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On the Application of IPRA Tool in Risk Assessment and Management of International Construction Projects

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Abstract: Construction companies face threats from competition and must be able to adjust to modern technology and changes in customer expectations. These issues require efficient risk management techniques. The success of construction companies running projects in international markets depends on how the risks arise from the host country conditions as well as the project specific risk factors. Successful management of risks requires identification of risks, construction of a risk model which can be used to assess the magnitude of risks, and implementation of response strategies so that an acceptable risk-return balance can be achieved. The project success usually depends on the combination of all risks, response strategies used to mitigate risks, and a company's ability to manage them. There exists a need to develop risk models containing the risks of doing business in international markets and factors that affect manageability of these risks. One of the market's critical challenges is scheduled management and the understanding and application of program management. This paper uses systematic risk identification, classification and analysis, and measurement and response methodologies to help international contractors quantify the risks of project development and accomplishment.

Key words: International construction projects, IPRA tool, fuzzy risk assessment, risk identification, risk management.

1. Introduction

Today, the construction industry is one of the biggest global industries with a $3.5 trillion profit per year or 10% of the GDP (gross domestic product). The new markets, domestic competition, and globalization have forced owners, contractors, and inventors to look for international opportunities [1]. These come with their own unique risks. The international projects require owners to investigate the associated political, geographical, economic, environmental, regulatory, and cultural risks. Also, contractors need to analyze similar risks related to cost, project timetable, and execution, making the international construction industry a risky business. The success of international construction companies depends on the host country's risks and the methodology of risk recognition and management [2].

Unfortunately, limited research has been performed on this topic. Most of the published research about risk investigation and management is fragmented and lacks a comprehensive investigation for project managers. This has resulted in delays in the project timeline while incurring extra costs. Although a successful risk management depends on knowledge of the risks, models of risk analysis, and use of effective strategies, the evidence shows that there is a gap between knowledge of risk management and how it is used by contractors. Therefore, there is a great need for an applicable management tool for finding and analyzing international construction projects.

In 2001, the CII (Construction Industry Institute) set a goal to develop a risk management tool. They then assigned the development of this tool to the Project Management Institute. By the end of 2003, the Project Management Institute developed the IPRA (International Project Risk Assessment). IPRA is a systematic tool for finding, analyzing, and prioritizing risks in the project life cycle. IPRA is a valuable tool because it was developed based on a data from real projects [2]. After reviewing the IPRA tool by

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identifying and assessing international construction project risks, a further step was taken to introduce effective methods to interfere and manage risks in international construction projects (Fig. 1).

2. Study of Critical Risk Factors in International Construction Projects

Global risk factors, e.g., political and economic, receive the highest attention from researchers. In this vein are included risks factors associated with international construction practices that are impacted by cultural differences between multinational project participants, regulatory restrictions, constructed arrangements, and differences in standards. Some country-specific conditions are listed in the following [3, 4]:

- instability of economic conditions;
- changes in currency rates;
- changes in taxation policies;
- social unrest;
- high levels of bureaucracy;
- immaturity of the legal system;
- restrictions for foreign companies;
- unavailability of local material;
- poor international relations;
- poor attitude towards foreign companies;
- unavailability of equipment;
- unavailability of local labor;
- unavailability of local subcontractors;
- lack of necessary infrastructure;
- lack of sufficient experience;
- immaturity of legal system;
- changes in governmental and international relations;
- policies;
- instability of political condition;
- poor macroeconomic conditions;
- cultural and religious differences.

3. Risk Management Implementation

RM (risk management) is about defining sources of uncertainty (risk identification), estimating the consequences of uncertain events/conditions (risk analysis), generating response strategies in the light of expected outcomes, and, finally, based on actual outcomes and risks determined, guaranteeing that the project objectives are met. RM in construction is a challenging endeavor as objective functions may change

Fig. 1 International construction project risk management.

during the project life cycle while a host of scenarios arise from changes in the macro-environment. Also, complicating factors include the diversity of constituents involved in the project value chain, and the one-off nature of construction processes.

Project RM has been considered as one of the nine PMBOK (project management body of knowledge) areas. Project management processes consist of RM planning, risk identification, qualitative and quantitative risk analysis, risk response planning, and risk monitoring and control. Even though RM is a tedious and costly strategy involving information gathering and analysis, it can improve the quality of cost estimating and decision-making to ensure projects are completed on time and within budget. RM can enable the projects to be conducted without a loss of continuity or even a slow-down. A formalized and standard process of RM has been found to be a critical attribute in measuring the RM capability and maturity since it facilitates the development of strong risk awareness and the flow of RM information throughout the entire project life cycle. Highlights for applying RM are shown in Fig. 2.

The ultimate purpose of risk identification and analysis is to prepare for risk mitigation. RM is a way of thinking and a philosophy that pervades the entire spectrum of project activities. Although RM is based on a variety of decision-making theories and associated techniques, major challenges persist due to poor definitions and ambiguity.

