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Managing Risks in Public-Private Partnership Projects: The Case of Izmit Bay Suspension Bridge

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Abstract
Public-Private Partnerships (PPPs) is one of the most widely used means of financing large-scale public projects. PPP agreements involve public and private sector whereby resources and risks are appropriately allocated. There has been a vast amount of research on the PPPs recently focusing on different aspects including the financing, critical success factors, risks, and concession periods. PPPs bring a number of benefits such as efficient use of resources, reduction in project costs and durations, and increase in the quality of public services. However, depending on the complexity of the projects and the procurement process, PPPs inherit a high number of risks. For a successful PPP project, risks should be managed carefully. The major objective of this research is to investigate the risk management process in a PPP project. PPPs have been increasingly used in Turkey for the last decade. In this respect, Izmit Bay Suspension Bridge linking the Turkish cities of Izmir and Istanbul is selected as a case study. Upon its completion, it will be the world's fourth longest suspension bridge. The paper first identifies the risks in this project, then presents the risk analysis, and finally mentions the risk response strategies. The paper provides recommendations on how to better allocate risks among the participants of a PPP scheme. The findings of the study suggest that the most significant risks are the political, legal and regulatory, financial, and construction risks.

Keywords
Public-Private Partnerships, Risk Management, Izmit Bay Suspension Bridge Project

1. Introduction

Public-Private Partnership (PPP) arrangements have gained considerable attention for the provision of the services by the private entity over the last decade. Especially, infrastructure projects that require high contingency budget and specialized expertise in construction lead to increasing number of contractual agreements between the public and private entities. Therefore, PPP arrangements are considered to be effective means for the delivery of the large-scale infrastructure projects (Ke et al., 2010). PPP projects are also efficient in integrating the benefits of competitive tendering and flexible negotiations to better allocate the risks on project parties (Bing et al., 2005). A considerable number of researchers have investigated the key aspects of operating PPPs. For example, Li et al. (2005) focused on the critical success factors for PPP projects and found that the most important success factors for PPP projects were strong private sector consortium, appropriate risk allocation and available financial market. The study essentially aimed to guide companies that are willing to establish PPP arrangements and lead them to establish strategic policies in PPP arrangements. Another study conducted by Ysa (2007) investigated the governance forms in PPP projects and it concluded that the form of governance in a PPP project affects

the management of the relationship between public and private party. This study also showed that the structure of a PPP project is very important in the success of the public-private collaborations. Smyth and Edkins (2007) conducted research on the relationship management of PPP projects. The study focused on the managing the relations between public and private entities to achieve success in PPP projects. Risk issue constitutes an important part in most of the studies conducted on PPP projects. Although some researchers have focused on the financing of PPP projects or management of relationships in PPP arrangements, a considerable amount of work has been done on risk management, risk identification, risk evaluation and risk allocation. Since clear understanding of the identification of project risks is a need, risk allocation and recognition of the potential risks is essential in PPP projects.

Given this background, this paper investigates the risk management process in a large-scale PPP project in Turkey. In this respect, firstly the risks are identified, then risk analysis is performed, and finally risk response strategies are proposed.

