Lack of experience in similar projects	0.72	0.71	0.51	Medium
11	Contractor Management	Poor safety practices	0.70	0.71	0.50	Medium
12	Equipment & Logistics	Inadequate plant and machinery	0.71	0.70	0.50	Medium
13	Subcontractor & Supply Chain	Supplier unreliability	0.69	0.68	0.47	Medium
14	Equipment & Logistics	Poor logistics planning	0.69	0.68	0.47	Medium
15	Equipment & Logistics	Equipment breakdown	0.70	0.66	0.46	Medium
16	Human Resources	High labor turnover	0.68	0.67	0.46	Medium
17	Contractor Management	Poor site management	0.68	0.67	0.46	Medium

Source: Field Survey Data Analysis, 2025

The analysis identified three risk factors in the High Priority category (Risk Score ≥ 0.60): poor planning and scheduling (RS=0.68), cash flow problems (RS=0.64), and ineffective monitoring and control (RS=0.62). These factors significantly outperformed others in both probability and impact dimensions, indicating their critical importance in causing schedule delays. The Medium Priority category contained all remaining 14 factors with Risk Scores between 0.46 and 0.56. Notably, no factors fell into the Low Priority category (RS < 0.46), suggesting that all identified risks were perceived as having at least moderate importance in the Phnom Penh context.

Analysis of High Priority Risks

Poor planning and scheduling emerged as the most critical risk factor with the highest combined score (RS=0.68). Respondents consistently rated this factor high in both probability (RII_p=0.81) and impact (RII_i=0.83), suggesting that inadequate planning is both common and detrimental to schedule performance. Qualitative comments from respondents indicated that planning deficiencies often manifest as unrealistic project timelines, insufficient detail in work breakdown structures, inadequate consideration of activity interdependencies, and weak progress monitoring systems.

Cash flow problems ranked second (RS=0.64) with particularly high impact assessment (RII_i=0.83) indicating that financial constraints are perceived as having severe consequences when they occur. The probability rating (RII_p=0.76) suggests that cash flow issues are relatively common in Phnom Penh high-rise projects. Respondent feedback highlighted specific manifestations including delayed progress payments, inadequate working capital, irregular payment cycles to subcontractors and suppliers, and limited access to financing options for capital-intensive high-rise construction.

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Ineffective monitoring and control ranked third (RS=0.62) with balanced ratings for both probability (RII_p=0.79) and impact (RII_i=0.79). This finding indicates that while project monitoring systems may be in place, their effectiveness in controlling schedule deviations is perceived as inadequate. Respondents noted issues with irregular progress tracking, delayed problem identification, and insufficient corrective actions when schedule variances occur.

Analysis of Medium Priority Risks

The top medium priority risks (ranking 4–9) showed distinctive patterns in their probability-impact profiles. Delay in subcontractor works (RS=0.56) demonstrated moderate but equal probability and impact ratings (RII_p=0.75, RII_i=0.75), indicating balanced concerns about both occurrence likelihood and consequences. This reflects the critical role of specialized subcontractors in high-rise construction and the cascading effects of their performance on overall project schedules.

Inadequate project management practices (RS=0.55) and low productivity (RS=0.54) showed similar importance levels, suggesting interconnected challenges in management effectiveness and workforce performance. Respondent comments frequently mentioned issues with management competency, decision-making processes, workforce skill levels, inadequate supervision, insufficient training programs, and motivational challenges as contributors to these problems.

Shortage of skilled labor (RS=0.54) and poor coordination with subcontractors (RS=0.52) completed the top eight medium priority risks, highlighting human resource and coordination challenges specific to the Phnom Penh construction environment. These factors represent systemic issues that may require industry-wide interventions beyond individual contractor efforts.

Category-Level Analysis

Aggregating individual risk factors at the category level reveals important patterns in perceived risk importance. As shown in Table 3, Project Planning & Management risks dominate the high-priority rankings, with all three high-priority risks originating from this category. Financial risks also show significant importance, particularly cash flow problems which ranked second overall.

Table 3. Category-Level Analysis of Risk Scores

Category	Number of Risks	Average Risk Score	Highest Risk in Category	Lowest Risk in Category
Project Planning & Management	3	0.62	Poor planning and scheduling (0.68)	Inadequate project management practices (0.55)
Financial & Resources	2	0.58	Cash flow problems (0.64)	Resource misallocation (0.52)
Subcontractor & Supply Chain	3	0.52	Delay in subcontractor works (0.56)	Supplier unreliability (0.47)
Human Resources	3	0.51	Low productivity (0.54)	High labor turnover (0.46)
Equipment & Logistics	3	0.48	Inadequate plant and machinery (0.50)	Equipment breakdown (0.46)

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Contractor Management	3	0.49	Lack of experience (0.51)	Poor site management (0.46)

This pattern suggests that construction professionals in Phnom Penh perceive management and organizational factors as more critical to schedule performance than purely technical factors. The high importance assigned to planning and financial management reflects both the complexity of high-rise construction and potential systemic challenges in Cambodia's construction industry development.

