

Risk Management and Decision Analysis for Construction Projects

Shi Yue^{1, a}

¹Chongqing Lancheng Liangjiang Industrial Development Co. Chongqing, China

^a383960371@qq.com

Abstract: As construction projects continue to grow in size and complexity, risk management and decision analysis are increasingly becoming critical key factors in ensuring the successful completion of projects. The special nature of construction projects requires project teams to be able to comprehensively and systematically assess and deal with potential risks to ensure that the project can be completed with high quality within the scheduled time and budget. Based on analyzing the importance of risk management in construction projects, this paper discusses in depth the current situation and problems of risk management in construction projects, and puts forward countermeasures to strengthen the risk management of construction projects, so as to improve the feasibility and success of the project.

Keywords: Construction projects; Project management; Risk management; Decision making.

1. Introduction

1.1. Background of the study

As a complex and large engineering system, construction projects involve multiple stakeholders, numerous variables and uncertainties. Throughout the life cycle of a project, it is inevitable that it will face various risks, which may come from a variety of aspects such as technology, economy, law, management, and environment. Effective risk management and decision analysis are of key importance to ensure that projects are completed as planned and with high quality.

Many construction projects in the past have suffered from project delays, over-budgeting, and substandard quality due to failure to properly handle risks. As a result, more and more attention has begun to turn to how to identify and manage risks early in the project and how to make informed decisions to cope with change and uncertainty during project execution^[1]. This has made risk management and decision analysis a popular research topic in the field of construction project management. In the current economic environment, the number of global construction projects is increasing, as well as their scale and complexity. Against this background, traditional project management methods can no longer meet the higher requirements for project success, and more emphasis is placed on scientific and systematic handling of risks and uncertainties in projects. Therefore, it is necessary to deeply study and apply advanced risk management methods and decision analysis tools to cope with the multi-level and multi-dimensional challenges faced by construction projects. This dissertation will explore risk management and decision analysis in construction projects, with a view to providing practical guidance and theoretical support to the industry and improving the feasibility and success of construction projects.

1.2. Purpose and significance of the study

In today's society, the success of construction projects, as an engine to promote social and economic development, is directly related to the sustainable prosperity of the whole society and the rights and interests of relevant stakeholders.

However, due to the complexity and uncertainty of construction projects, projects are exposed to potential risks at multiple levels and in multiple areas. Therefore, this study aims to provide an in-depth understanding of risk management and decision analysis in construction projects with the objective of improving the feasibility and success of the projects.

In-depth understanding of risk characteristics in construction projects, through careful analysis of risks in different project phases, this study aims to gain a deep understanding of the characteristics of risks in construction projects in various aspects, such as technical, economic, legal, managerial and environmental, to provide a more comprehensive cognitive foundation for the project team; exploring effective risk management methodologies, this study will study and summarize current effective risk management methodologies, including but not limited to risk identification, risk assessment and risk response, aiming to improve the project team's ability to identify and respond to potential risks, and to ensure that the project can respond quickly and effectively when facing challenges; to study the application of decision analysis tools in construction projects, through in-depth study of decision analysis tools, including decision tree analysis, cost-benefit analysis and simulation analysis, etc., the study aims to provide project decision-making with more scientific and objective support. more scientific and objective support to help project teams make more informed decisions in an uncertain environment.

By conducting risk management and decision-making research on construction project envy, it not only helps to improve the success rate of construction projects^[2]. Through in-depth research and application of risk management methods, the primary significance of this study is to effectively reduce all kinds of risks faced by the project, so as to improve the feasibility and success rate of the project, and to contribute to the socio-economic development of the society with more considerable benefits. Moreover, it is conducive to the optimization of the project decision-making process: the introduction of decision analysis tools helps the project team to consider various factors more comprehensively, making the decision-making more

scientific and rational, thus optimizing the entire project decision-making process and improving the efficiency and quality of project execution. It promotes the construction project management field to better adapt to the ever-changing social needs, pushes the industry to pay more attention to the practice and research of risk management and decision analysis, and injects new vitality into the development of the whole field.

2. Major Risks in Construction Projects

In construction projects, various types of risks are intertwined and may have a significant impact on the implementation of the project. This section will explore in detail the major risks of construction projects, including technical risks, economic risks, legal and compliance risks, and management and organizational risks.