2. Risk Assessment in PPP Projects

Several researchers indicated that the establishment of a risk assessment model is crucial for the success of PPPs. For example, Delmon (2000) implied that PPP projects are completed with the existence of several risks and thereby their impacts are significant since those risks arise from several different resources such as market conditions, economic environment, construction cost and policies. Shen and Wu (2005) conducted research on developing a risk concession model in Build-Operate-Transfer (BOT) projects where the impacts of the risks are evaluated and basic interest of both government and private entities are protected. Shen et al. (2006) investigated the role of PPPs in managing the risks in public sector projects in Hong Kong. The study indicated that the establishment of PPP arrangements has been an effective way of reducing the project risks. Another study investigated the outcome of a risk perception analysis in terms of evaluating risk management capability, risk allocation preference and determination of factors that affect the risk acceptance of principal stakeholders (Thomas et al., 2003). Abednego and Ogunlana (2006) investigated the owner's perception on proper risk allocation and project success besides revealing the impact of risk allocation schemes on the project performance through the analysis of risk allocation strategies. The results of the study have proved that a proper risk allocation can only be achieved with the identification of the risk type, selection of the party that can best bear the risk and the risk management strategy implemented to manage the risk. The importance of the risk allocation strategy was also implied in another study conducted by Ng and Loosemore (2007) stating that communities can only benefit from the provision of private sector in PPP projects under well-set risk allocation strategies. Previous work clearly implies that proper identification, analysis, and allocation of risks provide a better risk control structure for the project parties that are responsible for managing the risks. In the light of the previous studies, the major objective of the paper is to investigate the use of PPP arrangements for the delivery of an infrastructure project and to reveal an accurate risk management strategy where the key risks are identified and appropriate strategies are developed. Since there is a need in the literature for an accurate risk management approach, this study is conducted by the inclusion of a major infrastructure project. In this respect, a suspension bridge is selected as a case study. The major risks for the project are categorized under risk types and a qualitative analysis of the risks is conducted. Finally, the risk response strategies are proposed to successfully manage PPP structures for the provision of infrastructure projects.

3. Research Methodology

The data used in this study is collected through in-depth interviews conducted with project parties. The interviews intended to reveal the major risk types, the impact of the risks and the probability of

occurrences. The interviews also aimed at constructing a risk management scheme by the accurate risk allocation and development of risk response strategies. To reveal the major risks, the interviewees are selected among the senior managers or executives of both public and private parties. The first section of the interviews intended to identify key risks that might arise in the project. In the second section, the impacts and probability of occurrences of those identified risks are discussed with the interviewees.

4. Case Study Background

The case study selected for this research is located in Izmit, Turkey. The reason behind the selection of this project as a case study is that the project is a typical PPP arrangement adapting BOT delivery system. The project consists of the construction of a highway that will connect Istanbul and Izmir through a suspension bridge. Within the scope of this research, only suspension bridge is going to be evaluated since it is a large-scale project by itself with its high budget and scope. As indicated above, interdepartmental relations between public and private parties are important in the success of PPP projects, an organization chart is presented below to reflect the relations among project parties. As it can be seen in Figure 1, EPC contractor of Izmit Bay Bridge is a Japanese construction consortium 'IHI-ITOCHU' being the sole responsible for the engineering, design and construction. Besides, the project organization chart consists of several subcontractors. The responsible party for the coordination of EPC contractor and all subcontractors is OTOYOL A.S. and the six-contractor consortium that is responsible for the construction of highway is 'NOMAYG' (Figure 1).

The crossing of the bridge is located at the eastern end of Marmara Sea and it is roughly 50 km away from Istanbul and it allows access to the southwestern region of Turkey. The main span of the bridge is designed to be 1550 meters between its pylons and its total length is around 3 km. With this length, the bridge is going to be fourth longest suspension bridge in the world. The bridge is now under construction and almost half of the construction work has been completed so far. The bridge is going to be delivered by BOT project delivery system and the consortium has the right to operate the bridge for 22 years and 4 months after its construction has been completed. The project budget is estimated to be 1 billion US Dollars and it is one the most prestigious projects in Turkey since several foreign entities are involved and the latest construction techniques are implemented. The project completion is around three years as per clause of the contract and a time extension is strictly guaranteed by the contract clauses.

