A Multilevel Project-Oriented Risk-Mining Framework for Overseas Construction Projects

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Abstract: As international construction market increases, the importance of risk management in international construction project is emphasized. Unfortunately, current risk management practice does not sufficiently deal with project risks. Although a lot of risk analysis techniques have been introduced, most of them focus on project's external unexpected risks such as country conditions and owner's financial standing. However, because those external risks are difficult to manage and take preemptive action, we need to concentrate on project inherent risks. Based on this premise, this paper proposes a project-oriented risk mining approach which could detect and extract project risk factors automatically before they are materialized. This study presents a methodology regarding how to extract potential risks which exist in owner's project requirements and project tender documents using state of the art data analysis method such as text mining. The project-oriented risk mining approach is expected to effectively reflect project characteristics to the project risk management and could provide construction firms with valuable business intelligence.

Keywords: Overseas construction, Risk management, Project-oriented management, Text mining

I. INTRODUCTION

Construction project is a progressive work for materializing uncertain owner's requirements. Owners typically provide contractors with a set of tender documents for a bid proposal upon which a contract may be let and executed (Murdoch & Hughes 2008). Since contractors can understand project objectives and owner's design intent from the tender documents, analysis of tender documents is a very important and primary work in the project initial phase. However, many contractors are being awarded overseas construction projects without close examination of tender documents due to a lack of tender period and large amounts of documents. The insufficient analysis of potential risks existed behind the tender documents leads to cost increases and construction delay which cause claims and disputes. Therefore, tender documents analysis should be managed from a risk management aspect.

In the life cycle risk management view, the effect of risk management in the early stage is much greater than the late risk management because early risk management can take preemptive action. However, information uncertainty and the amount of available information is poor at a beginning step (Figure 1). Since available information in the early stages is not enough and clear, initial risk management is important to find risk factors. This also explains unclear information should be detailed and take anticipative response to maximize initial risk management effects.

This study presents a methodology how to extract potential risks which exist in owner's project requirements based on the analysis of construction tender documents especially in international projects. Since international projects are inherently exposed to unpredictable and complicated risk scenarios (Han, S. H. et al. 2007), this study selected overseas projects as research object and analysis overseas project's tender documents and risk factors using state of the art data analysis method such as text mining.

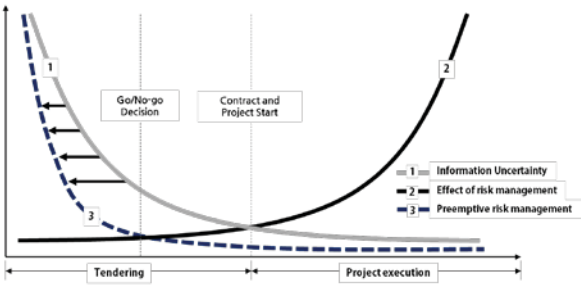

FIGURE I
LIFE CYCLE RISK MANAGEMENT

II. PROBLEM STATEMENT

Risk management researches have been performed in several aspects: 1) definition of risk factors, 2) building a risk response framework or system and 3) risk quantification for risk evaluation. However, the risk factors analysed at the previous studies were weighted toward high-level of risks, such as country risk or company risk, not project-oriented (low-level) risks. Moreover, most existing risk management system and framework are based on quantitative techniques which require numerical data. However, much of the information related to risk analysis is not numerical. Rather, this information is expressed as words or sentences in a natural language (Kangari & Riggs 1989). That is the reason current risk management practice does not sufficiently deal with project risks in the real construction world. Besides, since majority of risk quantification studies relies on survey based statistical analysis which deals with generalized risk, the result from the analysis is difficult to reflect each project's characteristic.

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Therefore, this study proposes project-oriented risk management methodology so that text-based tender documents could be analysed and detected.

III. Research Methodology

In this section, multi-level project-oriented risk mining methodology is presented. Since every risk exists from bottom (project inside) to the top (project outside), multilevel project-oriented risk mining approach would be necessary to predict risk level accurately.