4. Fuzzy Risk Assessment

The fuzzy risk assessment method is used to develop a generic model for estimating the cost overrun risks in international projects using influence diagrams and for proposing risk assessment procedures. The first step to apply fuzzy risk assessment is regrouping some of the risks based on fuzzy information [5]. This provides a promising tool to quantify risk ratings where the risk impacts are vague and defined by subjective judgments rather than objective data. The major contribution of this work to the RM literature in construction management is to model risks using influence diagrams together with fuzzy sets and to develop risk assessment methodologies based on the proposed risk model [6]. Decision-making schemes, e.g., risk assessment results in construction projects, are very important, and the multi-criteria decision-making methods based on fuzzy information renders more realistic outcomes [7].

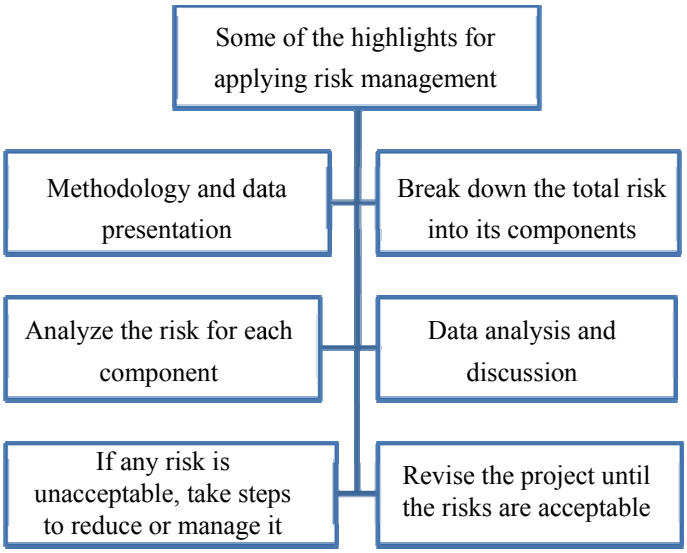

Fig. 2 Highlights for applying RM.

Fig. 3 Risk resilience factors.

5. Risk Resilience

Risk resilience looks for ways to enhance the ability at all organizational levels: (1) to create processes that are robust and flexible to monitor and revise risk models; and (2) to use resource reactivity in the face of disruptions or ongoing production and economic pressures. This new approach deals with risk especially in high-risk environments [8] (see Fig. 3).

6. SEM (Structural Equation Modeling)

Throughout risk assessment of construction projects, SEM (structural equation modeling) is used to express the relationships among assorted risk factors in order to identify risk paths instead of individual risk factors. Since international construction projects are influenced by foreign country conditions, they have more complicated risk-appearance patterns. It seems that classification of a network of interactive risk paths, that each of them commenced from diverse susceptibilities of the project system, is considered to be a more realistic reflection of the actual condition of construction projects than the application of generalized individual risk checklists. Risk assessment using SEM assists decision makers to simulate the effects of interdependent risks on the whole network of interrelated risk factors [9]. SEM is offered as an adequate technique.

The first step in constructing the risk-path model is the development, verification, and validation of the hypothetical constructs that are measured by observed variables through CFA (confirmatory factor analysis) offered by SEM-based software packages. The second step is estimation of the structural relationships of hidden factors and prioritizing them. The final step is to create a model based on the previous steps. This model demonstrates the interdependencies among hidden factors through various possible scenarios. SEM is considered to be an adequate technique for development of predictive models in the fields of construction management. The prediction capabilities of SEM and the realistic nature of this model make it an effective tool for estimating the levels of potential risks and cost overruns.

7. Concluding Remarks

This paper uses systematic risk identification, classification and analysis, and measurement and various response methodologies to help international contractors obtain a quantified determination of the risks of project development and execution. Managing the risk of a construction project is a comprehensive and crucial task that must occur before the acceptance

of an international project. Many international projects face similar risks; thus, the company's international database can be used to determine what risks are faced by international construction projects. Some of the effective tools and methods which have been discussed in this paper can be summarized as following:

• The IPRA tool is a comprehensive and sound method for identifying and assessing the relative impact of the majority of risk issues encountered on international capital facilities;

• The IPRA tool and the baseline relative impact values help the project team to identify the risk factors of highest importance to the project team;

• The IPRA tool offers a systematic and integrated risk identification, assessment, and management method for international projects. This method addresses both the full project life cycle and the portfolio of risks encountered by both owners and contractors;

• Risk management is implemented to improve project performance by the following processes:

(1) organize and formalize a risk management process and keep it as simple as possible;

(2) keep a broad perspective to get the diversified input required;

(3) undertake adequate pre-project planning, analysis, and engineering;

(4) partner with owner and contractor management;

• Recognize that certain projects are more disposed to risk and experience in such regions is important;

• Success depends on a flexible and coordinated approach for better management of risks before they have a significant negative impact on the project;

• Establish and maintain management commitment to performing risk management on all capital projects;

• Noting poor working environments, inadequate building safety, and damaged surroundings at construction sites.

• Based on the findings of this study, the following suggestions are made for future investigations:

(1) set up a systematic approach for management of risk by following a risk identification-analysis-response-monitor loop, propose a learning-based approach for RM [10], and compile a database of lessons learned of risk-related information;

(2) start the risk management process early in the project life cycle prior to approval of mission needs;

(3) evaluate project risks and risk responses periodically during the project life cycle through approval of the start operations;

(4) develop risk mitigation plans and update these as the project progresses;

(5) tie a project's level of risk to cost and schedule estimates.

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