Reliability and Consistency Analysis

Instrument reliability was assessed using Cronbach's alpha coefficient for the measurement scales. The probability assessment scale achieved $\alpha = 0.812$, while the impact assessment scale achieved $\alpha = 0.829$, both exceeding the conventional threshold of 0.70 for acceptable internal consistency (Nunnally, 1978). These results indicate that the measurement instrument produced consistent responses across related items.

Consistency of risk perceptions across different respondent groups was examined through subgroup analyses. While minor variations existed in absolute scores, the relative ranking of risk factors remained remarkably stable across subgroups defined by professional role, years of experience, and organizational type. This consistency enhances confidence in the generalizability of the findings within the Phnom Penh high-rise construction context.

Interpretation of Critical Risk Factors

The dominance of planning and control-related risks in the top three positions aligns with established project management literature emphasizing the foundational importance of planning and monitoring in project success (Assaf & Al-Hejji, 2006). However, the specific configuration of risks in the Phnom Penh context reveals distinctive challenges. The exceptionally high scores for poor planning (RS=0.68) and ineffective monitoring (RS=0.62) suggest potential gaps in both planning quality and execution control that may differ from more mature construction markets.

The high impact ratings for these factors (RII_i=0.83 for planning, 0.79 for monitoring) indicate that respondents perceive deficiencies in these areas as having cascading effects throughout project execution. This aligns with systems thinking perspectives in construction management that identify planning and control as root causes influencing multiple downstream performance issues (Yang & Ou, 2008). The finding suggests that investments in planning and monitoring capacity including training, tools, and dedicated resources may yield disproportionate benefits for schedule performance in Phnom Penh's high-rise construction sector.

The prominence of cash flow problems as the second highest risk (RS=0.64) reflects the financial dynamics of Cambodia's construction industry and the capital-intensive nature of high-rise projects. Unlike more established markets with stable payment systems, diversified financing options, and mature credit markets, Phnom Penh's construction sector may face challenges related to delayed progress payments, limited access to construction financing, volatile material costs affecting budget stability, and working capital constraints particularly affecting small and medium-sized contractors (World Bank, 2022).

The high impact rating for financial risks (RII_i=0.83) underscores the fundamental importance of financial stability for construction operations. This finding has significant implications for contractor selection processes, project financing arrangements, and payment term negotiations. Contractors operating in this environment likely need to develop robust financial management systems, maintain adequate working capital reserves, establish contingency

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plans for payment delays, and potentially explore alternative financing mechanisms to mitigate cash flow risks, consistent with recommendations by Famiyeh et al. (2017) for construction projects in developing economies.

Subcontractor and Coordination Challenges

The significant ranking of subcontractor-related risks (positions 4 and 8) highlights the increasing complexity and specialization in high-rise construction. Modern high-rise buildings incorporate numerous specialized systems (structural, mechanical, electrical, plumbing, facade, etc.) requiring coordination among multiple specialized subcontractors (Doloi et al., 2012). The moderate probability but substantial impact profile of these risks suggests that subcontractor issues, while not universal, create significant schedule disruptions when they occur due to activity interdependencies and critical path implications. This finding points to potential opportunities for improving subcontractor management practices in Phnom Penh's high-rise construction sector. Recommended approaches might include more rigorous subcontractor prequalification processes, clearer contract terms specifying performance expectations and liquidated damages, enhanced coordination mechanisms such as regular interface meetings and integrated scheduling, and performance monitoring systems with early warning indicators for subcontractor delays. These practices align with international best practices in subcontractor management while requiring adaptation to the specific contractual and relational norms of the Cambodian construction context.

Human Resource and Productivity Considerations

The identification of productivity and skill-related risks in positions 6 and 7 reflects broader human resource challenges in Cambodia's construction industry. Rapid industry growth may have outstripped the development of skilled workforce capacity, training infrastructure, and supervisory expertise. The balanced probability-impact profiles suggest that these issues represent both frequent occurrences and significant constraints on project schedules.

This finding has implications for contractor strategies regarding workforce development, supervision systems, and productivity enhancement. Contractors investing in targeted training programs, structured supervision systems, productivity measurement and feedback mechanisms, and workforce motivation approaches may gain competitive advantages through improved schedule performance. These approaches support Kaming et al.'s (1997) emphasis on human resource development as a critical success factor in Southeast Asian construction, while requiring adaptation to Cambodia's specific labor market conditions, skill availability, and regulatory environment.

Managerial vs. Technical Risk Priorities

he concentration of high-priority risks in managerial, financial, and planning categories, with technical and equipment factors generally ranking lower (positions 12-17), suggests an important evolution in risk perceptions within Phnom Penh's construction sector. While earlier studies in developing countries often emphasized technical deficiencies and equipment limitations as primary delay causes (Odeh & Battaineh, 2002), this study's findings suggest that as construction industries mature and technical capabilities develop, managerial and organizational factors may become the binding constraints on performance improvement.

