Assessing the Risks of Asian Development Projects: A Theoretical Framework and Empirical Findings

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Abstract
The global construction market has been gradually changing from general contracts to development projects. It is necessary to perform risk management for international construction projects because there can be multiple risks for which the degree of risk can be very high. Although international construction project risk management is important, there has been very little research regarding objective and quantitative risk assessment that reflects the project characteristics and decision-making. Therefore, research into risk assessment in Asia-centered international development projects (IDPs) is necessary. The purpose of this study is to identify and analyze key risk indicators (KRIs) through a proposed risk assessment framework for Asian Development Projects (ADPs). The methods and procedures of this study are as follows: First, quantitative indicators of main risk are identified. Second, critical risk indicators are analyzed and assessed by applying Fuzzy theory and the Analytical Hierarchy Procedure (AHP) methods. Finally, risk response attitudes are suggested and 12 risk indicators are selected according to priority evaluation in ADPs.

Keywords: Asian Development Projects; fuzzy theory; AHP; risk assessment framework; risk indicators

1. Introduction
Although the method for placing orders in the global construction market has gradually changed from simple subcontracting to development projects, the reality is that IDPs in the local construction industry have not yet been revitalized. Moreover, governments and construction companies are forging ahead into the foreign construction market due to recent limits looming over domestic development projects.

According to statistical data from the International Contractors Association of Korea (ICAK) (1978–2011), the work of Korean construction companies comprised more than 70% of the total work of contract orders in Asian regions, with higher percentages in some regions. In addition, a review of existing literature regarding IDPs and case research on local construction companies revealed that there has been minimal research on the risks of the relevant projects. The need for risk assessment and analysis on IDPs is thus apparent.

Several studies have been conducted to define the concepts of construction industry risk (Edwards 1995; Raftery 1994; Baloi and Price 2003; Chapman and Ward 1998). Identifying and assessing project risk are critical for projecting success, and they usually become essential factors in the decision-making process (Williams, 1995). Many risk analysis methods, such as Fault Tree Analysis (FTA), Event Tree Analysis (ETA), probability and impact grids, Sensitivity Analysis, and Failure Mode and Effect Analysis, have been conducted for international construction projects (Ahmed et al., 2007).

As a result of a review of international construction project risk assessments, methods for risk analysis that respond to diverse factors depending on the country/industry/project have been proposed. However, existing risk assessment methods do not reflect objective assessment. Accordingly, the purpose of this study is to prioritize major risk indicators through a proposed risk analysis framework and to select risk indicators targeting Asian regions where the degree of contract orders in IDPs is very high. Finally, it is necessary to understand the risk characteristics of ADPs, and to establish a risk response strategy accordingly.

2. Literature Review
2.1 Characteristics of IDPs
IDPs are a type of project that uses financial-
method-based standards. In this method, the contractor raises funds and recovers investments through the construction of facilities and operations or sales of residential units or industrial complexes.

Table 1. Cost Occupancy Rate of IDP Contracts in the Korean Construction Industry

| Period       | Asia region | Others | Overall | Overall cost of international construction contract | Cost occupancy rate of IDPs, ** |
|--------------|-------------|--------|---------|------------------------------------------------------|-----------------------------|
| Cost of IDPs contract (1,000$) | Asia region | Others | Overall | Overall cost of international construction contract | Cost occupancy rate of IDPs, ** |
| 1978~1990    | 0           | 2      | 2        | 934                                                  | 0.21%                       |
| 1991~1997    | 87          | 20     | 107      | 516                                                  | 20.7%                       |
| 1998~2004    | 7           | 25     | 32       | 404                                                  | 7.92%                       |
| 2005~2011    | 102         | 24     | 126      | 2,607                                                | 4.83%                       |
| Total        | 196         | 71     | 71       | 4,461                                                | 5.99%                       |

*: Middle East, North America/Pacific, Europe, Africa, Central and South America
**: cost of IDPs contract/cost of international construction contract=100

The results of the analysis of contracts according to IDP region are shown in Table 1., among the orders received, USD267,000 was from the whole region, while the orders received from Asian regions amounted to USD196,000, or 73.4%. Project dependence in Asian regions is assumed to be very high. It is recognized that concentration in a specific region is a risk factor for increasing construction orders from the international market and for securing a competitive edge. Thus, business should be geared toward the region and field where international construction can be forged through market diversification.

