Critical Risk Factors of Implementing Public–Private Partnership Projects

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Due to the fact that risks can cause project delays and increase project implementation costs, successful construction project completion requires effective and holistic risk management. Identification and evaluation of critical risk factors (CRFs) associated with different types of projects are the most significant components of accurate risk management.

Keywords: risk management ; risk factors ; PPP ; water and wastewater

1. Introduction

Today, risk and its related trends have found their place in various fields including investment; trade; insurance; safety; health and treatment; industrial and construction projects; and even political, social, and military issues. In the meantime, risk management has a special place and a common root with the project. Features such as the project uniqueness; relative reliability in the assumptions; the project goals and requirements; uncertainty in the estimations, design, supply, and procurement of the main equipment of the project; the effect of environmental factors on the project; the relationship between the members and the goals of the project; and expecting to achieve the desired product at the end of the project process are the sources of risk in the project. Hence, there is an inevitable need for strategic management planning to check project uncertainties and risks [1].

Risk management is a logical and systematic method to analyze, evaluate, and deal with risk related to any type of activity, enabling organizations to minimize losses while taking advantage of opportunities. The greatest benefit of risk management for a company is the general reduction in the occurrence of avoidable accidents and related costs, subsequently contributing to the continuity of business activity. Risk management leads to more informed decision making, coherent planning, and efficient use of resources. The complexity of the environment, the intensity of competition, the spread of novel and advanced technologies, the development of information and communication technology, new ways of supplying goods and services, environmental issues, etc., are among the main factors leading to numerous and even unforeseen risks for organizations and economic enterprises during their lifetime [2].

Due to the limited financial and budgetary resources, governments often face many problems besetting with financing large-scale construction projects and infrastructure services. The demand for investment in large and infrastructural projects has prompted countries to use a method called public–private partnership (PPP) alongside the public sector [1].

PPPs have been widely used in developing countries to carry out numerous projects in the energy, water and wastewater, telecommunication, airport, railway, and port sectors. In recent years, there has been a strong need for infrastructure in many countries due to increasing population growth and economic development [1]. Hence, governments are trying to find a new solution for these shortcomings by employing and activating the private sector in infrastructure projects [3].

Ke et al. [4] investigated the preferred risk allocation in China's public–private partnership projects using the Delphi technique. The results indicated that the public sector was solely responsible for the risk (style of ownership and localization), and government officials were responsible for the majority of the next identified risks, which required their actions. In addition, 14 risks that the public and private sectors can deal with should be equally shared between the two parties. The private sector is responsible for 10 risks at the project level, according to which executive solutions should be proposed to overcome the identified risks. Chan et al. [5] investigated potential obstacles to the successful implementation of PPPs in Beijing and Hong Kong and prioritized 13 potential barriers to participation, extracted from the research literature. According to the research findings, lengthy delays in negotiation, lack of experience and appropriate skills, and lengthy delays because of the political debate were the top three obstacles rated by the Beijing respondents. Likewise, the first and third obstacles were also ranked within the top three by the Hong Kong respondents, while the factor of "very few

schemes have reached the contract stage (aborted before the contract)” ranked as the second barrier to the partnership in Hong Kong.

Liu et al. [6] evaluated the critical factors affecting the effectiveness and efficiency of tendering processes in PPPs in Australia and China. The research identified 14 critical factors underpinning the implementation of PPP tendering under seven dimensions: robustness of business case development, quality of project brief, public sector capacity, governance structures, the effectiveness of communication, the balance between streamlining and competition, and level of transparency of tendering processes. The results of the comparative analysis of these factors in the two mentioned countries showed significant statistical differences regarding the importance of these factors among their PPP projects. It was emphasized that both public and private entities engaging in PPP projects would be in a better position to structure and manage the tendering processes by adopting the recommended strategies. Noorzai et al. [3] focused on selecting an appropriate PPP financing method to finance railroad projects in Iran. Sadeghi Shahedani et al. [7] investigated the priority development of PPPs in the transport sector of Iran. Najafi and Malekan [8] examined a strategy to finance new infrastructure PPP projects. Heibati et al. [9] studied the relationship between economic freedom and PPPs and provided a model for Iran. Maki-Abadi et al. [10] sought to identify and assess critical risk factors (CRFs) in HSR projects through PPPs in developing countries. Meanwhile, the precise identification of risks can significantly influence the management of risks within a project. The presence of risks within PPP contracts can lead to unfavorable outcomes and serve as a deterrent for contractors. In the context of developing countries, the reluctance to involve the private sector in the construction of water and sewage industry infrastructure can be attributed to the presence of several risks and uncertainties associated with such investment endeavors. Hence, the identification and examination of these risks and uncertainties, along with efforts to address them, can serve as a foundation for increased involvement of the private sector and the effective execution of PPP initiatives. Furthermore, the identification and thorough assessment of the risks involved can be regarded as a crucial first phase in the appropriate allocation of these risks between the private and public sectors. Consequently, this process will exert a substantial influence on the success and advancement of the objectives associated with these projects.

2. Determining the Critical Risk Factors of Implementing Public–Private Partnership in Water and Wastewater Infrastructure Facilities

The widespread demand and lack of capital for water infrastructure have led to the rapid growth of PPPs in the water sector. However, the current trend in this market shows that many foreign companies have either reduced their activity or are withdrawing from the market [11]. These conditions can be associated with specific risks in investing in water and wastewater infrastructure (WWI), including the current low level of water prices and the difficulty of (market) regulation. Thus, accurate identification of the risks of PPP projects in WWI is necessary along with appropriate solutions to deal with such risks [12][13][14][15].

