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Project Risk Management for the Repair and Upgrade of Nhi Thien Duong 1 Bridge, Ho Chi Minh City, Vietnam

Nguyen Huu Hung [1], Tran Vu Van Hoa*[2], Dang Huy Viet[3], Luong Anh Tien[3]

[1]DEOCA Group, Vietnam
[2]The SDCT Research Group, University of Transport Ho Chi Minh City, Vietnam
[3]University of Transport Ho Chi Minh City, Vietnam

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ABSTRACT

No project is without risks, especially in the construction industry, which harbors numerous potential pitfalls. Some risks may occur with a low probability but can have a significant impact, while others may manifest repeatedly across various projects. Negative risks, when realized, result in losses that affect the project's objectives. Meanwhile, project participants aspire to capitalize on opportunities presented by positive risks. Therefore, identifying risks, elucidating risk management methods, and formulating risk response strategies for construction projects are crucial to ensure their success. Through methods such as analysis, synthesis, comparison, and reference, this article identifies risks associated with the repair and upgrade project of the Nhi Thien Duong 1 Bridge in Ho Chi Minh City. Additionally, it proposes a set of risk response solutions from the investor's perspective in terms of construction investment management.

Keywords: Risks, Risk Management, Nhi Thien Duong 1 Bridge, Solutions, Strategy.

I. INTRODUCTION

Concept of Risks

In the process of researching risks, the concept of risks is currently divided into two approaches. One focuses on the origin and frequency of risk occurrences, while the other is concerned with the outcomes resulting from risks. However, whether focusing on the origin or the outcomes of risks, the essence of risk remains unchanged. The determination of the aspects considered in risk assessment depends on the researcher's perspective on risk [1] [2].

In the construction field, three research perspectives on risk have evolved since the introduction of the term 'risk': the Traditional View, the Neutral View, and the Expanded View.

Traditional View: This perspective emphasizes the positive aspects of risks. Risks are characterized by being dangers that can cause damage, loss, or deterioration. Risks are associated with uncertainties and result from the combination of the probability of an event or hazard occurring and its consequences.

Neutral View: This perspective emphasizes the nature of altering project objectives. Risks are uncertain events or conditions that impact and modify project objectives. The change in objectives can be either positive or negative. Risks involve the combination of the probability of an event occurring and its impact on project objectives.

Expanded View: This perspective highlights the positive (opportunities) or negative (challenges) outcomes when risks occur. Characteristics of risks include having both positive and negative aspects, being measurable by the probability and frequency of risk occurrences multiplied by the degree of loss, damage, or benefits resulting from the risks. Risks are uncertain events or situations.

Today, when examining an issue, not only risks but also in various areas of study, researchers and managers tend to consider both positive and negative aspects. This optimistic viewpoint is evident in the field of management science.

For projects, including construction investment projects, the widely accepted concept of 'project risk' is proposed by the Project Management Institute (PMI) as follows [3]: 'A risk is an uncertain event or condition that, if it occurs, has an impact on at least one project objective, such as scope, schedule, cost, and quality. Risks are always in the future. A risk may have one or more causes and, if it occurs, may have one or more impacts. The causes of risk can be a requirement, assumption, constraint, or condition that creates positive or negative outcomes.'

According to this concept, risks can affect projects in various ways and at different times throughout the project lifecycle. However, the consequences can be traced back to impacting one or more objectives among the four main project objectives mentioned above. This essay primarily focuses on studying risks with negative implications, specifically those associated with construction investment projects.

Classification of Risks

Risks are highly diverse, and there are numerous ways to categorize them. Risks are commonly classified from various perspectives, including: based on the risk object, the nature of the activity, the scope, insurability, quantifiability, the industry sector, and the source of the risk [1]. Although this classification is interpreted for enterprise risks, it can still be referenced to categorize risks in projects.

For projects, due to their complex nature, risks are also classified based on the level of identification as follows [3]:

Known Risks (identified): These risks have been recognized and analyzed, allowing for proactive planning and response. Known risks that cannot be actively managed should have a contingency reserve allocated.

Unknown Risks (not identified): These risks cannot be actively managed and therefore require a specific contingency reserve allocation.

Introduction to Project Risk Management

Project risk management is the process of identifying and analyzing risk factors, measuring the level of risk, and, based on that, selecting, implementing measures, and managing activities to limit and eliminate risks throughout the project lifecycle.

Risk management is the proactive control of future events based on forecasting results before events occur rather than a reactive response. Therefore, an effective risk management program not only reduces errors but also minimizes the impact of these errors on achieving project objectives.