2.2 Classification of risk through previous research Classification according to risk characteristics

From the results of analyses of research trends in overseas regions, risk can be classified according to the characteristics of the construction industry, as shown in Fig.1. Risk theory was established in the early stages of research; since then, research on political and economic/legal risks (Ashley and Bonner, 1987; Wang and Tiong, 1999), the risks of financial affairs/financing (Kapila and Hendrickson, 2001), social/cultural risk (Chan and Tse 2003; Ling and Hoi, 2006), performance risk (Baloi and Price 2003; Luu et al., 2009), human resources risk (Thevendran and Mawdesley 2004; Lin, 2011), and project risk (Aleshin, 2001; El-Sayegh, 2008; Abdelghany and Ezeldin, 2010) has been conducted. Recently, research on contract risk (Lam et al., 2007; Chan et al., 2011) and safety (Fung et al., 2010; Pinto et al., 2011) has also been carried out.

A review of previous works from overseas countries revealed that most research has been restricted to cases in the individual host country or individual projects when selecting the subjects for risk analysis. In addition, research on risk characteristics has often been limited to items related to specific fields.

Classification according to management procedure

As shown in Fig.2., study trends in the existing literature were classified into the following four research fields: classifying and identifying of risk (Wang and Tiong, 1999; Chan and Tse 2003; Ling and Hoi, 2006), suggesting process and evaluating methodology of risk (Zhi, 1995; Diekmann et al., 2007; Luu et al., 2009), developing a system and model of risk management (Hastak and Shaked, 2000; Han and Diekmann, 2001; Lam et al., 2007), and presenting improvement and management measures of risk (Aleshin, 2001; El-Sayegh, 2008; Lin 2011). A hierarchical structure of risks should be developed according to where the risk characteristics centering on the target project and the user have been reflected and to select major risk indicators. In addition, having applied risk analysis and assessment methods, this study presents a risk management system in which decisions made by all business entities (the employer, contractor, and developer) are reflected.

2.3 Risk assessment method for international construction projects

Risk assessment methods have ranged from simple classical methods to fuzzy mathematical models (Karimi Azari et al., 2011). Many construction project risk assessment methods currently used are comparatively mature tools (Zeng et al., 2007). Monte Carlo Simulation (Sadeghi, 2010), Sensitivity Analysis (White, 1995), Critical Path Method (Kaufmann and Gupta, 1988), Fault Tree Analysis (Terano et al.,...
1992) and Event Tree Analysis (Huang et al., 2001) are the classical quantitative methods used in the construction industry for risk assessment. From the above review, diverse risk assessment methods are proposed according to the country/industry/project. However, most risk assessment methods adopt the analytical method widely used in social sciences, and thus do not sufficiently reflect objective assessments of construction projects.

3. A Theoretical Framework of Risk Assessment

3.1 Triangulation approach: combining qualitative and quantitative methods

In this study, a theoretical risk analysis framework was proposed for efficient risk identification, suggestion, analysis, and assessment. As shown in Fig. 3., the proposed framework is divided into two stages: the risk indicator selection stage (qualitative analysis) and the risk indicator assessment stage (quantitative analysis). The two stages occur in sequence to maintain a complementary relationship. Based on this theoretical framework, this study suggested a risk assessment procedure.

3.2 Qualitative Risk Assessment Procedure

The risk indicator selection stage indicated characteristics of risk through qualitative analysis methods. First, it decided the standards for the type, the subjects, and the range in order to select risk indicators. Second, it collected data through theoretical investigation and case studies and completed a hierarchical structure of risks on the basis of the main and secondary criteria. Third, it selected the preliminary risk indicators through interviews with experts and prior questionnaire surveys on the classified hierarchical structure of risks, and determined the final risk indicators through verification processes to see whether or not they are appropriate.

3.3 Quantitative Risk Assessment Procedure

The risk indicator assessment stage is a process to assess values by reforming the indicated risk characteristics through qualitative analysis. Thus, the quantitative analysis stage can be divided into five steps: (1) Decision of analysis criteria and method. (2) Assessing the significance of risk (SR). The detailed procedure for SR risk assessment is as follows: deciding assessment criteria for SR, measuring significance via responses to the questionnaire and calculating assessment values through risk assessment methods, and eliciting the key risk indicators (KRIs) through verification of accuracy with regard to the calculated assessment values. (3) Assessing influence of risk (IR). The detailed procedure for IR assessment of risk is as follows: deciding the criteria for IR targeting KRIs, calculating the assessment values through measurement of IR by means of the responses to the questionnaire, and eliciting the final results of IR through verification of accuracy with regard to the calculated assessment values. (4) The high-ranking...
risk indicators are selected through total assessment of SR and IR. (5) The final conclusions are presented according to the indicators selected.

