

# *Risk Analysis and Research for Construction Projects*

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**Abstract:** As the population grows and the demand for public infrastructure increases, more and more construction projects are being carried out. In order to avoid the failure of construction projects due to their high level of complexity, risk anticipation and risk response can be made through the study of project risks, which can greatly improve the success of construction projects. The investment and time spent on a construction project are huge and if the project fails or is delayed, there will be serious consequences. This is why construction project risk management is so important for construction projects. Therefore, this paper analyses the risks of construction projects. It finds that construction project risks can be classified as internal and external risks and suggests improvements to the existing three-step project risk management process Identify-Assess-Respond, adding a project risk review. This paper enriches the study of risk classification and management processes for construction projects and proposes risk management process measures that have implications for future construction projects to deal with risks more efficiently.

**Keywords:** construction projects, project risk classification, project risk management process

## 1. Introduction

The number of construction projects is constantly increasing in response to the increase in the world's population and the construction of better social infrastructure services. The fixed risks and characteristics of construction projects pose key difficulties for the interests of project stakeholders and for project teams managing projects. Project risk management is a key skill for project managers[1]. Also, Damjanovic [2] suggests that risk management is one of the important functions that enable project managers to complete construction projects. Therefore, risk management is of great importance to construction projects.

Construction projects have certain characteristics compared to other projects, such as software development and event planning. Professor Perrenoud [1] advises project managers to place risk management before and during the construction phase of a construction project. Risk management can improve the profitability of construction companies[3]. The complexity and long lead time of construction projects are summarised in extensive literature descriptions. Meanwhile, Dong Yandong [4] found that construction projects can be classified according to internal and external based on his research. Classifying risks from internal and external sources can give project managers a clearer definition of risk levels and impacts. Bradford [5] also states that organizations that do not have a consistent definition and sources of risk can present additional challenges. Of the existing project risk management systems, Perrenoud [1] suggests that risk identification is the first step in project risk

management, where the project team reviews the project information to fully identify project uncertainties, and Ansah [6] suggests that a risk assessment properly helps to rank and prioritise the identified risks. This allows for a more efficient allocation of work resources.

Project response can be categorised in two ways. The first is to walk through the pre-work and review before the risk occurs to avoid it. The second is the approach that should be taken to respond to the risk when it arises. In the literature review, it was found that risk management for construction projects only occurs before or during the construction of a construction project. There is no focus on reviewing and summarising project risks after construction, which has led to many risks that could be applied to different industries or jobs being forgotten and ignored.

The construction project is first studied by reading the historical literature. Then summarise the characteristics of construction projects and the risk management process. Finally, the existing risk management process is suggested for improvement to increase the likelihood of successful risk management in future construction projects.

## **2. Construction Project Risks**

The uniqueness of construction projects is identified through historical literature and a summary of the characteristics is made. This is then summarised and analysed according to the classification of risks by scholars.

### **2.1. Risk Characteristics of Construction Projects**

Risks are uncertainties that will affect the project in the future and which, if not anticipated and prevented in advance, will become problems affecting the project. Construction projects take a long time and involve a lot of machinery, processes, and people. Failure to promptly process the information on construction projects can result in information lags and incorrect assessments, which can lead to risks.

Objectivity and universality are fundamental characteristics of risk, but they are magnified in construction projects with long lead times. Without proper risk prediction and management of each step and process during the project, the frequency of risks can be greatly increased and affect the project schedule or outcome.

The construction and management processes involved in construction projects are complex. Therefore, in construction projects with high complexity, the degree of impact of risks on the project will be more severe, making the project even more complex.

### **2.2. Risk Classification of Construction Projects**

Through extensive literature reading, there are many risks faced by construction projects and these risks have a greater impact on the success of the project. Different scholars classify construction project risks through different cases. Dong Yandong [4] classifies project risks into internal and external risks through his study of a construction project in an African country. Kong Xiangkun [7] classifies project risks into cultural, management, economic and political risks through his study of the Railways of Iraq project. Li Junmei [8] classifies project risks into macro, meso, and micro risks in his study of the D Hotel green building project. Chen Zhiming [9] and Qin Wei [10] classified project risks into design risk, construction risk and quality control risk through the analysis of the construction industry. In this article, the analysis and classification of modern construction project risks will be carried out through the summary of historical literature.