Risk management is an ongoing process, implemented in all stages of the project cycle, from its inception to

completion. Projects often face high risks in their initial formation stages. Throughout the project lifecycle, many work phases also involve a high level of risk, requiring division into multiple stages for reviewing and analyzing risks. Based on this analysis, suitable solutions are selected to reduce and eliminate risks.

Steps to Develop a Process for Identifying and Managing Project Risks

Typically, project risk management is carried out through three main steps: risk identification, risk analysis, and risk response planning. However, the Project Management Institute (PMI) has enhanced and detailed these contents, proposing a 6-step process for project risk management [3], including: 1) Risk management planning; 2) Risk identification; 3) Qualitative risk analysis; 4) Quantitative risk analysis; 5) Risk response planning; 6) Risk monitoring and control.

1) Risk management planning

Risk management planning is the process of determining how to conduct risk management activities for a project. The primary benefit of this process is to ensure that the level, nature, and visibility of risk management align with both the risks and the project's significance to the organization.

Risk management planning is crucial to secure agreement and support from all stakeholders, ensuring that the risk management process is endorsed and effectively implemented throughout the project lifecycle. Careful and clear planning enhances the likelihood of success for other risk management processes. Planning is also vital to allocate sufficient resources and time for risk management activities and establish a unified foundation for risk assessment.

The risk management planning process should commence when a project is formed and should be completed early in the project planning phase. This ensures a comprehensive foundation for evaluating risks and facilitates a coordinated approach to risk management activities throughout the project's life cycle.

2) Risk identification

Risk identification is the process of determining which risks could impact the project and documenting their characteristics. The primary benefit of this process is that it provides documentation on existing risks and knowledge for the project team to anticipate events.

Risk identification is an iterative process, as new risks may emerge throughout the project lifecycle. The frequency of iteration and involvement in each cycle will vary depending on the circumstances.

3) Qualitative risk analysis

Qualitative risk analysis is the process of selecting and prioritizing risks for management focus. The primary benefit of this process is that it allows project managers to reduce uncertainty levels and concentrate on high-priority risks.

Qualitative risk analysis assesses the prioritization of identified risks by using their likelihood of occurrence, the corresponding impact on project objectives if the risk occurs, as well as other factors such as the response time frame and the organization's risk tolerance concerning project objectives in terms of cost, schedule, scope, and quality.

4) Quantitative risk analysis

Quantitative risk analysis is the process of analyzing the numerical impact of identified risks on the project's objectives. The main benefit of this process is that it generates quantitative risk information to support decision-making aimed at reducing project uncertainty. Quantitative risk analysis is performed on the risks that have been prioritized through the qualitative risk analysis process, indicating a significant likelihood and impact on the project's objectives.

5) Risk Response Planning

After analyzing risks, the selected risks need to be planned for response, meaning creating action plans to enhance opportunities and minimize the potential risk impact on project objectives. The main benefit of this

process is that it addresses risks according to their prioritization, allocating resources and activities to the budget, schedule, and project management plan as needed.

Planning risk response requires risk managers to carefully consider selecting fundamental strategies for risk response. From these considerations, action plans are developed accordingly. The basic risk response strategies are categorized into two groups for risks and opportunities, each group having four fundamental strategies [3]. Risk response strategies for risks include avoidance, transfer, mitigate, and accept, while strategies for opportunities include exploit, enhance, share, and accept.

For risks, the avoidance strategy is implemented by seeking to eliminate the risk or avoid its impact. The transfer strategy involves shifting the risk to another organization for handling, possibly through insurance or performance bonding. The mitigate strategy is carried out through measures aimed at reducing the probability or impact of the risk. The accept strategy means acknowledging risks, whether identified or unidentified, with potential adverse consequences. This strategy is further categorized into proactive and passive acceptance. Proactive involves setting up contingency plans for risk response, to be implemented after the risk has occurred, while passive acceptance lacks preemptive plans for risk response when the risk occurs.

It can be observed that the key distinction between the accept strategy and other strategies lies in the fact that, regardless of the proactive risk response planning, other strategies require actions to be taken to respond to risks before they occur, while the accept strategy does not. Only a proactive acceptance strategy is related to setting up contingency plans for implementing activities if risks occur (after the risk has manifested).

6) Risk control

Risk control is the process of implementing risk response plans, monitoring identified risks, overseeing remaining risks, identifying new risks, and evaluating the effectiveness of the risk management process throughout the project. The primary benefit of this process is to enhance the efficiency of the risk management approach over the project lifecycle, continually optimizing risk response plans.

