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Assessment of Risk Factors to Cost and Schedule in High-Rise Building Projects

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Gunes Bardakci is a senior construction manager at AECOM with a special focus on high-rise buildings, joining the company in 2013. Throughout his career, he has managed complex and large-scale construction operations successfully in various regions. Bardakci has overseen all phases of high-rise building construction. He has a civil engineering background with PMP certification, and holds two master's degrees in the fields of construction management and project management. His dissertation project at Salford University assessed the risk factors to cost and schedule overruns in high-rise building projects.

Abstract

High-rise projects routinely suffer from delays and cost overruns, which can result in severe economic consequences, or even failure to complete. The lack of risk assessment, from the perspective of project management, is one of the key contributors to the problem. This research aims to assess the risk factors to high-rise building construction in the Commonwealth of Independent States (CIS) region, focusing on Azerbaijan, Kazakhstan, and Russia. A total of 56 risk factors in four different categories were identified through an extensive literature review and interviews with high-rise professionals. The identified risks were analyzed and ranked separately in terms of time and cost impact. The relationships among critical risk factors in different groups were further investigated, based on key variables, to minimize subjectivity, and to improve understanding of the perception of the risk ratings of 72 respondents. Risk-response plans to the top seven high-ranking risks are presented, based on the literature review and professionals' contributions.

Keywords: Construction Delays, Cost Overruns, Risk Assessment

Introduction

The construction industry plays an extremely important role in many countries' economies. As such, while construction projects significantly contribute to national economic development when successfully completed, these projects may tremendously jeopardize those economies when they fail (Shah 2016). Therefore, it is vital to minimize or avoid negative risks and complete projects on time, within budget and at the desired level of quality and safety, which can be summarized as key success indicators (Patil & Bhangale 2016).

Although the risks are inherent in every construction project, effective risk management is much more crucial for the success of high-rise projects, because of their high level of complexity, special technical requirements, and degree of uncertainty over long time periods (Santoso, Ogunlana & Minato 2003). Failure to analyze risk and develop response models in the early stages of high-rise construction projects can lead to mission-critical delays and cost overruns (Basari 2017; Sakthiniveditha & Pradeep 2015).

Overview of the Research

This research examines the implementation of risk management processes to minimize delays and cost overruns for high-rise building projects.

The primary aim of this research is to assess the risk factors that cause delays and cost overruns in high-rise building construction projects in the Confederation of Independent States (CIS) region, encompassing Azerbaijan, Kazakhstan, and Russia. Objectives include:

> "Although contractors' high ranking of 'delayed payments by the client' may have been anticipated, the risk of an 'unrealistic duration imposed by the client' was surprisingly the lowest-ranked by contractors."

1. Appraising the major risks that cause delay and cost overruns in high-rise building construction;
2. Analyzing the risks, using the probability-impact method, and ranking them;
3. Developing risk-response plans for the highest-ranking risks;
4. Investigating the relationship among the critical risk factors, and other variables

Significance of the Research

In the CIS region countries, investment in the construction of tall and supertall buildings has been increasing. Ongoing construction of the Abu Dhabi Plaza in Nur-Sultan, Kazakhstan (310 meters); the recent completion of Lakhta Center (462 meters) in St. Petersburg, Russia; and the under-construction Crescent City (210 meters) and Baku Tower (276 meters) projects in Baku, Azerbaijan, illustrate rising interest in and development of high-rise towers in the CIS region (CTBUH Skyscraper Center 2020).

This research investigates the problems regarding the construction of high-rise buildings, and presents the methods of managing the risks in the CIS region, with a specific focus on the countries of Kazakhstan, Russia and Azerbaijan. An exhaustive literature review found no research that addressed the assessment of cost and schedule risk factors to high-rise buildings within the CIS countries.

Overview of External Risk Factors in the CIS Countries

Investigation and analysis of the external factors for each country is extremely important to assessing the risks that can significantly contribute to delays and cost overruns for high-rise building projects. Political, economic, social, technological, environmental, and legal (PESTEL) factor analysis will be performed (Rastogi & Trivedi 2016). In addition to a literature review, key information provided by the respondents to the researcher's survey were also used in the PESTEL analysis.