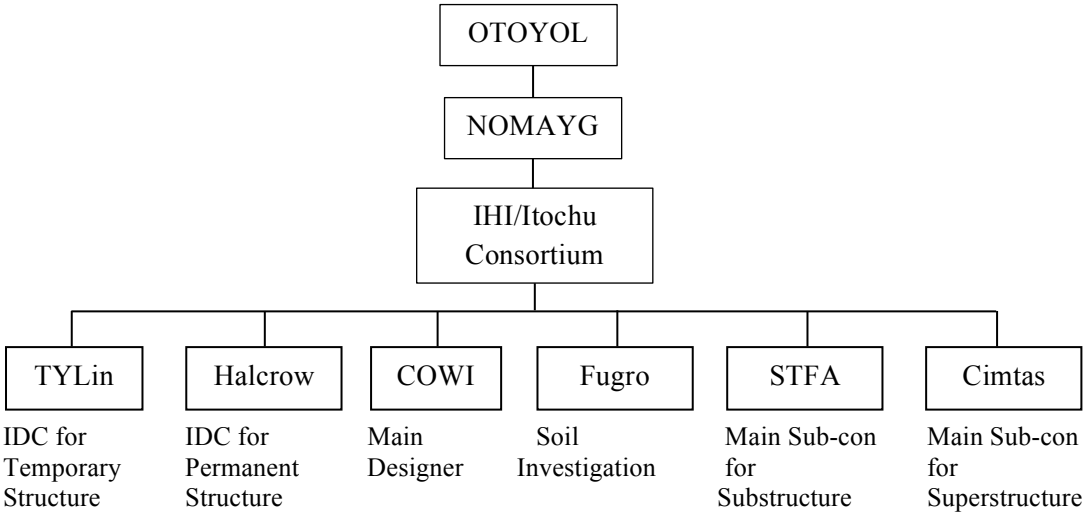

Figure 1. Organization Chart

5. Risk Identification

The risks in a PPP arrangement usually arise due to the size and complexity of the projects. Since Izmit Bay Crossing Suspension Bridge is a large-scale project, several risk types are observed. Those risks are determined through the in-depth interviews conducted with the experienced personnel of both private and public parties. The content and the spectrum of the risk types are summarized below.

• Technical Risks: Izmit Bay Crossing Suspension Bridge is a large-scale project. Therefore, the technical expertise is crucial for the completion of the project. The interviews conducted with the project executives showed that the project has several technical risks such as design failures or lack of engineering expertise.
• Financial Risks: The project requires a high budget since it is a large-scale project. Therefore, financial risks might also arise due to problems in cash stream during the project or unexpected costs might occur during design or construction phase. Since the project is privately financed by IHI-ITOCHU consortium, the financial risks are not covered by the public entity, therefore government support is not considered for the completion of the project.
• Legal, Regulatory and Political Risks: Legal risks of the project are determined as the incompatibility of the legal regulations in terms of specifications, codes and requirements with those of the awarded company are familiar with. Political risks are those that the Turkish government acts unsupportive for certain cases. The project involves several foreign entities that take part in the design and construction processes and therefore, faulty applications in the local regulations and legal cases might arise. Thus, it is determined that the legal, regulatory and political issues are among the risks of the project.
• Force Majeure Risks: Unexpected events such as wars and acts of God might occur in any project. Therefore, force majeure risk is also determined as one of the risks of the bridge project.
• Design Risks: Design risks also exist for most of the projects. These risks consist of faulty applications in design services and lack of design expertise. Bridge design is an endeavor that requires complex design schemes and the careful consideration of the simple and important details. Even though the designer of the company has experience in infrastructure projects and bridge design, design risk always exists.
• Engineering and Construction Risks: Engineering and construction risks exist for almost all construction projects. For this project, those risks encompass the application of faulty construction techniques, delays in construction schedule, and lack of engineering expertise. Since the construction works are assigned to several different subcontractors, the lack of coordination among subcontractors, different construction techniques and expertise levels might trigger the faulty applications which in turn lead to the arising of the risks.
• Demand/Revenue Risks: Demand and revenue risks are also common for most of the engineering projects. These risks consist of unexpected high and low demand compared to the initial assessment. Since the case study requires a continuous cash flow and supply of goods, demand and revenue risks are expected.
• Environmental Risks: Environmental risks are determined as failure in meeting the environmental requirements and obtaining the necessary environmental permits. The project site is located in a region where environmental conditions are not safe enough because the project location is in an industrial zone, where chemicals might create defective cases. Hence, environmental impact assessment needs special attention. Therefore, environmental risks are strongly underlined by the project executives.
• Operation and Maintenance Risks: Operation and maintenance risks are determined as failure to meet operation and maintenance demands. The project has a long operation and maintenance duration after the concession period and several risks are expected to arise during the operation and maintenance phase.
• Quality Assurance and Control Risks: Quality assurance and control risks encompass failure in meeting quality requirements, standards and objectives. Due to the fact that the project has several quality targets, there are the risks of meeting some of those targets. Thus, quality assurance and control risks in the project are unavoidable.
• Safety Risks: Safety risks are determined as failure in meeting safety standards and regulations. The project employs a considerable number of construction workers, project safety managers, and safety