4. Empirical Validation

4.1 Empirical analysis method

In this study, questionnaire surveys were conducted to select the major risk indicators of ADPs and to implement priority evaluation. A detailed description of the questionnaire surveys is shown in Table 2.

| Table 2. Detailed Description of the Questionnaire Surveys |
|-----------------------------------------------------------|
| **Type**       | 1st questionnaire survey       | 2nd questionnaire survey       |
| **Period**     | 2011. 08. ~ 2011. 09 (1 month) | 2011. 12. ~ 2012. 01 (1 month) |
| **Target**     | Experts from each specialized field including government agencies and associations, public institutions, and construction companies | Working-level personnel who had already participated in or were participating in IDPs from large and medium-size construction companies |
| **Method**     | Wire, email and interview       | Wire, email and interview       |
| **Purpose**    | Evaluate SR                     | Evaluate IR                     |
| **Response rate** | 44% (24/55)                     | 70% (42/60)                     |

4.2 Hierarchical structure of risks

The criteria of risk classification in construction projects can be divided into three types: classification according to the characteristics of risk; classification in terms of the construction process according to the time dimension; and classification in terms of the occurrence fields of the construction work according to the space dimension (Kim, 2004). In this study, a classification method appropriate for construction activities with an emphasis on the spatial dimension was chosen. The hierarchical structure of risks is shown in Fig.4.

In this study, risk-related research from both Korea and abroad for selecting major risk indicators of IDPs was investigated, experts who were working on site were interviewed, and case studies from ICAK were reviewed. To select detailed risk indicators that correlate to the hierarchical structure of risks, the authors referred to major risk factors presented by Perry and Hayes (1985), Strassmann and Wells (1988), Zhi (1995), Han and Diekmann (2001), and Dikeman et al. (2007). Major risk indicators were based on information gathered from interviews with experts at worksites and from prior questionnaire surveys. Examples of risk management by local and overseas construction companies, case interviews (2011), and "Prediction of Profitability of International Construction Projects and Practical Guide to Risk Management" compiled by ICAK (2005) were carefully reviewed. Using the works described above, 4 main criteria, 17 sub-criteria, and 82 detailed risk indicators were selected. The 82 detailed risk indicators, classified according to main reference, are shown in Table 3.