Factor	Details
Political Factors	Inefficient government bureaucracy, corruption, poor work ethic in national labor force, government and policy instability are the most problematic factors for business. Political conflict between Armenia and Azerbaijan is a factor.
Economic Factors	GDP: US$37.6 billion GDP per capita: US$3956.50 Inflation rate: 12.4% Total tax rate is 39.8% Currency: Manat (AZN) • Poor access to financing, foreign currency regulations, exchange rates, tax regulations and inflation are the most problematic factors.
Social Factors	Population: 9.4 million Higher education and training rank: 68/137 Local availability of specialized training services: 44/137 • English is not widely spoken among the local workforce. • The inadequately educated workforce is a main problematic factor.
Technological Factors	Technological readiness: 56/137 Quality of scientific research institutions: 48/137 Availability of scientists and engineers: 37/137 Quality of electrical supply: 50/137 Overall quality of infrastructure: 51/137 • Procurement of special equipment and building materials is one of the biggest challenges related to construction. • Electricity supply can be unreliable.
Environmental Factors	Ease of cross-border trade: 83/190 • Baku is called "wind city", due to extremely windy weather, and is located in a potential earthquake zone.
Legal Factors	Reliance on professional management: 46/137 Strength of auditing and reporting standards: 86/137 Ease of obtaining construction permits: 161/190 • Insufficient building codes and standards for high-rise projects. • Tax regulations, restrictive labor regulations, low legal rights index, high rates of crime and theft are also highly problematic factors.

Table 1. PESTEL Analysis for potential external risk factors in Azerbaijan. Country ranks are indicated, where applicable, followed by other factors in each category. Sources: Schwap, 2017; The World Bank, 2018; Jeong et al. 2015; Countryeconomy, 2018

Azerbaijan

After Azerbaijan's independence from the Soviet Union in 1991, the country's economic growth and stability have driven high-rise building development. Rapid growth in the economy and an increase in the population accompanying an oil boom induced Baku, the capital of Azerbaijan, to develop master plans with the central government's support, calling for high-rise commercial and residential buildings along the Caspian Sea, despite the potential earthquake threats and notoriously strong winds (Jeong, Eu, Roh & Sim 2015). For an effective risk management implementation, identification of external risk factors is a vital step which may vary from one country to another. Table 1 represents PESTEL analysis of external factors in Azerbaijan.

Russia

Russia, as a member of the BRICS (Brazil, Russia, India, China, and South Africa) group with its emerging economy, commenced a new period of development of high-rise building construction projects in the 2000s. With the boom in high-rise construction, more than 50 buildings of 150 meters' or greater height have been completed in Russia (CTBUH Skyscraper Center 2020). PESTEL analysis for Russia is found in Table 2.

Kazakhstan

According to the Organization for Economic Cooperation and Development (OECD) (2014), "Over the past two decades, Kazakhstan has emerged as one of the most developed countries in the Central Asia and South Caucasus region. Due to its rich natural resources, it has one of the world's fastest-growing economies and attracts more foreign direct investment

Factor	Details
Political Factors	Corruption is the most problematic factor for doing business; inefficient government bureaucracy, government and policy instability are the other most problematic factors. The government has strict restrictions for high-rise buildings' locations and height. Significant restrictions exist regarding maintenance of historical views in cities such as St. Petersburg.
Economic Factors	GDP is US$1.28 trillion GDP per capita: US$8928.70 Inflation rate: up to 7% Currency: Ruble (RUB) • Tax rates and regulations, access to financing, inflation and foreign currency regulations are the most problematic factors for doing business.
Social Factors	Population:143.4 million Higher education and training rank: 32/137 • English is not widely spoken in the country. • An inadequately educated workforce, crime and theft are most problematic factors for business. • Labor-employer relations are weak.
Technological Factors	Technological readiness: 57/137 Quality of scientific research institutions: 41/137 Availability of scientists and engineers: 50/137 Quality of electrical supply is ranked in 59/137 Overall quality of infrastructure ranked in 74/137 • Difficulty of supplying high-quality building materials and modern building technology. • Insufficient capacity to innovate.
Environmental Factors	• There is a lack of precision in geological and geomorphic research and monitoring. • Extreme cold and windy weather prevails in many regions.
Legal Factors	• Ease of obtaining construction permits: 115/190 • Insufficient building regulations/standard/codes for high-rise construction. • SNIP (construction rules and regulations) are not fully adequate for high-rise towers. • Federal legislation and state standards (GOST) do not fulfill high-rise safety requirements.