Several studies have identified and investigated obstacles and risks related to WWI in developing countries [16][17]. According to these studies, various risks threaten the development of WWI, including failure to provide sufficient funds on time, failure to provide and pay the contractors and manpower claims on time, failure of the employer to obtain necessary permits, uncertainty, and purchase of the project site by the employer. Some studies also show that managerial, financial, legal, and political risks are the most CRFs of water projects in developing countries, including Iran [18]. As can be seen, financial problems and issues are at the top of the risks related to the development of WWI in developing countries. PPP contracts can be a suitable solution to deal with this issue [14]. However, it is noteworthy that the use of such contracts should be accompanied by the necessary awareness of uncertainties, enabling the parties to the contract to participate in the development of infrastructure with greater certainty of success in the realization of their goals [14][18].

Risk results from the interaction of project goals, i.e., time, cost, quality, performance, the scope of work, and uncertainty, which can lead to threats or opportunities. The independent analysis of risk allocation in the water and wastewater sector has value and information content. Project risk management includes six steps: 1. risk management planning, 2. risk identification, 3. qualitative assessment, 4. evaluation, 5. risk response planning, and 6. risk monitoring and control [2].

Priya and Jesintha [19] discussed the public–private partnership among the domestic and foreign players and found that using both groups in these projects would lead to progress in India. Kayaga (2008) emphasized that local conditions in PPP water projects are often not carefully examined, due to which the project structure cannon comply with the prevailing constraints. As a result, many PPP water projects in developing countries are not carried out properly, face conflicts, or get involved in disputes that affect their performance negatively.

Ameyaw and Chan [20] introduced 40 risk factors in PPP water projects in developing countries and highlighted CRFs in this field after examining six cases from these countries. These factors included weak regulations, financial weakness, non-payment of claims, lack of experience in research related to risk identification, and limited evaluation of PPP contracts according to the environmental conditions of developing countries. Wibowo and Mohamed [21] investigated risk factors in PPP water projects in Indonesia and identified 39 risk factors, some of the most important of which included uncertainty of pricing (tariff), breach of contract by the government, lack of raw water, and high costs of infrastructure construction.

Ezeldin and Badran [22] identified 59 CRFs affecting PPP water projects through a literature review and interviews with experts and divided them into several CRFs groups. The risk factors were investigated by distributing a questionnaire among 25 experts who worked internationally and were active in the Egyptian market. They introduced risk factors such as financial and macroeconomic, commercial, legal, political, government supervision, government maturity, and technical and unforeseen risks as most CRFs groups.

In Ghana, Ameyaw and Chan [23] identified 40 risk factors in PPP water projects and introduced 22 risk factors in the form of three financial/commercial, social/political, and technical/technical groups as CRFs. In this investigation, the financial/commercial group had the highest level of total risk, followed by the social/political and technical/technical groups in the second and third ranks, respectively.

Yin et al. [24] examined PPPs in water projects in China and introduced nine risk groups, namely, construction, cooperation relationship, operational, policy, environment, political, design, macroeconomic, and financing risk factors. According to the results, financial risks were found to be the most critical group of risks in PPPs for water projects in China.

Issa et al. [25] focused on a risk allocation model for construction projects in Yemen and concluded that construction projects in Yemen always experience high levels of risk due to their complex and dynamic environments. The model was developed considering 54 risks in 10 groups. They stated that the 30 identified CRFs must be allocated to the owner or contractor, or shared between them. The results showed that this model is easy to understand and use by contract parties. The model also helps decision-makers make appropriate decisions regarding the selection among different projects based on risk factors in the bidding and price proposal stages. The risk allocation model enables risk management.

Liu et al. [6] obtained 14 critical factors in the implementation of PPP water projects according to a literature review, interviews with experts, and the distribution of questionnaires. Rezaei Noor and Mousavi [18] dealt with risk ranking in PPPs of water supply projects using failure mode and effect analysis (FMEA) and fuzzy synthetic evaluation methods in Qom province. First, 39 risk factors were introduced according to the literature and national and international research. The risk priority values were then obtained using the failure mode and effect analysis (FMEA) method. After normalization, 22 factors were recognized as CRFs and classified into four managerial, legal/political, financial, and technical subgroups. According to the examination and calculation of the overall level of risk in each subgroup using the fuzzy synthetic evaluation method, the managerial subgroup was the most critical subgroup, followed by the financial, legal/political, and technical subgroups in the next priorities. The total risk of PPPs for water projects in Qom province was 6.19, indicating high levels of risk for the mentioned projects. Rasouli et al. [1] identified, ranked, and allocated CRFs of public–private partnership stages using the Delphi technique in the framework of a resistance economy in WWI Gilan province. Their article identified, evaluated, and allocated CRFs of WWI projects in Gilan province in different stages and within each stage. The study used Build–Operate–Transfer (BOT) to extract CRFs from executive agents with direct responsibility for contracts concluded using the method of construction. A total of 37 samples were identified for the study. Then, using the Delphi technique, 17 risks with a significant degree of ≥3 were extracted and distributed among the samples through a questionnaire. Nonparametric statistical methods were used to analyze data collected in each stage of the public–private partnership (feasibility assessment, procurement, construction, operation, and transfer). The results showed a significant relationship between the risks with a significant degree of > 3 in different stages of public–private partnership in WWI of Gilan province. Also, this relationship was significant for each risk in each stage, except for one case.

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