2.1. Technical Risks

Technical risk is one of the most significant risks in construction projects and involves the uncertainty of the technology, processes and equipment used in the project. Specifically, technical risk includes three main aspects, firstly, technical innovation difficulty, the introduction of new technology in the project may lead to uncertainty in the implementation of technology, and the need to solve the problems and challenges posed by the new technology. Second is technical feasibility, in the project start-up phase, the technology selected is fully evaluated to ensure its feasibility in practical application, in order to avoid technical difficulties affecting the project progress. Lastly, supply chain risk. Dependence on specific suppliers or manufacturers may bring about unstable supply, delays, or quality problems, affecting the entire project.

2.2. Economic Risk

Economic risk is another important aspect of construction projects and is affected by factors such as market fluctuations, price changes and financial pressures[3]. The main economic risks are firstly price fluctuation, the fluctuation of construction materials and labor costs may lead to the project cost exceeding the budget, which affects the project's economic efficiency; secondly, the change of market demand, the uncertainty of market demand may lead to the project facing the leasing difficulties or poor sales in the operation stage, which affects the project's economic return. Finally, there is financing risk. Projects that rely on financing may be affected by interest rate fluctuations and uncertainty in the financing market, which may result in higher financing costs or failure to obtain sufficient financial support.

2.3. Legal and compliance risk

Legal and compliance risk relates to the level of compliance of a construction project at the legal, regulatory and contractual levels. This category of risk regulations changes government regulations that may bring additional compliance requirements to the design, construction and operation of the project, requiring the project team to make timely adjustments; contractual disputes, unclear or imperfect contractual terms may lead to disputes between project partners, increasing the legal risks of project implementation; environmental regulations, when the project involves environmentally sensitive areas, non-compliance with

environmental protection regulations may lead to legal liabilities and fines, affecting the sustainability and reputation of the project.

2.4. Management and Organizational Risks

Management and organizational risks are concerned with challenges in the project team and organizational structure that may affect project implementation and synergies. Key management and organizational risks include: people management, where the organization, training, and management of the project team may be affected by factors such as staff changes, lack of competence, or internal strife; communication issues, where unclear or lagging communication may lead to poor transfer of information, which may in turn affect project decision-making and execution; and supply chain management, where instability in the supply chain may lead to disruptions in the supply of materials and equipment, causing delays and problems for the overall project implementation. implementation, causing delays and problems.

Technical, economic, legal and compliance as well as managerial and organizational risks in construction projects need to be comprehensively identified, assessed and addressed at different stages of the project to ensure that the project can be carried out efficiently and in an orderly manner and achieve the desired goals.

3. Countermeasures to Improve Risk Management of Construction Projects

3.1. Increase the cultivation of talents

All management work of the enterprise, large to the development of enterprises, small to the implementation of project management standards, and ultimately must rely on people to complete. No talent, can only be on paper[4]. At present there is a prominent problem is the shortage of talent. The use of talent, especially young people, not only to dare to press the burden, bold use, but also to correctly treat the problems that arise in the process of growth, not to exaggerate, not to minimize the evaluation of objective and fair, so that the talent to grow.

3.2. Adoption of systematic and comprehensive assessment method

The systematic and comprehensive evaluation method is to refer to the quantitative indexes of economic calculations, combined with the qualitative indexes described by various "non-economic factors". Focusing on the experience and wisdom of experts and evaluators of the engineering project risk management process for a comprehensive analysis of the assessment method. It can objectively reflect the characteristics of engineering project risk management such as long cycle, complex risk treatment countermeasures and far-reaching consequences. It is a breakthrough in the analysis from the methodological point of view compared with the single economic indicator as the basis of assessment. It is a breakthrough in analyzing from the methodological point of view. It is based on fuzzy mathematics, gray system theory and interval analysis theory. It is characterized by the complementarity of theory and experience, the combination of quantitative analysis and qualitative analysis, and strong operability.

3.3. Risk transfer

Risk transfer refers to the fact that some operators or units consciously transfer the risk to others in order to protect and reduce the damage of the risk they suffer. Risk transfer has control type non-insurance transfer, financial type non-insurance transfer and insurance transfer in three forms. Control-type non-insurance transfer, the transfer is the loss of legal responsibility, through the contract or agreement to eliminate or reduce the assignor to the assignee's loss of responsibility and the third party's loss of responsibility. Financial non-insurance transfers are those in which the assignor seeks, through a specialized agency and in accordance with the relevant law, compensation for the loss in the form of external funds. An insurance transfer transfers the risk to an insurance company by obtaining indemnification from the insurance company[5].