| Table 3. Classification of All Risk Indicators in IDPs |
|-------------------------------------------------------|
| **Code** | **Risk indicators** |
| CR11 | Inconsistency of policy |
| CR12 | Government intervention and regulation |
| CR13 | Unstable political situation and change of government |
| CR14 | Insufficient support in political and diplomatic aspects |
| CR15 | Corruption Perception Index (CPI) |
| CR16 | Forcing home currency policy |
| CR21 | Worsening economic/financial conditions |
| CR22 | Dropping of sovereign credit rating and sovereign ratings |
| CR23 | Inadequate financing and financial management |
| CR24 | Financial crisis |
| CR25 | Impact of macroeconomic variables |
| CR31 | Unique features of construction environments |
| CR32 | Social disturbance |
| CR33 | Language barriers and cultural differences |
| CR34 | Religious and racial conflicts |
| CR35 | Conflicts with the organizations concerned |
| CR41 | Physical features of the region |
| CR42 | Force majeure by natural disasters |
| CR43 | Environmental changes and pollution |
| CR44 | Epidemics and disease |
| CR45 | Security and criminal risk |
| CR46 | Insufficient infrastructure |
| IR11 | Economic recession and overbuying |
| IR12 | Market entry barrier and market fluctuation |
| IR13 | Sluggish business in industries and deteriorating economy |
| IR14 | Changes in demand structure |
| IR21 | Inadequate regulations and laws |
| IR22 | Unfair imposition of taxes and tax rate |
| IR23 | Excessive tariff and duties |
| IR24 | Delay of license approval and administrative procedures |
| IR31 | Changes in circumstances of obtaining an order |
| IR32 | Worsening market conditions |
| IR33 | Intensified competition between bid participants |
| FR11 | Business inefficiency and lack of driving force |
| FR12 | Lack of expertise and insufficient utilization |
| FR13 | Lack of experience and inadequate feasibility study |
| FR14 | Poor strategic concept and inadequate project management |
| FR21 | Lack of technical skills and construction experience |
| FR22 | Insufficient standard provisions (specification and standards) |
| FR23 | Absence of advance information (host country and firms) |
| FR24 | Inadequate information about and inadequate management of order receiving / bidding |
| FR25 | Lack of capability for fund procurement and management |
| FR26 | Lack of financial resources and financial capability |
| FR27 | Inadequate cost forecasting and insufficient use of management techniques |
| FR28 | Insufficient level of knowledge of international finance |
| FR29 | Inadequate financing and project management (PM) |
| FR31 | Inadequate use of and inadequate level of keeping up with talented human resources |
| FR32 | Lack of organizational flexibility and cooperative works |
| FR33 | Lack of manpower training and management systems |
| FR34 | Insufficient personnel networks and infrastructure |
| FR35 | Unclear contract terms, conditions, and provisions |
| FR36 | Inappropriate contract terms and methods |
| FR37 | Errors in contracts and unreasonable standards |
| FR38 | Lack of resources and unreasonable requirements on the part of the employer |
| FR39 | Lack of understanding and capability for carrying out the project on the part of the employer |
| FR41 | Uncooperative and illegal actions on the part of employer |
| FR42 | Non-standardized materials/equipments/machines and devices |
| FR43 | Excessive need for quality assurance (QA) / quality control (QC) |
| FR44 | Vulnerable quality control and system |
| FR45 | Inadequate safety education, training, and system |
| FR46 | Reconstruction on account of design errors and defects |
| FR47 | Occurrence of accidents |
| FR48 | Lack of design capabilities and experiences |
| FR49 | Reconstruction on account of design errors and defects |
| FR50 | Poor accessibility to the construction site and vulnerable construction conditions |
| FR51 | Insufficient information transfer and cooperative works |
| FR52 | Lack of capability for project management (PM) |
| FR53 | Worsening in relations between constituent members and organizations |
| FR54 | Inadequate capability in supervising engineers/supervisors and dealing with business |
| FR55 | Insufficient distribution of resources and process control |
| FR56 | Inadequate document management and record maintenance |
| FR57 | Conflicts between local firms and subcontractors |
| FR58 | Inadequate recruitment of and effort to secure manpower/resource procurement |
| FR59 | Reduced equipment supplies and lowering of operating rate |
| FR60 | Problems with cash flow |
| FR61 | Delay of completion of construction and test run |
| FR62 | Delay of precedent and succeeding construction works |
| FR63 | Insufficient use of the organizations/experts for dealing with disputes |
| FR64 | Unreasonable requests for changes in design from employer |
| FR65 | Unreasonable requests for changes in design from employer |
| FR66 | Filing individual public petitions and class action suits |
| FR67 | Dispute with regard to solution process and time required |

4.3 Significance of risk (SR)

- Determining the analysis criteria and methods

SR indicators were measured first by a questionnaire survey according to the hierarchical structure of risks. Second, relative significance values (RSV) were calculated using AHP techniques described by nine attributes. (1 = equal, 3 = moderate, 5 = strong, 7 = very strong).
7 = very strong, 9 = extreme, 2/4/6/8 = intermediate value) Consistency verification of the risk indicators and reliability was conducted based on questionnaire results. In addition, absolute significance values (ASV) were calculated according to a Likert 7-point Scale (from 1 = "not important" to 7 = "absolutely important"). Third, correct significance values (CSV) were calculated using Sugeno λ-Fuzzy Measures based on RSV and ASV.

- Measuring the SR

To determine the significance of the final risk indicators, CSV were calculated using RSV by AHP and ASV using the Fuzzy Measure concept proposed by Sugeno (1974). For significance correction, the following are the modifying examples of six detailed risk indicators (C1–C16) related to sub-criteria, such as "Politicians and Policy" (C1), that are included as categories of "Country and Circumstance for placing an order" (C), which belongs to the main criteria.