II. CURRENT RISK STATUS OF THE PROJECT OF REPAIRING AND UPGRADING THE NHI THIEN DUONG 1 BRIDGE AND PROPOSING SOLUTIONS TO RESPOND TO RISKS

Overview of the project of repairing and upgrading the Nhi Thien Duong 1 bridge

The Repair and Upgrade project for the Nhi Thien Duong 1 Bridge has a total investment of 163.295 billion VND. The project is managed by Urban Traffic Management Zone 4, Ho Chi Minh City (now transferred to the Project Management Board for Investment in Construction of Transport Works).

The project involves constructing a new Nhi Thien Duong 1 Bridge with reinforced concrete and prestressed concrete, measuring approximately 161.10 meters in length and 12 meters in width. The bridge's approach road connects with Tung Thien Vuong Street and National Highway 50. The project includes features such as lighting systems, greenery, traffic organization, and several related auxiliary items.

Risks of the project of repairing and upgrading the Nhi Thien Duong 1 bridge

The occurrence risks of the Nhi Thien Duong 1 project are summarized in Table I.

TABLE I

RISKS OF THE NHI THIEN DUONG 1 PROJECT

Risk codes	Risk
	Risks in the project preparation phase
RR1	Quality risks of self-conducting survey, investment project formulation and construction design
RR2	Risks caused by survey consultancy, investment project formulation and construction design to the project because the consulting products do not ensure quality
	Risks during the project implementation phase
RR3	Risks of not managing every aspect of the project well
RR4	Quality risks self-implementation of selection of contractors and consultants
RR5	Risks of quality self-implementation of construction supervision
RR6	Risks caused by the contractor abandoning or not continuing to participate in the bidding
RR7	Risks caused by the contractor abandoning or not continuing to perform the contract
RR8	Risks caused by the contractor not using the contract advance money for the right purposes and objects
RR9	Risk of incidents for construction workers on the construction site
RR10	Risks due to project problems affecting third parties
RR11	Risks caused by failure to implement, or failure to ensure the good performance of construction work, traffic assurance by normal measures
RR12	The risk of additional unknown volumes from the design increases project costs
RR13	Risk of construction incidents during construction
RR14	Risks incurred by the mass factor
RR15	Risks due to slippage factor
	Risks in the end of construction phase
RR16	Risks caused by damage or defects in the construction work during the warranty period

III. PROPOSING SOLUTIONS TO RESPOND TO RISKS FOR THE PROJECT OF REPAIRING AND UPGRADING THE NHI THIEN DUONG 1 BRIDGE

The authors proposed some risk response solutions of the Nhi Thien Duong 1 bridge project as shown in table II.

TABLE II

RISK RESPONSE SOLUTIONS OF THE NHI THIEN DUONG 1 BRIDGE PROJECT

Risk codes	Risk	Impacted project objectives	Risk response strategies	Specific measures	Expense items
	Risks in the project preparation phase				
RR1	Quality risks of self-conducting survey, investment project formulation and construction design	- Costs increase. - Time increases. - The quality of construction decreases.	Transfer	Hire consultants for surveying, project planning and construction design	Counsel

Risk codes	Risk	Impacted project objectives	Risk response strategies	Specific measures	Expense items
RR2	Risks caused by survey consultancy, investment project formulation and construction design to the project because the consulting products do not ensure quality	- Costs increase. - Time increases. - The quality of construction decreases.	Mitigate	Request advice on buying professional liability insurance, construction investment consultancy	Counsel
	Risks during the project implementation phase				
RR3	Risks of not managing every aspect of the project well	- Costs increase. - Time increases.	Mitigate	Organize training and improve the capacity of the project management apparatus	Project management
RR4	Quality risks self-implementation of selection of contractors and consultants	- Costs increase. - Time increases. - The quality of construction decreases.	Transfer	Hiring a contractor selection consultant	Counsel
RR5	Risks of quality self-implementation of construction supervision	- Costs increase. - Time increases. - The quality of construction decreases.	Transfer	Hiring a supervisory consultant	Counsel
RR6	Risks caused by the contractor abandoning or not continuing to participate in the bidding	- Costs increase. - Time increases.	Dodge	Request the contractor to make a bid guarantee	Build
RR7	Risks caused by the contractor abandoning or not continuing to perform the contract	- Costs increase. - Time increases.	Dodge	Request the contractor to perform a contract performance guarantee	Build
RR8	Risks caused by the contractor not using the contract advance money for the right purposes and objects	- Costs increase. - Time increases.	Dodge	Ask the contractor to provide an advance guarantee	Construction and consulting