As shown in Fig. 1 internal project factors can be classified as quality risk, management risk, construction risk, contractual risk, internal financial risk, etc. External factors can be categorised as political risk, external financial risk, contractor or third-party risk, natural risk, etc. Construction

projects are characterised by long lead times and high complexity. By classifying internal and external risks, the sources of project risks can be categorised more clearly and unambiguously. Internal project risk sources are related to internal project stakeholders and external project risk sources are related to external project stakeholders. The internal stakeholders usually have more rights and interests than the external stakeholders, so the internal stakeholders are involved in the project management and operational phase of the work, while the external stakeholders are involved in the supply and social environment of the project.

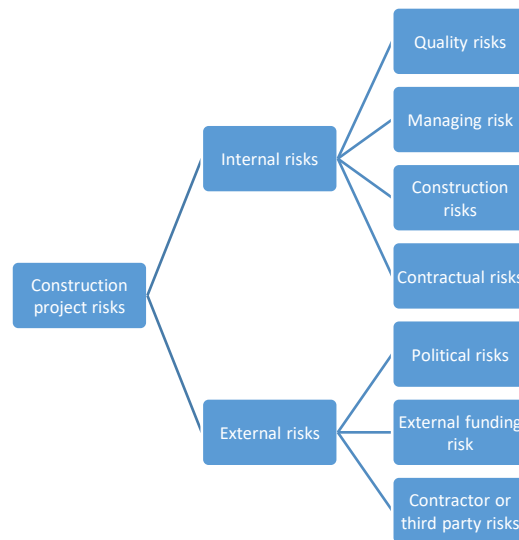


Figure 1: Construction project risk classification. (photo credit: Original)

### 3. Risk Management in Construction Projects

A categorical understanding of risk is followed by the need for a systematic risk management plan. Risk management is first introduced, and then problems with risk management in construction projects are presented. Finally, the risk management process is summarised and suggestions for improvement are made.

#### 3.1. Overview of Project Risk Management

The uncertainty of project risk indicates that there is some threat and danger to the project. Yoojung Yoon [3] suggests that reducing losses due to risk events can improve the profitability of construction projects. Qin Wei [10] points out that scientific risk management can have a direct impact on construction projects. Ding Li [11] states that while engineering projects can be highly profitable for contractors, they are also subject to high levels of risk and uncertainty. Therefore, through risk analysis and management, there is a reasonable basis for decision-making in construction projects and the ability to maximise risk-benefit through their risk-taking capabilities.

#### 3.2. Problems with Project Risk Management

A summary of the historical literature is used to analyse and summarise the main risk management issues that exist in the actual project process. A source for later summary and reflection on the risk management process for construction projects.

### 3.2.1. Problems with Risk Management Systems

Construction projects involve many people and third parties. In the face of risk prediction and management processes, it is difficult to quickly upload information and issue preventive measures for construction projects. Risk management systems include risk management processes, risk reporting systems, contract management systems, etc. These systems ensure that project risks are correctly predicted and prevented, and that information and instructions from the top and bottom of the hierarchy are communicated as quickly as possible when project risks arise. By standardizing and completing the risk management system, irregularities in risk implementation can be effectively avoided. At the same time, if any of the relevant project managers violate the system during the supervision process, they will be punished accordingly. Xu Lei [12] points out that in construction projects, following a sound risk management system for construction projects can effectively avoid risks.

### 3.2.2. Risk Prevention and Implementation Issues

Risk forecasting in most construction projects is limited to the project manager, which can lead to an incomplete scope of risk forecasting. For example, the project manager does not understand the company's asset structure, which leads to the project manager blindly purchasing large equipment resulting in a shortage of project funds. This is why it is important to involve a wide range of people when forecasting risks and providing input. This is how risks can be prevented in their entirety.

During construction projects, project managers cannot execute risk prevention for project implementation. Construction companies may have established their risk management measures, but these are limited to quality and safety. These risk management measures only exist in the system documentation. Construction project managers only focus on the results of the project and do not pay attention to the actual implementation of the project.

### 3.3. Risk Management Processes for Construction Projects

Summarises the construction project risk management process in response to the problems that arise in most construction projects.