Applying the AHP method for RSV as in the assessment indicators, $X = \{x_1, x_2, x_3, x_4, x_5, x_6\}$ can be shown to be $\{w_i = \{0.12, 0.11, 0.23, 0.08, 0.28, 0.18\}$. ASV by Fuzzy Measure can be shown to be $\{w_r = \{0.68, 0.66, 0.72, 0.55, 0.81, 0.64\}$.

Sugeno (1974) proposed a $\lambda$-Fuzzy Scale based on the union scale, which is derived from individual elements in accordance with definite laws and from Sugeno’s $\lambda$-Fuzzy Scale. We can find the variable $\lambda$ on the basis of the boundary condition as in value equations with $g(x)=1$.

$$\frac{1}{1+\lambda} = \prod_{i=1}^{n} (1+\lambda g_{ai}) \quad \text{(Formula 1)}$$

Following Formula 1, six assessment items can be written with an equation in conjunction with ASV according to the Fuzzy Scale: $\{w_i = \{0.68, 0.66, 0.72, 0.55, 0.81, 0.64\}$.

We can solve this equation in the following manner:

$$1+\lambda = (1+\lambda g_{a1})(1+\lambda g_{a2})(1+\lambda g_{a3})(1+\lambda g_{a4})(1+\lambda g_{a5})(1+\lambda g_{a6}) \quad \text{(Formula 2)}$$

When substituting the $g_{ai}(i)$ value, the following is obtained:

$$1+\lambda = (1+0.68\lambda)(1+0.66\lambda)(1+0.72\lambda)(1+0.55\lambda)(1+0.81\lambda)(1+0.64\lambda) \quad \text{(Formula 3)}$$

If we solve the above hhexic equation using MATLAB for a $\lambda$ score, we obtain $\lambda = 0.999$. The CSV in the assessment item, which has been corrected, is $c \times \{w_i\}$ after RSV is multiplied by the constant of the Fuzzy Scale (c). It is as follows:

$$\{w_j = c \times \{w_i\} = c \times \{0.12, 0.11, 0.23, 0.08, 0.28, 0.18\} \quad \text{(Formula 4)}$$

The $c$-score can be found by applying the boundary condition of Sugeno’s $\lambda$-Fuzzy Scale to $\{w_j\}$, and expressed according to the following:

$$1+\lambda = (1+\lambda \times 0.12c)(1+\lambda \times 0.11c)(1+\lambda \times 0.23c)(1+\lambda \times 0.08c)(1+\lambda \times 0.28c)(1+\lambda \times 0.18c) \quad \text{(Formula 5)}$$

Having substituted $\lambda = 0.999$ into the above equation, solving for c yields $c = 3.414$. The final significance score is $\{w\} = \{0.41, 0.38, 0.79, 0.27, 0.96, 0.61\}$. The resulting final scores, where the significance of the whole risk indicators have been modified according to the same method shown above, are shown in Table 4.

- Eliciting KRI

Zimmermann (1994) proposed the concept of linguistic variables (LV) using Fuzzy Theory, and classified the assessment scales of LV into nine steps from 0 to 1: VH (Very High), H (High), RH (Rather High), SH (Sort of High) A (Average), SL (Sort of Low), RL (Rather Low), L (Low), and VL (Very Low).

The interval width of the LV assessment scales were also defined as: VH(x): $1.0 > x \geq 0.9$, H(x): $0.9 > x \geq 0.8$, RH(x): $0.8 > x \geq 0.7$, SH(x): $0.7 > x \geq 0.6$ A(x): $0.6 > x \geq 0.4$, SL(x): $0.4 > x \geq 0.3$, RL(x): $0.3 > x \geq 0.2$, L(x): $0.2 > x \geq 0.1$, and VL(x): $0.1 > x \geq 0$.

Regarding selection criteria for KRI, the authors assume $\{x\} = \{1.0 > x \geq 0.6\}$, which exceeds the interval of the average A grade (Average, $0.6 > x \geq 0.4$) in the 9-step assessment scale. In this case, risk significance as a function of area is high. In the results, the LV assessment scale includes VH, H, RH, SH, and the risk indicators corresponding to these scales indicate a high risk level. From the LV results, 35 KRI are shown in Table 4.