Table 2. PESTEL Analysis of potential external risk factors in Russia. Country ranks are indicated, where applicable, followed by other factors in each category. Sources: Schwap, 2017; The World Bank, 2018; Shuvalova, 2015; Harris, 2016; Lavrov & Perov, 2016; Countryeconomy, 2018

Factor	Details
Political Factors	Corruption, policy and government instability, and inefficient government bureaucracy are most problematic factors for doing business.
Economic Factors	GDP: US$133.8 billion GDP per capita: US$7,452.80 Inflation rate: up to 14.6% Currency: Tenge (KZT) • Tax rates and regulations, access to financing, inflation and foreign currency regulations are the most problematic factors for doing business.
Social Factors	Population: 17.9 million Higher education and training index: 56/137 • English is not widely spoken in the country. • Inadequately educated workforce, poor work ethic and poor public health are the most problematic factors for business.
Technological Factors	Technological readiness: 52/137 Quality of scientific research institutions: 78/137 Availability of scientists and engineers: 66/137 Quality of electrical supply: 82/137 Overall quality of infrastructure: 77/137 • Local supplier quantities and quality are low. • There is difficulty finding high-quality building materials and modern building technology.
Environmental Factors	• Astana is the second-coldest capital in the world. • Astana faces intense, gusty winds and a high water table, with unstable soil. • Almaty is situated in a high seismic zone and has a high ratio of accumulated exhaust gases in the air.
Legal Factors	• Insufficient building regulations/standard/codes for high-rise constructions • SNIP code is used but not developed enough for high-rise construction. • Federal legislation does not fulfill all high-rise safety requirements. • Restrictive labor regulations.

Table 3. PESTEL Analysis for potential external risk factors in Kazakhstan. Country ranks are indicated, where applicable, followed by other factors in each category. Sources: Schwap, 2017; The World Bank, 2018; Kantchev, 2014; Countryeconomy, 2018

(FDI) than all the other countries in Central Asia together."

For assessing external factors for Kazakhstan, PESTEL analysis is performed and presented in Table 3.

Risk Analysis and Ranking

One of the main objectives is to analyze the risks presented in each country by using the probability and impact method and rank them; therefore, the research questionnaire was designed in a matrix format. In this exercise, the risk rating is equal to "probability times impact." The research comprises 56 established risk factors across four categories.

The main principle for analyzing the identified risks and ranking them was to calculate the risk rating value both for delays, which is formulated as "probability times impact on time"; and for cost overruns, which is equal to "probability times impact on cost."

An overall ranking analysis was performed among 56 risk factors (see Table 4); the results for the top seven highest-ranking risk factors contributing to construction delays and cost overruns are shown in Table 5. This is followed by a discussion of potential response plans for each factor.

Risk Response Plans

Risk (MR8): Hiring unqualified professionals/ subcontractors

Risk Response to (MR8): First, the project stakeholders (client, contractor and consultant) must comprise a pool of personnel with high-rise experience. Implement a well-structured prequalification process into the HR management plan for staff, and into the specifications for selection of subcontractors. The clauses regarding the personnel and subcontractor selection should be set forth in these specifications. The client should not be allowed to dictate that the contractor nominate a chosen subcontractor; nor should the contractor employ any

subcontractors that have not passed through a control process or project management team approval. Once contractors are hired, performance monitoring is an important aspect of minimizing the risk impact.

Risk (TR1): Poor coordination among the drawings of different trades

Risk Response to (TR1): An on-site design consultant should be assigned to cover coordination works between all disciplines. The consultant should be available at the early stages of the project to ensure transmission of coordinated drawings to the site once requested. Utilization of a coordinated building information model (BIM) throughout the project lifecycle by the professional team is essential, particularly for complex high-rise projects, as supported in the research of Ibrahim (2016). Ensure that all details are made available in a timely manner and approved by consultant(s) before commencement of construction. There should be clear and integrated milestones and design deliverables for every stakeholder. The process of obtaining client buy-in for changes at each stage should be managed closely.

Risk (MR13): Lack of cost control and cash-flow management integration into the program

Risk Response to (MR13): Develop resource and cost-loaded schedules to control cash flow based on the bill of quantities (BOQ). Requirements need to be outlined in detail and approved by key stakeholders. Costs should be monitored and forecast analyses should be performed. In case of any changes or alternatives, such as "what-if" scenarios, an accompanying cost assessment should be done.