Risk codes	Risk	Impacted project objectives	Risk response strategies	Specific measures	Expense items
RR9	Risk of incidents for construction workers on the construction site	- Costs increase. - Time increases.	Transfer	Request the contractor to purchase insurance for construction workers on the construction site	Build
RR10	Risks due to project problems affecting third parties	- Costs increase. - Time increases.	Transfer	Require the contractor to purchase civil liability insurance for third parties	Build
RR11	Risks caused by failure to implement, or failure to ensure the good performance of construction work, traffic assurance by normal measures	- Costs increase. - Time increases. - The quality of construction decreases.	Dodge	Design special construction methods in accordance with work requirements	Build
RR12	The risk of additional unknown volumes from the design increases project costs	- Costs increase.	Transfer	Included in the general item cost estimate	Different
RR13	Risk of construction incidents during construction	- Costs increase. - Time increases. - The quality of construction decreases.	Transfer	Buy construction insurance during construction	Different
RR14	Risks incurred by the mass factor	- Costs increase.	Accept	Arrange a contingency	Redundancy
RR15	Risks due to slippage factor	- Costs increase.	Accept	Arrange a contingency	Redundancy
	Risks in the end of construction phase				
RR16	Risks caused by damage or defects in the construction work during the warranty period	- Costs increase. - The quality of construction decreases.	Mitigate	Request the contractor to make a warranty guarantee	Build

Table II shows that the above risks are responded to by different strategies from the perspective of the project investor.

The strategies used include avoidance, transfer, mitigation, and acceptance.

- The risk avoidance strategy is used for risks RR6 "Risk of contractor abandonment, discontinuation of bidding," RR7 "Risk of contractor abandonment, discontinuation of contract implementation," RR8 "Risk of the contractor not using the contract's advance payment for the intended purpose and target," and RR11 "Risk of not being able to implement or ensure the effective implementation of construction and traffic safety by conventional means." The corresponding response solutions for these risks are "Require the contractor to ensure implementation" and "Design special construction measures suitable for job requirements." Implementing these solutions is expected to prevent the occurrence of risks (RR6, RR7, RR8, RR11) or protect the project from adverse impacts if these risks occur (RR6, RR7, RR8). However, using the risk avoidance strategy with RR11 may not guarantee complete risk avoidance, as it depends on the competence and capability of the contractor.

- The risk transfer strategy is used for risks: RR1 "Risk of quality for self-conducted survey, investment project planning, and construction design," RR4 "Risk of quality for self-selecting contractors and consultants," RR5 "Risk of quality for self-conducted construction supervision," RR9 "Risk of accidents for construction workers on site," RR10 "Risk of project incidents affecting third parties," RR12 "Risk of additional unspecified quantities from design causing project cost increase," and RR13 "Risk of construction incidents during the construction period." Risks RR1, RR4, and RR5 are addressed by the measure of "Hiring consultants" to perform project tasks. These risks are not removed from the project but transferred to the consultant with the expectation that they manage these risks better. Similarly, risks RR9, RR10, and RR13 are addressed by the measure of "Require the contractor to purchase insurance," transferring these risks to the insurance service provider. Risk RR12 is entirely transferred to the contractor, who is responsible for additional work scope if their initial estimation is inadequate, while the project owner accepts payment for this work scope and has already calculated it in the tender price.

- The risk mitigation strategy is used for risks RR2, "Risk of advisory survey, investment project planning, and design causing project risks due to poor quality consulting products," RR3, "Risk of not managing all aspects of the project well," and RR16 "Risk of construction defects or deficiencies during the warranty period." Risk response actions for RR2 "Require consultants to purchase professional liability insurance for investment construction consulting," RR3 "Organize training, enhance the project management team's capacity," and RR16 "Require the contractor to ensure the warranty" only help to mitigate the likelihood of these risks (RR3) or mitigate the consequences of these risks (RR3 and RR16).

- The risk acceptance strategy is used for risks RR14, "Risk of volume-related factors arising," and RR15, "Risk of price fluctuation factors," when the contract used is an adjusted unit price contract. In this case, a contingency fund is allocated in advance to proactively deal with these risks when they arise.

IV. CONCLUSION

In general construction investment projects, and specifically in transportation infrastructure projects, risks are diverse and complex, with significant impacts on project objectives. This study has identified various risks in the Repair and Upgrade of the Nhi Thien Duong 1 Bridge project. Additionally, it proposes specific risk mitigation solutions from the investor's perspective on the management of construction investment projects. These findings can be beneficial

for stakeholders involved in risk management and may serve as a foundation for more in-depth future research.

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