4.4 Influence of risk (IR)

- Deciding the criteria of IR

Influence of risk is defined as the scores that express relative influence values, in which the risk indicators concerned will be distributed between two populations (A is the geographical group of Asian regions and B includes regions outside of Asia). The populations can be classified according to A>B, A<B, A=B. If interpreted individually, it can be determined that, in the case of A>B, the risk indicator (x) is more highly affected by the A group than the B group, and that, in the case of A<B, by B group rather than A group. In the case of A=B, both A and B groups equally exert an influence so that there are no relative influence values (RV). This study measured IR, targeting the KRI of IDPs, which have been previously selected, and, based on the resulting scores, tried to assess the priority risk indicators in Asian regions.

- Measuring the IR

The measurement of IR is as follows. First, questionnaire surveys were conducted after the second questionnaire based on 35 indicators that were selected as KRI. Second, based on the results, RV were calculated using a 5-point Likert scale. This assessed the final IR. The assessment scale to measure IR and the contents is shown in Table 3.

4.5 Priority evaluation of risk in Asia

This section assesses the causes of risk in Asian regions when propelling IDPs, and also proposes appropriate methods for responding to risk.

In this study, comprehensive assessment for the SR and IR of the major risk indicators in Asian regions was conducted. Through this, priority indicator risks were identified. An analysis and assessment of the
Table 4. Results Calculating of KRI, SR and IR in IDPs

| Main Criteria          | Sub-Criteria          | Indicators Code | Significance of risk (SR)          | Influence of risk (IR)          | KRI |
|------------------------|-----------------------|-----------------|-----------------------------------|---------------------------------|-----|
|                        |                       |                 | RSV  | AVS  | λ   | e   | CSV  | LV  | Asia* | Others** | Common Rank |               |
| **Politician & Policy**|                       |                 | 0.12  | 0.68 | -0.999 | 3.414 | 0.41 | A    | -     | -         | -           |               |
|                        |                       |                 | 0.11  | 0.66 | -0.999 | 3.414 | 0.38 | SL   | -     | -         | -           |               |
|                        |                       |                 | 0.23  | 0.72 | -0.999 | 3.414 | 0.79 | RH   | 1.00  | -         | -           |               |
|                        |                       |                 | 0.08  | 0.55 | -0.999 | 3.414 | 0.27 | RL   | -     | -         | -           |               |
|                        |                       |                 | 0.28  | 0.81 | -0.999 | 3.414 | 0.96 | VH   | 4.08  | ✔         | -           | 5            |
|                        |                       |                 | 0.16  | 0.84 | -0.999 | 3.414 | 0.61 | SH   | 3.85  | ✔         | ✔           | 10           |
| **Economy & Finance**  |                       |                 | 0.16  | 0.63 | -0.998 | 2.764 | 0.44 | A    | -     | -         | -           |               |
|                        |                       |                 | 0.99  | 0.68 | -0.998 | 2.764 | 0.25 | RL   | -     | -         | -           |               |
|                        |                       |                 | 0.11  | 0.70 | -0.998 | 2.794 | 0.30 | SL   | -     | -         | -           |               |
|                        |                       |                 | 0.35  | 0.84 | -0.998 | 2.764 | 0.97 | VH   | 1.00  | -         | -           |               |
|                        |                       |                 | 0.78  | 0.78 | -0.998 | 2.794 | 0.80 | H    | ✔     | ✔         | -           | 20           |
| **Country and order - dings** |           |                 | 0.23  | 0.66 | -0.986 | 2.950 | 0.51 | A    | -     | -         | -           |               |
|                        |                       |                 | 0.14  | 0.53 | -0.986 | 2.950 | 0.47 | A    | -     | -         | -           |               |
|                        |                       |                 | 0.12  | 0.44 | -0.989 | 2.942 | 0.32 | SL   | -     | -         | -           |               |
|                        |                       |                 | 0.17  | 0.55 | -0.989 | 2.942 | 0.45 | A    | -     | -         | -           |               |
|                        |                       |                 | 0.24  | 0.63 | -0.986 | 2.950 | 0.71 | SH   | 4.00  | -         | ✔           | -            |               |
| **Region & Environment** |                       |                 | 0.23  | 0.62 | -0.998 | 2.624 | 0.71 | RH   | 2.52  | -         | -           | 15           |
|                        |                       |                 | 0.33  | 0.77 | -0.989 | 2.624 | 0.87 | H    | 4.02  | -         | ✔           | 6            |
|                        |                       |                 | 0.11  | 0.45 | -0.989 | 2.642 | 0.29 | RL   | -     | -         | -           |               |
|                        |                       |                 | 0.12  | 0.44 | -0.989 | 2.642 | 0.29 | RL   | -     | -         | -           |               |
|                        |                       |                 | 0.09  | 0.41 | -0.986 | 2.950 | 0.35 | SL   | -     | -         | -           |               |
|                        |                       |                 | 0.24  | 0.63 | -0.986 | 2.950 | 0.68 | SH   | 3.40  | -         | ✔           | 7            |

