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Priority Analysis of Dispute Factors in Overseas Construction Based on FIDIC Contract Conditions

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Abstract

With the globalization of the construction market and the recession in Korea's construction economy, construction companies in South Korea are extending their business into new international markets. However, there are still more than a few companies that are not making due profits despite the streams of contracts available outside the country. This is because Korean construction companies are undergoing complications in the resolution process of overseas construction claims and disputes. Therefore, the present study examines research from a construction company's perspective, based on the FIDIC Red Book, a standard form of contract that is typically used overseas for separate bid-based construction contracts. Disputable items were selected through analysis of contract documents and the final dispute factors were derived through literature reviews and interviews with experts. To determine the priority of the dispute factors suggested by the experts who are practically in charge of overseas construction contract management, an FMEA method survey was performed and feedback was received using the Delphi method. Based on the survey results, the priority of dispute factors was analyzed, and the top 10 factors were selected as preeminent key factors for potential improvement and procedural amendment. In addition, this study analyzes whether individual or company system capabilities should be addressed in order to prevent such dispute factors. Based on the findings of this study, it is expected that Korean construction companies will establish strategies to cope with disputes at a corporate level and gain competitiveness in the overseas construction market.

Keywords: *overseas construction contract, construction dispute factor, contract document, conditions of contract, FIDIC red book, FMEA method*

1. Introduction

According to Global insight (2013), the global construction market value reached approximately USD827.1 billion in 2013, and is expected to increase to USD26 trillion by 2026. Along with the global market expansion, Korean construction companies place significant weight on expanding into overseas markets. As a result, according to the International Contractors Association of Korea, the amount of signed overseas contracts reached a total of USD660 billion by November 2014 and establishing a market presence in 92 countries.

Nevertheless, 20%~30% of Korean construction companies have not been making profits from overseas construction projects for the past 10 years despite expansion into lucrative overseas markets (Yonsei Univ. *et al*., 2010). Such an unfortunate outcome can be directly attributed to the unnaturally low bids placed by winning contractors. Another reason, however, can be traced to the Korean companies' poor management skills when it comes to handling claims and disputes that occur in overseas construction projects. According to the Global Construction Dispute Report published by EC Harris in 2013, the average cost of a dispute in overseas construction projects is USD 3,170, while the duration of the dispute resolution process averages 12.8 months. The occurrence of disputes represents a great loss for construction companies not excepting Korean companies. In particular, this report pinpoints the main causes of disputes as incomplete or groundless claims, as well as resulting from a misunderstanding of the responsibilities or from a failure to fulfill the contract agreement (Table 1). As for Korean construction companies, the Construction Economy Research Institute of Korea (CERIK) investigated the problems which evolve in the process of claim/dispute resolution in overseas construction projects. According to their report, the most severe problems are lack of professional knowledge related to claims and disputes, poor on-site preparation, inappropriate confrontation strategies for problems, and lack of corporate assistance and cooperation. In other words, severe economic loss is caused by inadequate countermeasures and lack of expertise regarding contracts, claims, and disputes, rather than by construction incompetence. This issue is extremely relevant to Korean construction companies that intend to expand to overseas markets then find themselves suffering from damages incurred from repeated claims and

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Table 1. Global Construction Dispute Trend and Cause of Occurrence, EC Harris, 2013

Region	Dispute values (US$ millions)			Length of dispute (months)		
	2010	2011	2012	2010	2011	2012
Middle East	56.3	112.5	65	8.3	9	14.6
Asia	64.5	53.1	39.7	11.4	12.4	14.3
US	64.5	10.5	9	11.4	14.4	11.9
UK	7.5	10.2	27	6.8	8.7	12.9
Mainland Europe	33.3	35.1	25	10	11.7	6
Global Average	35.1	32.2	31.7	9.1	10.6	12.8

2012 Rank	Cause	2011 Rank
1	Incomplete and/or unsubstantiated claims	New
2	Failure to understand and/or comply with its contractual obligations by the Employer/Contractor/Subcontractor	New
3	Failure to properly administer the contract	1
4	Failure to make interim awards on extensions of time and compensation	3
5	Errors and/or omissions in the Contract Document	2

disputes because they are not accustomed to overseas contracting practices.