Risk mining is defined as a methodology in this study which extract text-based risk factors, classify risk type and assess them based on the data type. In other words, project-oriented risk-mining could be defined as an automatic risk extraction method based on the analysis of tender documents. In order to perform the risk mining process data analysis method such as data mining, text mining and information visualization would be applied.

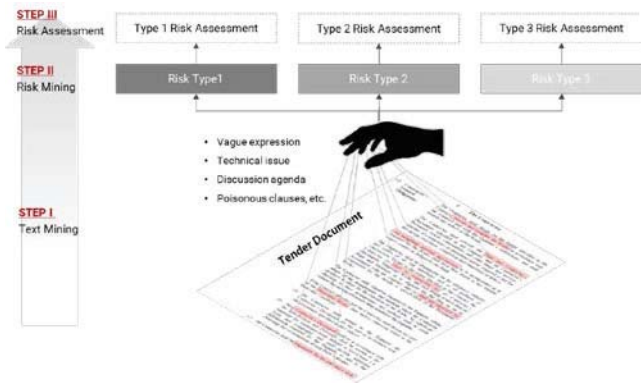

FIGURE II
Risk Mining Process

The first step of risk mining process is text mining which extract internal potential project risks behind the tender documents existed in text data form. Because the examination of tender documents has been conducted by some of experts so far, the quality of review was subject to be varied. Moreover, the analysis on tender documents has not been perfectly carried out due to the short tendering period and huge amounts of documents. Thus, text mining could be a helpful method to analysis risks on documents and discover meaningful information. Since text data is unstructured data, some of text-processing methods which transfer unstructured data into structured data should be conducted.

Second step is risk classification which classify previously mined risks according to the risk type. In this step risk type is defined using prior performed project-oriented risk factors. The risk type could be defined by risk predictability, risk controllability and level of risk, etc.

Final step is risk assessment which evaluate classified risk types in accordance with appropriate risk assessment method by risk type. Since the assessment method could be different by risk type which could be unstructured data or structured data, various data analysis method would be applied. In this step, the assessed risk type could be not only project-inside but also project-outside risk type. In other words, the initial analysis object is focused on project-oriented risks, which exist in tender documents, but the evaluated risk type from the risk mining process covers multi-level risk factors.

According to the risk mining process above the multilevel project-oriented risk mining methodology could be illustrated as figure III. Previously identified risk factors and types are stored in project-oriented risk DB, and the DB is used when the risk mining is in the process. In other words, the data stored in the DB is applied to the risk mining process as a mining subject. Thus, if newly incoming tender documents have similar words or phrases compared to the risk DB (risk vocabulary dictionary), the words or phrases are detected, classified and assessed them by risk mining process.

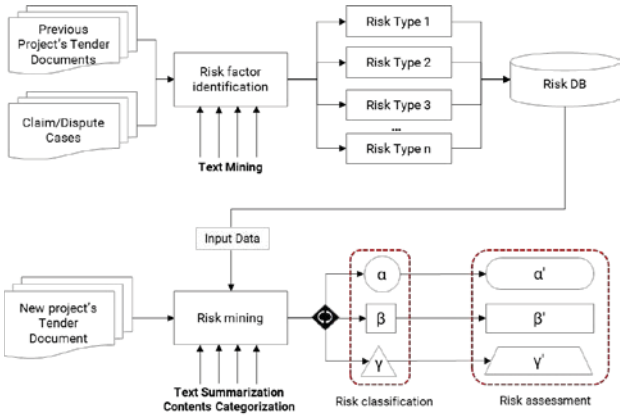

FIGURE III
Project-Oriented Risk Mining Methodology

IV. Conclusion and Future Study

This study aims to propose a new approach for managing text-based project-oriented risks. Since available information in the early stages is not enough and clear, identifying owner's design intent written in tender documents is crucial for proceeding construction project. However, current risk management practice in the early stages does not sufficiently deal with project risks. In this paper, multilevel project-oriented risk mining methodology is presented based on investigation of current state of risk management. If the study of previously performed project's tender documents will be conducted later, more practical risk factors could be derived and multilevel project-oriented risk mining process works well. The project-oriented risk mining approach is expected to effectively reflect project characteristics to the project risk management and could provide construction firms with valuable business intelligence.

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