*Asia: China, India, Vietnam, Philippines, Kazakhstan, etc. **Others: Iran, UAE, Qatar, Turkey, USA, Canada, Hungary, Russia, Angola, Mexico, etc.
final risk indicators was also conducted. The range of priority risks was limited to cases that satisfied the following criteria simultaneously: the assessment scores of the SR are more than Ave; 0.6 (1.0 > x≥0.6, the case in which the resulting score of assessment exceeds the average), and the assessment scores of the IR are more than Ave: 2.54 (5.0 > x≥2.54, the case in which the resulting score of assessment exceeds the average).

It can be judged that the risk level is very high when risk indicators are distributed across the upper level. After assessing SR and IR, the authors found 12 priority KRIs targeting Asian regions, 8 priority KRIs for other regions including the Middle East, North America/Pacific, Europe, Africa, Central and South America and 15 priorities for common regions. The results of an assessment of the priority risk indicators and the method for responding to them in Asian regions are subsequently described.

Aspects of country and order surroundings

The priority evaluations for "Corruption Perceptions Index" (CR15), "Forcing home currency policy" (CR16), "Impact of macroeconomic variables" (CR25), and "Insufficient infrastructure" (CR46) were high at the country level.

Because of the nature of most of the developing countries that propel ADPs, there are many high-risk, unstable factors in political and strategic affairs. Financial bases are too vulnerable to address the critical factors at the industry level. In order to respond to such risks, the terms and conditions of the contract should be specified in terms of the claim compensation rights for loss that will cover risks related to political/strategic factors as well as market fluctuations, corruption in the host country, market conditions, and other factors.

Aspects of the construction industry and market

The priority evaluations for "Economic recession and overheating" (IR11), "Delay of license approval and administrative procedures" (IR24), and "Intensified competition between bid participants" (IR33) were high at the industry level. Such consequences are a result of government agencies, employers, and the pertinent organizations lacking understanding of the project, and a lack of support for project procedures and operations. It may be necessary to establish a strategy for localization by using pertinent experts or professional institutions. It may also be necessary to clearly describe the requirements, which should be supported and fulfilled in the provisions of the contract in order to allow the opponent party to speed the administrative process.

Aspects of project implementation and management

The priority evaluations for "Lack of resources and unreasonable requirements on the part of the employer" (PR14), "Lack of understanding and capability for carrying out the project on the part of employer" (PR15), "Poor accessibility to the construction site and vulnerable construction conditions" (PR41), "Conflicts between local firms and subcontractors" (PR48), and "Problems with cash flow operation" (PR53) were high at the project level. This is a result of additional project expenses incurred due to generally inadequate construction conditions. In addition, participatory entities (e.g., employers, contractors, affiliated companies, and subcontractors) lack strategies for project standards, including standards for fair bid proposals, the selection of subcontractors, and funding schemes. It is necessary to decide whether or not to participate in the project after analyzing the business feasibility. It is also necessary to reduce the risk level by clearly describing the risk factors in the contract provisions.

5. Conclusion

In order to revitalize advancement into international construction markets and to respond to market diversification and competition, the government has recently expanded IDPs in order to diversify international construction projects.

This study reviewed the distinctive features of IDPs and developed a hierarchical structure of risks. In this study, 82 risk indicators, including 4 main criteria and 17 sub-criteria, were selected. Utilizing Fuzzy methods and AHP, the SRs of the risk indicators were measured and calculated. From the results of SR assessment, 35 KRIs were determined and IR targeting was calculated. Comparison of the SR and IR suggested that the risk response attitude and 12 risk indicators were selected according to priority evaluation in ADPs. These findings contribute to a better understanding of the nature of ADPs by providing an objective and quantitative theoretical framework. Subsequent research will develop risk assessment models in which the characteristics of IDPs according to region are reflected.

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