This pattern has important implications for contractor development strategies and industry capacity building initiatives. Rather than focusing primarily on technical skills and equipment acquisition, contractors may need to prioritize management system development, financial management capabilities, planning expertise, and organizational learning mechanisms. This reorientation aligns with broader trends in construction industry development where

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managerial innovation increasingly drives performance differentiation as technical capabilities become more widespread.

Comparative Analysis with Regional Contexts

Comparative analysis with similar studies in neighboring Southeast Asian countries reveals both similarities and instructive differences. Planning deficiencies consistently rank high across regional construction markets (Le-Hoai et al., 2008; Sambasivan & Soon, 2007), confirming their universal importance in construction project management. However, the specific prominence of monitoring and control issues in the Cambodian context may reflect particular challenges in project execution management that differ from neighboring countries.

Financial risks appear more prominent in the Cambodian context compared to some neighboring countries, possibly reflecting differences in payment practices, banking system development, contractor financial management capabilities, and macroeconomic stability. The relatively lower ranking of equipment-related risks compared to earlier studies in similar development contexts may indicate progress in equipment availability and management in Phnom Penh's construction sector. This potential improvement could result from increased equipment imports, rental market development, contractor capital accumulation, or technology transfer through international joint ventures and partnerships.

Implications for Risk Management Practice

The risk prioritization established in this study provides empirical basis for targeted resource allocation in contractor risk management programs. Rather than spreading limited resources thinly across all potential risks, contractors can achieve more efficient risk reduction by focusing on the high-priority areas identified. Specific implications include:

Planning and Control System Enhancement: Development of robust planning processes, adoption of appropriate planning and monitoring tools, allocation of adequate planning resources, and implementation of systematic progress monitoring and control mechanisms with timely corrective actions. Financial Management Strengthening: Improvement of cash flow forecasting and management systems, development of payment assurance mechanisms, establishment of working capital reserves, and exploration of financing alternatives suitable for high-rise construction.

Subcontractor Coordination Improvement: Implementation of structured subcontractor management systems including prequalification, contract management, coordination mechanisms, and performance monitoring approaches. Productivity and Skill Enhancement Initiatives: Investment in workforce training and development, implementation of productivity measurement systems, improvement of supervision practices, and development of motivational approaches appropriate to the local context.

Methodological Contributions and Limitations

The application of the RII method in this specific context demonstrates its utility for risk assessment in emerging construction markets with limited historical data availability. By synthesizing expert judgment, this approach provides actionable insights even when statistical analysis of delay causes is not feasible due to data limitations (Frimpong et al., 2003). The methodological approach demonstrated here could be replicated in similar contexts to support evidence-based risk management in developing construction industries.

However, several methodological limitations warrant consideration. The reliance on expert perceptions introduces potential subjectivity in risk assessment, though this was mitigated through adequate sample size, diverse respondent profiles, and consistency checks. The focus

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solely on contractor internal risks, while providing detailed insights into controllable factors, excludes potential interactions with external risks that may amplify or mitigate internal risk impacts. Future research could benefit from integrated frameworks considering both internal and external risk factors and their interactions.

The geographical limitation to Phnom Penh, while providing specific contextual insights, may limit direct generalizability to other Cambodian cities or different types of construction projects. Comparative studies across different locations and project types could enrich understanding of how risk profiles vary with contextual factors. Additionally, the cross-sectional nature of the study provides a snapshot of risk perceptions at a particular time, while longitudinal approaches could track how risk perceptions evolve with industry development and experience accumulation.

Conclusion

This study has systematically identified and prioritized contractor internal schedule delay risks in Phnom Penh high-rise building projects using the Relative Importance Index method. The findings reveal that planning deficiencies, financial constraints, and ineffective monitoring represent the most critical internal risks, followed by subcontractor coordination challenges and productivity issues. The prioritization provides empirical evidence to guide resource allocation for risk mitigation, addressing a significant gap in understanding of construction delays in Cambodia's rapidly developing construction market. The results indicate that managerial and organizational factors dominate internal delay risks in Phnom Penh's high-rise construction sector, suggesting that contractors' capacity development efforts should prioritize management systems, financial capabilities, and coordination mechanisms alongside technical skills and equipment. This pattern reflects potential maturation in Cambodia's construction industry where managerial innovation may increasingly drive performance differentiation as technical capabilities become more widespread. The methodological approach demonstrated in this research combining structured expert surveys with RII analysis provides a replicable framework for risk assessment in similar emerging construction markets facing data limitations and rapid industry transformation. The findings contribute to both academic knowledge on construction risk management in developing contexts and practical guidance for contractors seeking to improve schedule performance in challenging market environments.

Recommendations

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