Risk (ER1): Extreme weather conditions

Risk Response to (ER1): Risk of extreme weather needs to be accepted to some extent. Therefore, it is vital to incorporate realistic assumptions and consider the potential for downtime of cranes and external hoists while developing the baseline schedule. However, as a risk mitigation measure to minimize negative impacts, activities and

Risk Factor		Risk Factor Description
Technical Risks	TR1	Poor coordination among the drawings of different trades
	TR2	Lack of constructability analysis in the design for complex installations
	TR3	Poor fire strategy plan and fire details in specification documents
	TR4	Frequent change in special equipment or material specification
	TR5	Ambiguous and contradictory specification drawings
	TR6	Lack of coordination or underestimation of temporary works design and detailing for high-rise construction
	TR7	Concept and or schematic of MEP design, selection of equipment
	TR8	Poor soil investigation or unpredictable soil conditions due to extreme pressure and deep excavation req.
	TR9	Scope gap at interfaces
	TR10	Underestimation of the degree of the innovation, or incapability to innovate at initial design phase
	TR11	Faulty structural predictive study and underestimation of compensation/shortening
Management Risks	MR1	Inadequate planning and scheduling that misleads all stakeholders
	MR2	Lack of high-rise-experienced professionals/managers on the project
	MR3	Failure to meet planned cycle time of structural (concrete/steel) activities and façade
	MR4	Communication problem among stakeholders
	MR5	Lack of awareness or wrong selection of high-rise technology, systems and special instruments/equipment
	MR6	Lack of change control process (accepting imposed change by the client without analyzing)
	MR7	Slow decision-making process or clarification in case of any deviation from contract documents
	MR8	Hiring unqualified professionals/subcontractors onto the project
	MR9	Lack of knowledge in local regulatory requirements and associated coordination for high-rise construction
	MR10	Poor construction logistics and inadequate vertical transportation/crane hook time planning
	MR11	Delay in review of documents/drawings and passive approach by consultants
	MR12	Lack of planning for effective/sectional commissioning
	MR13	Lack of cost control and cash flow management integrated to the program
	MR14	Insufficient monitoring of resource productivity, key performance indicators and profitability
	MR15	Contractor's poor site management/supervision; defective rework
	MR16	Lack of risk management team and processes implementation, particularly risk monitoring and control
	MR17	Poor production and supply chain control
Commercial Risks	CR1	Delayed payment by the client
	CR2	Underestimation of project cost in the contract
	CR3	Unrealistic duration imposed by the client
	CR4	Wrong material cost estimation
	CR5	Lack of value engineering and constructability study at initiation phase
	CR6	Inadequate or poor tender process with contractor/subcontractors
	CR7	Underestimation of special consultancy requirements for high-rise construction
	CR8	Shortcomings in the measure and value process
	CR9	Delay in settling claims and contractual disputes
	CR10	Underestimation of the cost and time for special sampling and testing
	CR11	Inappropriate contracting type and delivery strategy for high-rise projects
	CR12	Unstructured partnering between foreign and local companies due to mandatory regulation
External Risks	ER1	Extreme weather conditions (wind and/or cold)
	ER2	Restricted logistic areas
	ER3	High inflation rates and currency fluctuations
	ER4	Insufficient local regulations and building standards for high-rise building construction, design and testing
	ER5	Difficulty in adaptation of international codes and specifications to local standards for high-rise buildings
	ER6	Difficulty in procurement of long-lead items and specific equipment/material across borders
	ER7	Shortage of qualified resources, laboratories, training possibilities in the local market
	ER8	Delay in regulatory authorities, approval at initiation and closing phase of the high-rise project
	ER9	Insufficient power supply, gas, water, etc. to the project (either temporary or permanent)
	ER10	Corruption, policy and government instability, inefficient government bureaucracy
	ER11	Low local supplier quantity and quality
	ER12	Ineffective and insufficient legislation for high-rise building safety requirements
	ER13	Restrictive labor regulations
	ER14	Difficulty in dealing with construction permits
	ER15	Project documentation and communication/language constraints
	ER16	Seismic risk and associated difficulty in high-rise design

Table 4. Summary table of risk factors used in the author's questionnaire to tall building design and construction professionals.

Risk Factor	Risk Rating for Time	Risk Rating for Cost	Overall Ranking (Delay)	Overall Ranking (Cost Overrun)	Risk Factor Description
MR8	17.49	16.11	1	1	Hiring unqualified professionals/subcontractors
TR1	17.01	15.90	2	2	Poor coordination among the drawings of different trades
MR13	14.90	15.90	10	2	Lack of cost control and cash-flow management integrated into the program
ER1	16.81	15.81	3	4	Extreme weather conditions (wind and/or cold)
MR1	16.58	15.53	4	7	Inadequate planning and scheduling that misleads all stakeholders
CR2	14.57	15.68	14	5	Underestimation of project cost in the contract
CR3	15.67	15.54	5	6	Unrealistic duration imposed by the client

Table 5. The top seven highest-ranking risks contributing to delays and cost overruns in the CIS tall building industry (overall assessment). Source: Gunes Bardakci

resources should be planned in the most effective way, based on seasonal data. Geographic extremes of weather conditions need to be researched in advance, and appropriate precautions taken, such as proper winterization plans. Resources should be managed accordingly and used for maximum productivity and efficiency.

