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: Complex Disasters and Disaster Risk Management

## Risk Factors Assessment considering Change Degree for Mega-Projects

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### Abstract

Recently, techniques in the construction industry have rapidly developed, and alongside these changes there have been demands for the complexification, advancement and enlargement of the technical level and size. Thus, the risks are becoming increasingly diverse in the process of progress on construction projects. It is necessary to minimize the impacts of negative factors on the projects through the investigation and management of risk factors before they occur. But, the investigation and analysis of impacts are difficult due to the interdependent relationships among risk factors, and mega projects, in terms of project units, are on the rise. It is necessary to investigate risk factors considering the relationship among many changes. Therefore, this study was conducted to investigate risk factors and to evaluate the importance among the risk factors of a construction project while simultaneously considering the risk impact and change impact. If, prior to the beginning of construction work, risk factors with great impacts are managed based on the analysis results, they are expectedly applied as index to support the successful execution of a construction project.

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### 1. Introduction

#### 1.1. Research Background and Purpose

As the construction industry nowadays faces a lot of challenges, such as complexification, advancement and enlargement, the related techniques are rapidly changing. The risk factors in construction projects are becoming increasingly diverse. Thus, it is necessary to consider risks that may occur to a project before the execution of the project.

According to Standish report, successful projects in terms of schedule, cost and quality did not total more than 32% of the entire projects, based on 2009. The projects whose schedules were delayed and whose costs were increased accounted for 44%; the projects which were cancelled reached 24% [Laurenz, J. E. et al. 2010]. In particular, construction projects include various risks according to each individual difference of the projects, unlike the manufacturing industry that repeats the same processes. Besides, the risk factors are difficult to forecast. Construction projects are occasionally confronted by schedule delays, cost overruns and claim occurrences sequentially, which can result in the failure of the projects. Therefore, it is very important to investigate and manage various risk factors that may occur in the project process of progress, prior to the beginning of construction work. However, as risk factors have interdependent relationships and program-type projects have increased recently, it is not easy to identify risk factors [Iyer, K. C. et al. 2010]. In particular, mega-projects include a lot of potential for change, and risk factors should be investigated in consideration of that. There are few previous studies that have simultaneously considered the potential for change and probability of risk occurrence.

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This study intends to assess the risk considering not only the existing Probability and Impact Assessment method (hereinafter referred to as PI) but also the potential for change and to assess the importance of risk factors and suggest indexes for risk management in terms of a construction program.

## 2. Literature Review

### 2.1. Risk Management

Risk management is a method of minimizing risk factors and maximizing opportunity factors by identifying and eliminating, or mitigating, the risk factors and uncertain factors that have effects on construction projects.

Project risk management is also a way to successfully carry out a project and consists of risk analysis and risk management. Risk management includes a response to and management of an identified risk. Risk analysis can be divided into a qualitative analysis and a quantitative analysis. The methods of identifying risks include one-to-one meetings, brainstorming, nominal group techniques, the Delphi technique and qualitative evaluation methods.

### 2.2. Mega-Project

Mega-project is an extremely large-scale investment project. Since the mega-project pursues integrated and mutually-coordinated worth, rather than simply multiple single project, it can be said that construction management system of program management perspective with single or multi-project management [KURC, 2<sup>nd</sup> year research report, 2008]. The European Cooperation in Science and Technology categories mega-projects as having "extreme complexity (both in technical and human terms) and by a long record of poor delivery". The U.S. Federal Highway Administration defines mega-projects as major infrastructure projects that cost more than US\$1 billion, or that project a significant cost that attracts a high level of public attention or political interest because of the substantial direct and indirect impacts on the community, environment, and budgets [Flyvbjerg, B. et al. 2003]. Mega-projects can also be defined as "initiatives that are physical, very expensive, and public" [Alan Altshuler. et al. 2003]. Hyun et al. (2009) analyzed 19 mega-projects to define a mega-project as the investments with "a total cost of over 500 million that accommodates the form of facilities with more than three uses, together with a consistent plan based on a single master plan, as a combined project that is executed with organic connection with all its functions".

### 2.3. Related Research

Studies were continuously conducted on construction project risk factors. Numerous risk factors presented by these studies are shown below.

Na et al.(2008) largely classified risk factors into 6 categories according to occurrence probability and similarities in correspondence strategy. They are institutional and administrative, economic and financial, social and cultural, participant and stakeholder, and designing and technological. Park et al.(2009) classified risk factors in construction phases into public institution, coordinator and association, construction company, and a management specialty company according to the participating entities. Lee et al.(2011) classified risk factors of a Mixed-use development project into the phases before and after construction, and connected the risk factors to the performance indicator.

All the existing studies presented and classified risk factors based on the occurrence probability and impact. However, a study has not yet been conducted to present risk factors considering changes that appear at occurrences of risk factors. It is necessary to conduct a study to derive risk factors considering the degree of changes arising from occurrences of risk factors.

## 3. Assessment of Risk Factors

### 3.1. Deduction of Risk Factors

In order to derive domestic and overseas construction project risk factors, an analysis was conducted on two domestic papers and one overseas paper among recently published papers that comparatively specifically present risk factors. An analysis concentrated on literature about a Mixed-use development project was conducted to select risk factors in construction projects where complexification and enlargement are increasingly demanded.

A total of 139 risk factors were presented by two domestic studies. 30 similar-contented risk factors among 139 ones were integrated, which were categorized into 109 risk factors.

A previous study on one overseas paper classified risk factors into eight items by causes, which presented a total of 122 risk factors. As that previous study dealt too comprehensively with the risks regarding schedule delays and cost overruns that occur in construction schedules, among the risk factors, this study excluded those items and categorized the risk factors. Based on these, 94 risk factors were used as potential risk factors of overseas construction projects.

This study intends to derive the risk factors of a construction project, based on 109 domestic construction project risk factors and 94 overseas construction project risk factors. Consultations with five construction project experts were conducted on the risk factors presented by the previous study, and the processes of integration, addition, modification and deletion for repeated risk factors were performed with a reassessment of the risk factors presented by the previous study. As a result, 30 mega-project risk factors were categorized and shown in Table 1.

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