agents, who are responsible for enhancing safety awareness. For the cases where the workers are not aware of the safety rules and safety agents are not good enough in teaching safety, high accident rates that might arise during the project. Thus, safety risks are inevitable for the project.
• Traffic Risks: Traffic risks are site and lands risks and failure in controlling flow of traffic. Since site reclamation and investigation works are highly sensible for the bridge project, traffic risks are expected to arise during construction work.
• Completion Risks: Almost every project has a completion risk. Completion risk is mainly due to the failure to complete the project within budget and within schedule. Thus, bridge project has also the risk of failure in completion, since it is a vast and complex project.

6. Risk Analysis

For PPP arrangements to be achieved successfully, the analysis of the risks is essential. Especially, risks need to be evaluated to investigate the risk approach from different perspectives. Within the context of the case study, the risk analysis is conducted by using a quantitative impact scale and probability of occurrence evaluation. The interviewees were asked to rate the impact and probability of occurrence for each risk. The average ratings are for both impact and probability of occurrence for each risk type are shown in Table 1. Moreover, the significance of the risks is also determined by multiplying the impact and probability of occurrence values that is called as risk severity. In this context, the effects of those risks on the project duration are determined. The risk impact definitions are as follows; 1: Very low (impact is negligible); 2: Low (little impact); 3: Medium (considerable effect on the project); 4: High (severe effect on the project); 5: Very high (project completion is threatened). The probability definitions are as follows; 1: Very low (unlikely to occur); 2: Low (may occur occasionally); 3: Medium (is as likely as not to occur); 4: High (is likely to occur) and 5: Very high (is almost certain to occur). The impacts and probability of occurrences of the risks were evaluated together to determine the significance of the risks where the risk (Table 1). For the significance values, which are lower than or equal to 5, the risk level is determined as “low”. For the significance values, which are between 5 and 12, the risk level is determined as “medium”. “High” risk levels are observed for the significance values, which are greater than 12.

Table 1. Risk Analysis of the Project

Type of Risk	Impact	Probability of Occurrence	Significance (Impact*Probability)	Risk Level
Technical	4	2	8	Medium
Financial	5	3	15	High
Legal, Regulatory, Political	5	4	20	High
Force Majeure	3	3	9	Medium
Design	4	3	12	Medium
Engineering and Construction	5	3	15	High
Demand/Revenue	3	3	9	Medium
Environmental	4	3	12	Medium
Operation and Maintenance	3	3	9	Medium
Quality Assurance and Control	3	3	9	Medium
Safety	4	3	12	Medium
Traffic	4	3	12	Medium
Completion	4	2	8	Medium

According to Table 1, the most significant risks of the project are determined as legal, regulatory, political; financial; and engineering and construction risks, since they have considerable impact on project

duration and their probability of occurrences are relatively high and they are categorized in the high risk level. In addition, design; environmental; safety; and traffic risks also deserve special attention in terms of affecting the project duration. Even though these risks have medium risk levels, their significance values are relatively high. Finally, force majeure; demand/revenue; operation and maintenance; quality assurance and control; technical; and completion risks are not significant as other risks having medium risk level but they might also create slightly significant impacts.

7. Risk Allocation and Risk Response

For a successful risk management scheme, the risks need to be allocated appropriately. In this project, the risks are also allocated to the party that can best manage the risk or the risks are shared between public and private entities. Table 2 shows the risks identified in the scope of Izmit Bay Crossing Suspension Bridge project and the allocation of those risks between project entities. According to Table 2, it is shown that the private sector entity is the sole responsible for the technical, design, engineering and construction, quality assurance and control and safety risks while the private entity is the sole responsible for legal, regulatory and political risks. Additionally, it is also observed that the financial, force majeure, demand/revenue, environmental, operation and maintenance, traffic, and completion risks are shared. Developing risk response strategies for the evaluation of risks in a project is one of the most important steps to complete the risk management scheme. Therefore, the risk level of the potential risks of the case study is determined and risk response strategies are developed accordingly.