Risk (MR1): Inadequate planning and scheduling that misleads all stakeholders

Risk Response to (MR1): Develop detailed design, procurement, and construction schedules with an effective sequence of works for all trades and departments. Develop monitoring and control mechanisms to rapidly identify delays, cost overruns, and other key risks. Have the program reviewed by managers with high-rise experience. Getting team buy-in and coordinating the schedule with key stakeholders (i.e., subcontractors and suppliers) at the project outset is also important.

Investigations of Relationships Among Different Variables

The final objective of the research was to investigate the relationship among the critical risk factors and other variables. To achieve this objective, IBM SPSS and Microsoft Excel software, particularly pivot tables, were used. Since the research focuses on a region rather than on a specific project, it was vital to investigate relationships based on fundamental variables.

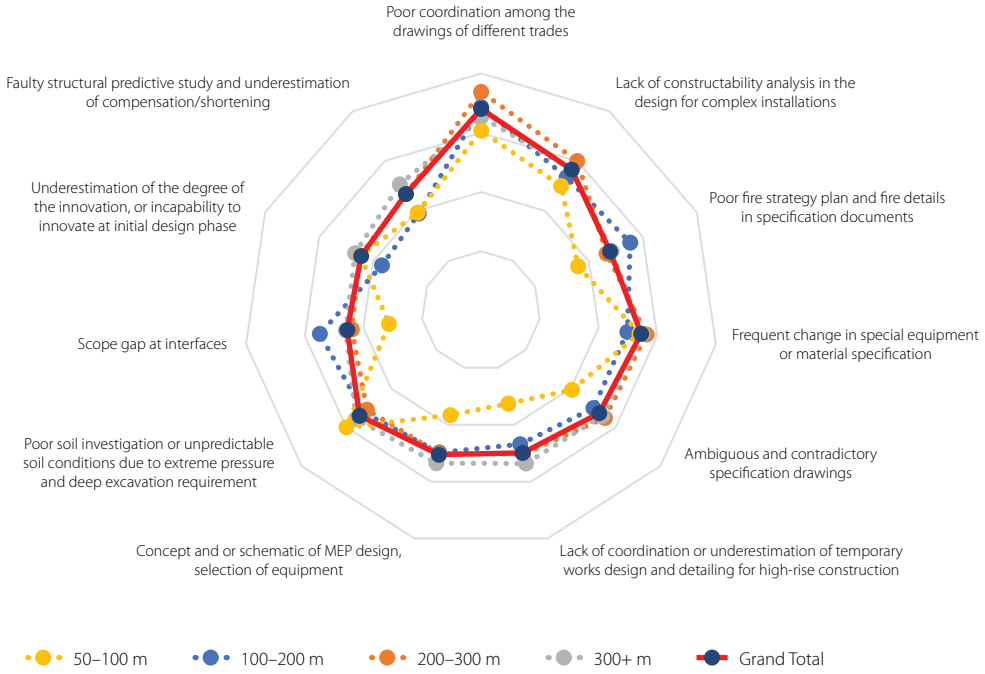

Figure 1. Technical risk factors' impact on project schedule, based on building height.

Technical Risk Factors: Impact on Schedule, by Building Height

In this section, risk factors' impact on the schedule is analyzed for varying heights of tall buildings, as categorized in the demographic and general information section of the questionnaire.

The technical risk factors' relationship with height is investigated as shown in Figure 1. The impact of technical risk factors on schedule is reduced for buildings of 50–100 meters' height. Only poor soil investigation risk has a higher risk rating for buildings in this range, which is likely subjective to the respondents' experience. Assuming that, as the building goes higher, the technical risk factors' impact on schedule will increase, our analysis significantly supports this assumption. Technical risks' negative impact on schedule significantly correlates with the height.

External Risk Factors: Impact on Schedule, by Country

The external risks factors' impact on schedule is analyzed, with the three studied countries compared in Figure 2.

Shortages of qualified resources, difficulty in procurement of long-lead items, and low

local supplier quality and quantity are predominantly more problematic factors for Kazakhstan. These results show a meaningful relationship with the findings in the literature review, which was presented in the PESTEL analysis.

High-rise projects in Russia have been significantly less affected by extreme weather conditions, when compared to its CIS peers, which may be because the country has more experienced project teams and contractors. Also, Russia's winters are is not as severe as Kazakhstan's, and wind is not as high as Azerbaijan's in most of the regions where tall buildings are typically constructed. Except in the case of insufficient power supply, which is a problematic factor for Russia, as presented in the PESTEL analysis, all other external risk factors are more controlled in Russia than in Azerbaijan and Kazakhstan, where those factors are higher-ranked.