4. Measures to Enhance Risks in Construction Works

4.1. Strengthen the risk management in the process of prediction and decision-making.

In the bidding decision-making process, each contractor facing possible risks should carry out risk investigation and prediction, mainly including the analysis and study of relevant documents, investigation and understanding of the local hydrology, weather, terrain, local raw materials, local folklore and rural regulations, relevant policy documents and so on, and then the relevant risk factors are divided into categories for generalization, to find out the impact of the greater, the probability of occurrence of a higher, greater loss of the risk factors, for each type of risk to develop appropriate preventive measures, put forward countermeasures to prevent risk, and develop risk when reducing losses. Risk factors, for each type of risk to formulate corresponding preventive measures, put forward risk prevention measures, and formulate emergency measures to reduce losses when the risk arises.

4.2. Strengthen the internal management of the enterprise, so that the risk is reduced to a minimum.

In the process of project management, most of the risks can be prevented and resolved, which requires each contractor for different projects should be assigned to different project managers and managers. Complex engineering, risky projects, should be selected and assigned experienced, high level of knowledge of the project management staff, and fully demonstrate the feasibility of the construction organization design (construction program), strengthen the functional departments of the project management and support, rational allocation and use of resources, in order to minimize the contractor's own reasons for the various risks brought about by the contractor.

4.3. Scientific attitude to risk, to avoid risk by legal means

Although risks are unavoidable and objective in the process of project implementation, we can approach these risks with a scientific attitude and avoid potential threats through reasonable means[6]. The creation and elimination of risks follow certain patterns, so taking effective preventive measures can usually minimize potential harm. In dealing

with risks, especially in eliminating and avoiding certain risks, we should adopt scientific and reasonable means, and legal means is one of the important preventive measures. By formulating appropriate legal policies and regulations, we can better protect our own interests and minimize potential losses. The implementation of legal means can not only regulate various behaviors in the process of project implementation, but also provide a clear relationship of rights and responsibilities and contractual obligations for all parties, thus providing a clear legal basis for dispute resolution when risks occur. This approach not only helps to improve the project team's awareness of legal risks and prevention, but also provides a strong legal guarantee for the smooth implementation of the project.

4.4. Adopt reasonable way to disperse and transfer risk

Engineering project management in the risk is a large number of existing, but some risks before the occurrence of can be dispersed, transferred or even eliminated, the key is to the correct method, the right strategy, the right skills. Shrewd contractors in the project before the implementation, has been in the use of skills to transfer risk, such as joint contracting, will be some of the individual project subcontracting, project insurance.

4.5. Strengthening linkages and coordination between

Helps to reduce risks caused by human factors. In the construction of engineering projects. Participate in the work of people from all aspects, everyone is working for their own interests, in the objective are caused by the contractor to deal with many uncertain risk factors. At the same time, project management is, to some extent, human management. Therefore, to strengthen the linkage and coordination of all aspects. Helps to reduce the risk caused by human factors. Avoid a lot of undue trouble. Thus, it is also conducive to the progress of the project. In addition, the composition of the risk management team also plays an important role in risk control. Ideal risk management team consists of risk manager and different levels of project management personnel, the team should include external experts[7]. The individual attitudes and experiences of different project participants can lead to different interpretations of the project objectives. Inevitably, this will affect how they identify, assess and manage potential risks.

In short, the risk of construction project management is objective, we only according to the characteristics of the construction project and the implementation of the enterprise itself, timely analysis of construction project management may produce risk factors, and targeted control measures. Do a good job in construction project risk identification, risk analysis, risk evaluation, risk countermeasures and risk control and a series of perfect and systematic risk management, for promoting enterprise development, reducing social costs, and practicing economy has a very important significance.

5. Conclusion

Driven by the new situation, construction projects face more complex and highly demanding challenges. In order to meet the requirements of this new era, the construction industry is carrying out a series of innovations and reforms.

Among them, by implementing the project economic management system, separating the management layer from the operation layer, market-oriented management of internal resources and other measures, it aims to realize the transformation of the enterprise from rough to intensive, from speed to efficiency, and from intensive to the combination of labor and technology, so as to improve the efficiency and quality of the construction and building units. However, there is still a certain gap between China's current construction market and that of foreign countries. Therefore, learning from the successful experience of foreign construction projects, risk prevention measures, for China's construction industry is an important progress. At the same time, we must explore and find the way of building construction projects suitable for China's national conditions on the basis of borrowing to ensure the smooth progress of the projects. This not only requires us to actively absorb the essence of foreign experience, but also to seek innovative paths with Chinese characteristics in practice, so that China's construction industry can be more competitive globally.

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