

A web-based integrated system for international project risk management

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Abstract

Overseas construction projects tend to have a high possibility of loss/failure compared to domestic projects. For this reason, risk management is becoming more emphasized and systemized in international projects so as to improve the quality of difficult decisions that normally encompass a higher level of risk exposures. Since each phase of an overseas project has different types of risks in the decision-making process, a decision support system should be tailored to satisfy the specific needs of a particular phase. In this way, various risks that arise through the life cycle of a project can be constantly checked and monitored. This study reviews basic decision-making processes in global construction projects, and presents a web-based decision support system that is closely associated with relevant risks and each cycle of sequential decisions. The system allows easier access than those of stand-alone or intranet systems. Through the proposed system, anyone can access the system anywhere in the world, anytime, with any device. Construction firms are expected to make better decision in pursuing international construction projects with a consideration of key risk factors at each stage of a project.

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1. Introduction

1.1. Background

Risk management has traditionally been applied in the area of safety, cost, and time management in construction projects. Its application area has also been expanded to include such fields as bid-decision making, feasibility studies, marketability studies, performance evaluations, and contingency management by reflecting the various factors spanning all phases of the project life cycle. Risk management becomes an integral part of project management and plays such an important role that its application goes beyond the traditional scope which normally centers on the construction phase [1]. Accordingly, it can be widely applied in various decision-making fields related to construction projects.

Decision-making is “a process by which a person, group, or organization identifies a choice or judgment to be made, gathers and evaluates information about alternatives, and selects from among the alternatives” [2]. This definition implies that decision-making involves risks in selecting one from several courses of action, which is usually compounded by time and information constraints [3]. International construction projects are exposed to more diverse and complex risks than domestic projects, which make international projects have a high possibility of loss [1,4,5]. Each phase of a project requires a unique decision-making process to accommodate unique risk factors. For this reason, Tah and Carr [6] emphasized the importance of establishing a systematic risk management process for each decision phase of a construction project.

The key decisions in risk management of international projects are made by asking the following questions [7]: (1) which projects are more favorable or less risky?, (2) how profitable is the potential candidate project based on the prospective conditions from the project?, (3) is it possible to enhance project conditions to optimize the bid contingency and negotiation strategies?, and finally (4) which risk variables are more

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eminent and important during the construction phase of a project, and how can the initial level of risk exposures be tracked and monitored throughout the entire project duration?

A strategic decision to find and control a profitable construction project implies sequential evaluation of the project from initiation to completion. Those decisions are, however, usually made in very unstructured and intuitive ways [8,9]. Despite the complexity and sequential nature of these decisions, a few researchers have described the risk analysis and decision-making tools in international construction projects considering the life-cycle of a project and its associated risk factors. Further, existing tools and methods are fragmented and separated, and are limited to the specific phases of decision processes or a specific fragmented area such as project appraisal [10,11], bid decision [12–14], go/no-go decision [9,15,16], portfolio-based investment decision [17,18], and others [19,20].

Thus, the objectives of this study are: (1) to carefully review major decision-making processes for typical international construction projects, (2) to produce specialized modules for risk management in each stage of construction projects, and finally (3) to develop a formalized and integrated risk management system that employs the aforementioned decision process in a web-based structure. Collectively, this system is designed to help construction firms: (1) identify critical risk factors that influence the successful outcome of the project, (2) make reliable decisions under the consideration of risks associated with each phase of key decisions, (3) design appropriate strategic alternatives to mitigate or avoid the unfavorable impacts of risk factors on project outcomes, and (4) monitor the imminent or significant risk factors and their actual or residual impacts on the performance during construction, both consistently and objectively.

1.2. Methodology

The methodology used for this research includes: (1) reviewing existing approaches to risk analysis and decision making in international construction projects and setting up an integrated and efficient approach applicable to this research, (2) developing the system architecture of a “web-based risk management model” that is closely associated with each phase of key decisions using documentation analysis and previous case reviews, (3) implementing a web-enabled system through data collection of 126 project samples, and (4) testing and demonstrating the system through the comparisons of three case applications. There are a number of methods to obtain knowledge from other sources, such as a literature review, existing case studies, interviewing experts, inferential flow analysis, repertory grid analysis, hierarchical clustering, and multi-dimensional analysis [21–23]. In this research, documentation analysis and previous case reviews are used for knowledge acquisition tools to develop a formalized risk management model. Documentation analysis of this study includes any fact, risk data, causes of business failure, case studies, and firms’ strategies for key decisions in the field of international construction projects. Analysis and synthesis of existing documentation provide an overview of existing domain knowl-

edge. In addition, knowledge can be acquired by a review of previous cases. The cases include the 126 international construction projects randomly selected out of 1085 overseas projects that have already been constructed around the world during the last decade. Through the case reviews, the decision components, i.e., decision strategies, risk factors, and output criteria, which affect the successful completion of international construction projects, are identified to develop the risk management model.

2. Overview of previous approaches

Studies about international construction projects have been performed since the 1980s. Purtell [24], and Arditi and Gutierrez [25] drew risk factors that are important for international construction projects and presented methods to manage those risk elements. Efforts were also made to develop methods for addressing specific risk issues. Bing and Tiong [4] identified risk factors and a management model for international joint ventures. Han and Diekmann [9] presented a model to support go/no-go decisions by structuring various influencing factors on international construction projects. In addition, efforts were made to manage risks in the entire cycle of construction projects. Ward and Chapman [26] suggested major items to be monitored in each stage of an international project. Hastak and Shaked [27] drew risk factors at country, market, and project levels, and presented a model to evaluate those risks. Del Caño and de la Cruz [1] developed a management model by systematizing a risk management process along with the project’s characteristics. Although those aforementioned studies regarding project risk management have contributed to the body of knowledge, the entire aspects of international project risks have not yet been fully addressed, leaving room for further research designed to develop systematic risk management processes that cover all the stages of a project’s life cycle.

Some risk management studies [1,26–28] followed the traditional risk control strategy (transfer, share, reduction or avoidance). The strategy—which typically consists of five steps: identification, analysis, evaluation, response, and monitoring—has been perceived as an effective method to identify risks that may occur in construction projects and to efficiently manage the identified risks. However, the amount of risk-related information collectable on a phase of the project differs from that of another phase. In addition, the depth and extent of why and how a decision maker evaluates the relevant risks becomes quite different at each phase of a project. In this sense, if the characteristics of all phases of the construction project are not considered adequately, it is difficult to bring the risk management into its full fruition. Moreover, risk factors of international construction projects are diverse, complex, and interrelated. Therefore, the traditional style of risk management has clear limitations in its applicability to international construction projects where not only management of probable risk factors but also continuous interaction between different decision-making processes is extremely important. Table 1 summarizes previous risk management studies on international construction projects.

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