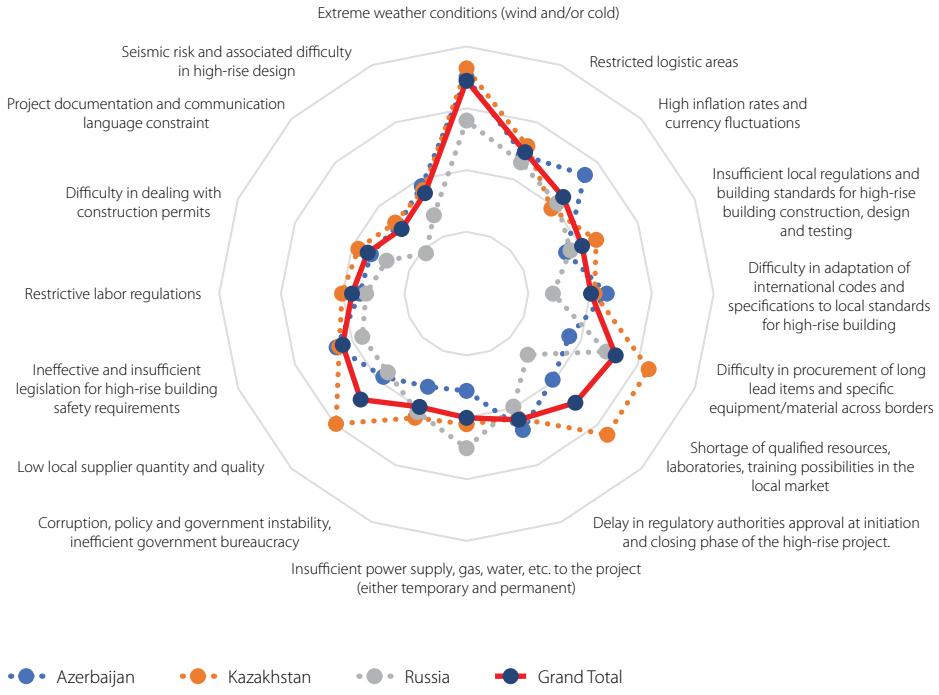

Figure 2. External risk factors' impact on schedule, compared across three CIS countries.

Management Risk Factors: Impact on Schedule, by Role

Perceptions of management risk factors vary from one role or discipline to another. Therefore, it is beneficial to investigate the relationship between management risk factors and construction delays, depending on project roles. Figure 3 demonstrates the risks to schedule classified by role.

According to the view of supervising consultants, management risk is given a much higher rating in analysis. For subcontractors, the greatest risk to schedule comes from a "lack of awareness, or erroneous selection of high-rise technology or systems". The main reason for this may be that the subcontractors tend to have a high awareness of the systems in terms of practicality, constructability, and efficiency. If these systems are poorly selected, subcontractors will be among the most affected. The hiring of unqualified professionals is the highest-ranked risk, according to the client and supervising consultants. Management consultants' assessments of risks are generally aligned or lower than the average ratings. Contractors' most problematic risk is delay in review of documents and drawings.

