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Risk Assessment and Prioritization in Projects with Private Public Participation Method Based on Combination of Fuzzy Multi-criteria Decision-Making Techniques (Case Study: North Freeway)

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ABSTRACT: Implementation of various infrastructure projects is one of the most important factors in the economic development of the countries. In recent years, due to the growing population and economic development of developing countries, there is a strong need for infrastructure development in many countries. One of the most important aspects of developing and developing construction projects is the financing of projects that play the most important role in project development and achievement of predetermined goals. For this purpose, in the present study, a case study of freeway projects in Iran has been conducted and semi-structured interviews with experts and experts on public-private partnership contracts in the country. For this purpose, in the first step, identifying and screening risks from the viewpoint of experts in public-private partnership contracts and introducing risk assessment criteria, then the grading weights grading analysis method was used to obtain the weight of the criteria. Finally, the final ranking of the risks of public-private partnership contracts has been taken into account, taking into account the results of the initial steps, using a comprehensive fit assessment approach. The results show that low-quality material and equipment risks, stakeholder resistance to approval, and lack of realistic goals are of great importance. The proposed framework can help stakeholders in public-private partnership agreements in developing countries to better manage the risks of public-private partnership contracts.

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1. Introduction

In a general definition, a public-private partnership is a framework contract between a private institution and a public institution that aims to provide infrastructural services to people with the help of the private sector. The nature of the development of construction infrastructure will always deal with the concepts of reliance and reflection such as risk acceptance and without accepting risk they are not able to profit and grow. One of the problems of these projects is the identification and how to deal with risk in a project, therefore, the risk identification and prioritization phase is an important issue in risk management. In this paper, we are looking for a useful way to decide and select the appropriate risk priority and rank them so that the results of this study will help project managers and experts. The research algorithm is designed based on identifying and prioritizing the risks of public-private partnership contracts. The specific method of reviewing and rating these risks is different from previous studies. First, identify the risks of public-private partnership contracts through a literature review then, using a questionnaire, engineering system experts are asked to select the effective risks in public-private partnership contracts based on their importance. In the following, risk assessment criteria are identified and the weight of each criterion will be evaluated using the SWARA method. Finally, the COPRAS method was used to rank the effective risks.

2. Research Methodology

The problem decision algorithm in this research is designed based on identifying and prioritizing the risks of public-private partnership projects and consists of three main parts. In the first part, the risks of these projects have been identified through literature reviews, such as scientific articles, Internet resources, books, and documents available in construction companies, then by designing a questionnaire, experts were asked to evaluate the risks to determine the importance of each risk, next the risk screening was done by considering the average of the total values and the risks that were more important than the total average were selected. The second part identifies the risk assessment criteria and then the weight of each criterion will be evaluated using the SWARA method. The third section focuses on assessing each risk in public-private partnership projects. This section includes design, distribution of questionnaires, and analysis using the COPRAS method.

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2.1. Stepwise Weight Assessment Ratio Analysis (SWARA)

The SWARA method is one of the new multi-criteria decision-making methods that was used in 2010 to develop a method for analyzing reasonable differences between criteria [1]. In this method, each expert determines the importance of each criterion according to their tacit knowledge, information, and experience, so that the most important criterion is ranked one and the least important of them will be ranked last, then according to the average value. Each criterion is determined by experts, the weight of each criterion [2]. SWARA is based on the opinions of experts and is a completely judgmental method. In this way, experts can consult with each other, this consultation makes the results more accurate than other MCDM methods [3]. The SWARA method is simple and understandable and is less complex than methods such as AHP and ANP and can be easily used for a large number of decision issues [4].

2.2. Complex Proportional Assessment (COPRAS)

The COPRAS method is a family of compromise methods first introduced in 1994 by Zavadskas et al. [5]. Although about two decades have passed since the introduction of this method, the use of this method has gone through an upward trend and is used in all scientific disciplines [6]. The advantage of this method over other methods is the simplicity of the steps, considering all the data of one criterion, separating the positive and negative criteria. In this method, different options are evaluated independently in terms of various criteria (not pairwise comparison) and are prioritized based on the purpose [7].

3. Results and Discussion

3.1. Evaluation of criteria weight by SWARA method

First, during the questionnaire, the statistical community was asked to prioritize the identified criteria, so that the most important criteria are in the higher categories and the less important criteria are in the lower categories. After ranking the criteria by experts, the bench-marking process was implemented using the algorithm mentioned in SWARA, and based on the computational results, risk response, identifiable risk, and unique risk were recognized as the first three criteria, respectively.

3.2. The final ranking of risks with COPRAS

First, the decision matrix with 26 risks and 12 criteria was provided to the experts, and the experts were asked to evaluate each option in terms of all criteria. Then the required calculations were performed. The final weight of each model index is calculated by the COPRAS technique. Among the effective risks of the problem, the risks of low-quality materials and equipment, resistance from stakeholders to approve ideas, lack of realistic goals, lack of information/documents for structural evaluation, and non-compliance with the standard with 100, 99/88, 97/46, 97/12, and 94/35, respectively, are of the highest importance according to experts.

4. Conclusions

Risks of public-private freeway projects are an integral part of executive actions to develop and implement project-oriented activities so that organizations cannot easily bypass this issue and is always an integral part of the project planning system. Now, companies implementing public-private partnership projects must identify these risks and take steps to mitigate their risk effects or be prepared to address them if the identified risks are not controllable. The purpose of this study was to identify the risks of the public-private partnership project, rank the risks and determine the most effective ones. Therefore, in this study, a newly developed framework for risk assessment in the public-private partnership project using the SWARA-COPRAS method is introduced. In this research, the usual risk assessment forecasting model has been extended by introducing new criteria for risk rating. Twelve risk assessment criteria were identified from the literature review, then the weight of these criteria was obtained by the SWARA method. SWARA results showed that the three criteria of risk response (C1), recognizability (C2), and uniqueness of risk (C3) with scores of 0.2265, 0.1879, and 0.1483 have the highest weight, respectively. The COPRAS method was used to obtain the risk rank based on the weight of the criteria. Initially, 52 risks were identified based on the literature study in this type of project, then 26 efficient risks were selected and evaluated using the opinions of experts. COPRAS results showed that the risk of low quality of materials and equipment (R35), resistance from stakeholders to approve ideas (R43), and lack of realistic goals (R63) are the three high risks in PPP projects, respectively. The findings of this study provide the basis for risk management in public-private partnership projects and help construction companies in Iran and developing countries to easily monitor and identify risks in these projects. According to the results of this study, it is suggested that the control measures of identified risks be evaluated and analyzed using the fuzzy FMEA technique.

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