Wang Jinfang [13] mentions that project risk management is consistent with the ultimate goal of the project and can be divided into pre-risk and post-risk objectives. Pre-risk management is to reduce the possibility of risk occurrence, and post-risk management is to reduce the harm caused by risk. In summary, the project risk management process can be composed of risk identification, risk assessment, risk response and risk review, as shown in Fig. 2. Gong Guangming [14] believes that project risk management is essential in the entire project management process, to accurately identify the risks arising from different factors in construction projects, to adopt targeted and effective measures, to efficiently reduce the frequency of risks and the impact brought about by risks, and to improve the construction efficiency of construction projects. Improve the construction benefits of construction projects.

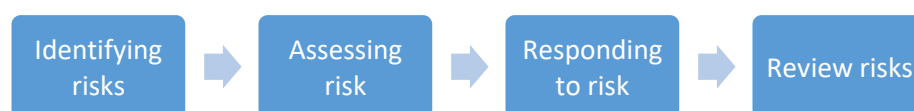


Figure 2: Risk Management Process. (photo credit: Original)

### 3.3.1. Risk Identification

Due to the complexity of a construction project, the project manager cannot focus on the specifics of each link or process. All project managers must conduct a comprehensive risk inventory of the project based on the project implementation plan and the team's capabilities and realistic environment. Risk identification does not only take place at the beginning of the project but also during the project phase when data is continuously collected and analysed to identify the risks to the project. The specific steps are as follows.

1. Form a risk identification team to make an initial risk forecast of project risks to avoid risk perception bias.
2. Make risk predictions based on field conditions and team capabilities, and seek guidance from professional risk identification experts.
3. Conduct a risk register and mark specific information for submission to the project manager.

### 3.3.2. Risk Assessment

The frequency and severity of risks are assessed based on the risk register. Risk assessments are generally carried out using qualitative, quantitative or a combination of qualitative and quantitative methods. By assessing the different risks, the order of priority or concern is based on the final ranking.

### 3.3.3. Risk Response

After clarifying the priority and severity of project risks, reduce the frequency of risks that have not occurred, or reduce the losses caused by risks that are occurring. There are four common risk response methods in project management: ignore risk, avoid risk, transfer risk, and control risk.

1. Risks that have a low probability of occurring and cause little damage when they do occur can be dealt with by ignoring the risk. The risk response will generate while resources outside the project. The most appropriate response to these small risks is to ignore them.
2. For risks that have a low probability of occurring but will cause unsustainable losses if they do occur, risk avoidance can be used. The project team avoids further investment by simply abandoning or terminating subsequent work and forfeits the possibility of profitability.
3. Risk transfer is used for risks that cannot be avoided and cannot be borne alone. Transferring the risk does not solve the risk, but only the body that bears it after it occurs. For example, a contract with a contractor or the purchase of insurance is a transfer of risk.
4. For risks that can only be borne by the project manager, or that the project manager does not want to give up, control risks can be used. Measures are taken to reduce the frequency of risks that have not yet occurred and to reduce the impact of risks that are occurring. This is a proactive approach to coping.

### 3.3.4. Risk Review

The project manager reviews the risks that have occurred and have been dealt with and makes a note of them and their impact. This facilitates the subsequent development of the project and also the accumulation of experience for the project manager. In his research, Yuan Shidong[15] found that most construction project managers lacked a systematic approach to risk management due to a lack of summary and research into the principles and methods associated with construction projects. Therefore, a retrospective summary is needed after risk treatment so that the knowledge contained in the field of project risk management can be completed.

#### 4. Limitations & Future Outlooks

The risk classification of construction projects and risk management approaches have been analysed above and scholars have different views on risk classification, but they cannot be separated from internal and external factors. The process of project risk analysis mostly ranges from risk identification, and risk assessment to risk response. However, when project managers encounter the same risks in different projects, they may not be able to react and respond in time. Adding a project risk review to the risk management process can enhance the project manager's understanding of the risks. Different types of construction have different risk factors, and the risks covered in this article are summarised through historical literature reviews and are not based on risks identified through actual work experience. Future research could be directed towards the study and exploration of risk management for different construction types of projects through more practical work experience and academic visits.

#### 5. Conclusion

This paper identifies, based on historical literature, that risks in construction projects can be categorised as internal or external. The paper also summarises the problems faced by risk management based on the historical literature and ultimately concludes that the project risk management process consists of three strategies: project risk identification, project risk assessment and project risk response. However, the literature review also revealed that the project risk management process is not perfect and adding a project risk review to the original strategy can add many neglected aspects to project risk management, both in practice and academically. This paper summarises the approach to project risk classification and management through a historical literature review and identifies the shortcomings of current project risk classification and management.

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