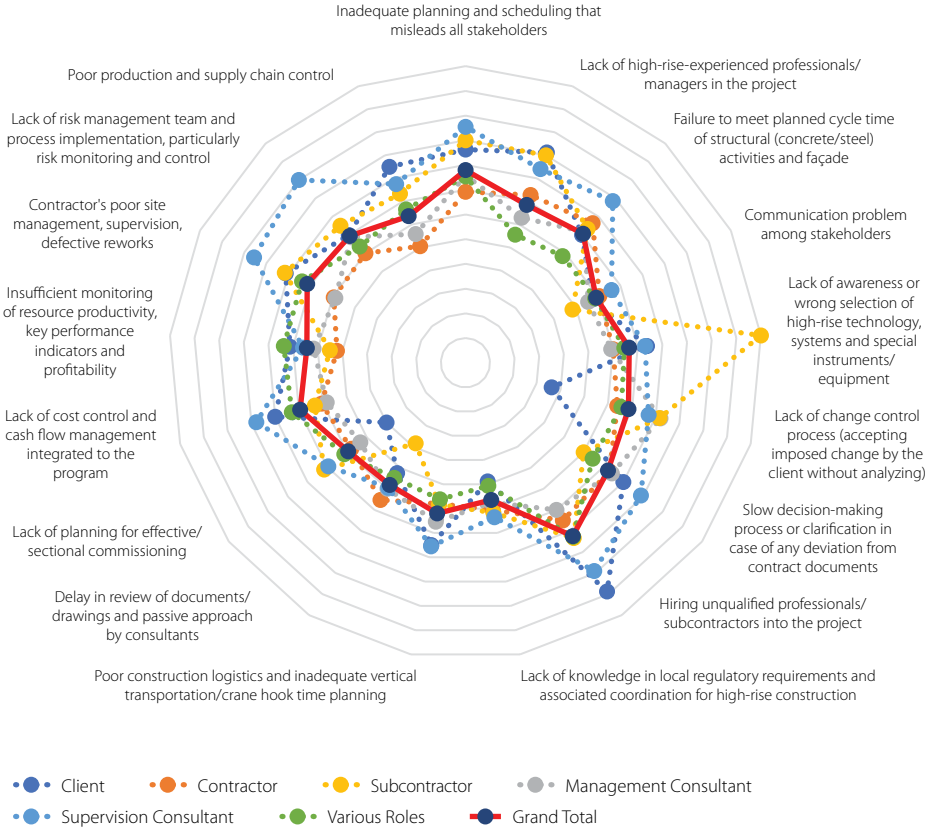

Figure 3. Management risk factors' impact on construction schedules, based on the roles of respondents.

Commercial Risk Factors: Impact on Cost, by Role

Commercial risk ratings are analyzed in terms of their contribution to cost overruns, from the viewpoint of different roles, as shown in Figure 4. Although delayed payment by the client is one of the highest-ranking risks, this risk was rated lowest, according to the clients themselves. However, client respondents did rank the risk of unrealistic duration imposed by the client as "above average."

Subcontractors tend to attribute a below-average risk rating to commercial factors, which may likely result in being causally linked to contractors; these parties may have less awareness or involvement in the projects' commercial issues at the executive level. Although contractors' high ranking of delayed payments by the client may have been anticipated, the risk of an unrealistic duration imposed by the client was surprisingly the lowest-ranked by contractors. Client-aligned respondents ranked "unstructured partnering" and "inappropriate contract type" as the risks most likely to drive cost overruns.

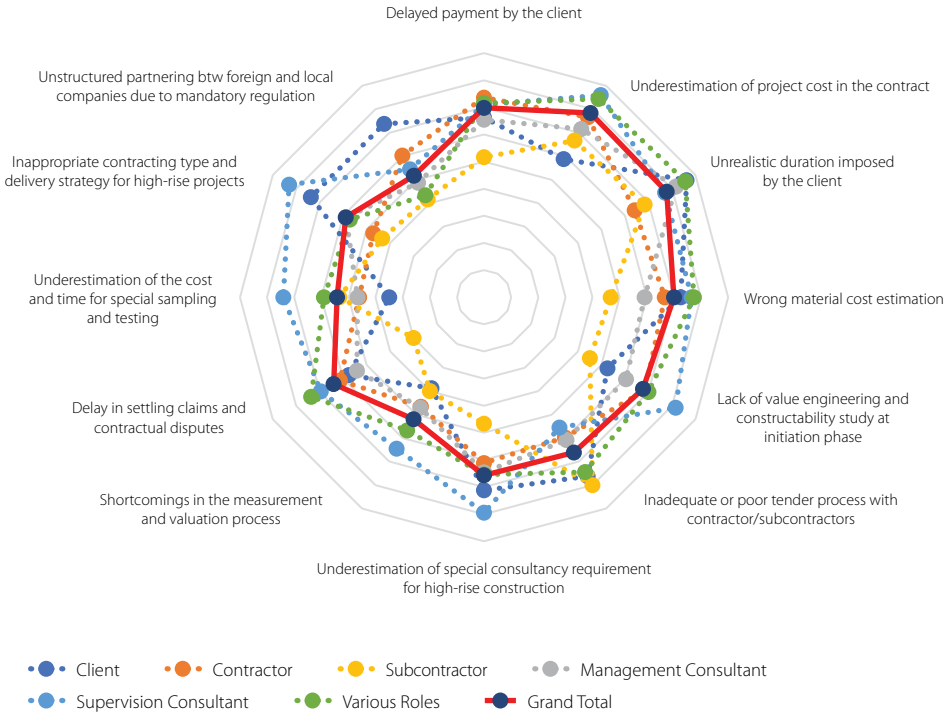

Figure 4. Commercial risk factors' impact on cost overruns, based on roles/disciplines.