The proposed strategies are summarized in Table 2. Based on the type of risks, it is suggested that the party that can best bear the risks overcome more risks. For example, technical risks are transferred to the public sector since public sector is able to provide technical support whenever required with its staff ready to solve technical problems. Another risk response strategy suggested is that setting up a high contingency budget from which unexpected costs might be covered. Moreover, it is also suggested that the legal, regulatory and political risks might be reduced where the familiarity is enhanced with the host country's laws and regulations. Force majeure risks are very common for most of the construction projects. Therefore, enhancing awareness of the project personnel is suggested as a risk response strategy to minimize the effect of force majeure risks. Moreover, preparing different design schemes is suggested as a risk response strategy to minimize the design risks. Engineering and construction risks also constitute a high-risk level thereby employing high skilled and qualified labor is suggested as the risk response strategy. Demand/Revenue risks are suggested to be minimized by enhancing cash stream control. Another risk response strategy is defined as preparation of the environmental impact assessment reports with higher sensitivity and evaluation of environmental conditions properly to eliminate environmental risks. Operation and maintenance risks also exist for large-scale projects. These risks might be minimized by high skilled operation and maintenance teams. One other risk response strategy is that defining quality objectives in a proper manner and implementing well-set quality control plans to minimize quality assurance and control risks. Safety risks are also among most important risk types since those risks have severe effects on project completion thereby enhancing safety awareness is one of the risk response strategies to minimize safety risks. Traffic risks are suggested to be minimized by conducting organized feasibility studies. Finally, completion risks might be overcome by coordinating the staff effectively to follow up changes in the project.

Table 2. Risk allocation between public and private entities in the project

Identified Risk	Risk Level	Risk Allocation	Risk Response Strategy
Technical	Medium	Private sector	Transfer the risk to public sector
Financial	High	Shared	Set up a high contingency budget
Legal, Regulatory, Political	High	Public sector	Enhance familiarity with the host country laws and regulations
Force Majeure	Medium	Shared	Enhance awareness for unexpected events
Design	Medium	Private sector	Prepare different design solutions in advance for design failures
Engineering and Construction	High	Private sector	Employ high skilled staff and increase quality of labor
Demand/Revenue	Medium	Shared	Enhance cash stream control
Environmental	Medium	Shared	Prepare environmental impact assessment report in greater detail and evaluate the environmental conditions
Operation and Maintenance	Medium	Shared	Employ skilled operation and maintenance teams
Quality Assurance and Control	Medium	Private sector	Enhance the understanding of quality objectives by well-set quality control plans
Safety	Medium	Private sector	Enhance safety awareness
Traffic	Medium	Shared	Conduct feasibility studies in an organized manner
Completion	Medium	Shared	Coordinate the staff effectively to follow up changes in project

4. Conclusions

The popularity of the PPP arrangements has shown a considerable increase over the last decade. Thus, PPP arrangements are highly preferred especially for the infrastructure projects. In the context of this research, a case study is selected from Turkey investigating the potential risks of Izmit Bay Crossing Suspension Bridge. As designed to be the fourth longest suspension bridge in the world, this project is found to have several risks such as technical, financial, environmental, traffic, control, completion, safety, quality assurance and control, force majeure, legal, regulatory and political, engineering and construction, force majeure, design, traffic, and demand/revenue that are common in other infrastructure projects as well. Among those, the parties involved in PPP arrangement stated that the most significant risks in the bridge project are financial, legal, regulatory and political, and engineering and construction. Therefore, the risks are categorized according to the risk level in which they are constituted. Since there are high risks in the project, the risks are allocated appropriately for the project parties to increase the efficiency of the PPP arrangement. Finally, risk response strategies are developed to control risks in an effective manner. Findings of this study are expected to guide construction professionals in setting up and operating big scale PPP projects.

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