Summary of Risk Factors

For technical risks:

- "Poor coordination among the drawings of different trades" is the most high-ranking risk to both schedule and budget.
- "Lack of constructability analysis in the design of complex installations" is in second place as a contributor to delays.
- "Frequent changes in special equipment or material specifications" is the second-highest-ranking cause of cost overruns.

For management risks:

- "Hiring unqualified professionals/ subcontractors" is the highest-ranking risk factor cited as negatively affecting high-rise projects' completion on time and to budget.
- "Inadequate planning and scheduling that misleads all stakeholders" is the second-highest-ranking risk to schedule.
- "Lack of cost control and cash-flow management integrated to the program" is the second-highest-ranking contributor to cost overruns.

For commercial risks:

- "Unrealistic duration imposed by the client" is the highest-ranking source of delays.
- "Underestimation of project cost in the contract" is the highest-ranking risk to budget.
- "Delayed payment by the client" is the second-highest source of delays.

For external risks:

- "Extreme weather conditions," particularly windy and/or cold weather, is the highest-ranking risk factor leading to delays and cost overruns in the CIS region.
- "Difficulty in procurement of long-lead items and specific equipment/material across borders" is ranked in second place for contributing to delays.
- "High inflation rates and currency fluctuation" is the second highest-ranking contributor to cost overruns.

Risk Responses

Risk responses were developed, not only through the literature review, but also through the questionnaires returned by experienced high-rise professionals. In addition, there were useful risk responses obtained via email at the outset of the research. Key risk responses to the highest-ranking risks are summarized below:

1. Implement a well-structured prequalification process into the human resources (HR) management plan for staff, and into specifications for selection of subcontractors. Introduce key performance indicators (KPIs) to the HR process, and for the evaluation of subcontractor productivity. High-rise experience is a required selection criterion.
2. To resolve design coordination problems, an on-site design consultant should be assigned to cover all coordination works between all disciplines in the project. Interface management and avoiding scope gaps are essential practices. Utilize coordinated BIM processes throughout the project lifecycle by a qualified team. Ensure all details are made available in a timely manner and approved by consultant(s) before the commencement of construction.
3. Develop resource and cost-loaded schedules to control cash flow based on the bill of quantities (BOQ). Monitor the costs and perform forecast analyses regularly. When considering changes or alternatives such as "what-if" scenarios, include the cost and time implications.

4. As a risk mitigation measure against extreme weather conditions, activities and resources should be planned in observation of seasonal data. Geographic extremes of weather conditions (temperature and wind, etc.) need to be researched, and appropriate precautions taken while planning the works.
5. Having a coordinated and sequential program reviewed by high-rise-experienced managers, representing all stakeholders, is crucial for success. Realistic programs should be communicated through to the stakeholders. Rather than relying solely on contractual enforcement to resolve errors post-facto, the team's buy-in should be obtained in advance of program changes.

Recommendations

For Government:

- Difficulty in procuring long-lead items and specific equipment/material across borders is one of the most significant factors leading to delays. Countries should resolve to improve the policies and make necessary investments to resolve supply-chain and logistic problems. In addition, the quality and quantity of local suppliers should be developed. These actions will reduce the cost and duration of projects significantly.
- High inflation rates and currency fluctuations were among the most problematic factors contributing to cost overruns. Governments should take all necessary actions to maintain stability in their economies, which will not only minimize the waste, but also attract more foreign investors for building projects.

For Key High-Rise Project Stakeholders:

- All the stakeholders involved in high-rise building projects should employ qualified professionals with a satisfactory level of high-rise experience. The prequalification process for subcontractors and professionals, using KPIs, should be settled at the contract stage, which would add the most value to on-time, on-budget project completion. Having qualified professionals and subcontractors will inherently reduce other risk factors, since most are people-driven.
- An on-site design consultant should be employed to support coordination and resolve problems rapidly. Every key stakeholder engaged with the design process should have a qualified BIM team throughout the project.
- The review and approval process should be fast-tracked. Design consultants should have integrated milestones, to afford smooth progress by contractors.
- Constructability analysis by construction managers should be finalized at the design stage, prior to execution. Method statements should be prepared for complex installations. BIM utilization with construction team buy-in will help to mitigate this risk.
- Cost- and resource-loaded schedules with team buy-in should be developed, and a high level of monitoring on-site should be performed.
- Clients should have a realistic budget and schedule, which would assist in successful project completion. Delaying payments or underestimating cost could result in catastrophic outcomes, including delays of more than 24 months and/or cost overruns of 50 percent or more.
- Risk-management processes should be systematically applied throughout the project. ■

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