There are various ways to increase a company's capability to cope with claims and disputes and to prevent damages. The most fundamental necessity is a thorough understanding of contract documents and contract conditions that form the basis of all contract issues, and to prepare countermeasures for resolving problems occurring on the basis of these contracts.

To this end, the present study aims to analyze the causes of claims or disputes and the risk level of each factor through the Failure Modes and Effects Analysis (FMEA) method in order to present strategic directions for preparing countermeasures. The basis for the analysis is the general conditions of construction contract from the International Federation of Consulting Engineers (Federation Internationale Des Ingenieurs-Conseils, FIDIC), which is the most frequently used contract in overseas construction markets. The result of the analysis is expected to provide crucial criteria for determining contract risks (such as claims and disputes based on contract conditions), and coping strategies for construction companies.

Generally speaking, construction involves various construction materials, equipment, technologies, and methods. Furthermore it is not an overstatement to describe it as a process of fulfilling contract conditions between the parties who signed the contract. However, due to the difference between the features of each construction project and the specific requirements of each party, in most construction cases, a standard form of contract is used which has been thoroughly examined for legal and practical application beforehand, in order to reduce complications and confusion

The present study derives and analyzes the risk factors that can cause claims or disputes, based on the FIDIC contracts, an established standard form of contract typically used in overseas construction projects. The risks procured from contract analysis will be referred to as "dispute factors". In addition, the contract used for analysis is limited to the Red Book, which is the most frequently used contract in the Design-Bid-Build (DBB) method of FIDIC contracts. The study is conducted from the perspective of general contractors. With regard to the analysis method, the FMEA method and Delphi method are applied on overseas construction experts who work at large-scale construction companies in Korea. With regard to the strategies to reduce claims and disputes, the strategy was roughly divided into two directions: improving individual capabilities and revising company systems.

2. Literature Review

2.1 International Federation of Consulting Engineers

The International Federation of Consulting Engineers (FIDIC) was established in 1913 to promote reasonable contract systems and avoid unreasonable contracts known to have been practiced during the colonial period. Since the first issue of the FIDIC contract in 1957, newly revised or developed templates have been used in construction markets worldwide. Moreover, FIDIC contract conditions, even when not applied directly, are used in numerous overseas construction contracts as a reference, which validates their high status (Choi, 2002).

The purpose of the FIDIC contracts is to clearly identify the roles, rights, and responsibilities of construction parties, as well as to reasonably distribute the risks between the employer and the contractor. Since the roles, rights, and responsibilities can change depending on the type of construction contracts, FIDIC proposes various standard forms of contract by taking into account the contract types. For example, concerned parties can choose from the Red Book for the Design-Bid-Build Contract (DBB), the Yellow Book for the Plant & Design Build Contract and the Silver Book for the Engineering Procurement and Construction (EPC)/Turnkey Contract. In this study, the Red Book's General Conditions in FIDIC DBB Contract are taken into account. The DBB contract is the quintessential contract and has become the foundation of other contract types. In addition, the analysis of the contract for construction will be particularly helpful since the present study focuses on analyzing the risks from the Korean construction companies' perspective. The

Table 2. List of FIDIC Red Book Clauses

Clause No.	Contents
1	General Provisions
2	The Employer
3	Engineer
4	The Contractor
5	Nominated Subcontractor
6	Staff and Labor
7	Plant, Materials, Workmanship
8	Commencement Delay and Suspension
9	Test on Completion
10	Employer's Taking Over
11	Defect Liability
12	Measurement and Evaluation
13	Variations and Adjustment
14	Contract Price and Payment
15	Termination by Employer
16	Suspension & Termination by Contractor
17	Risk and Responsibility
18	Insurance
19	Force Majeure
20	Claims Disputes and Arbitration

FIDIC Red Book largely consists of General Conditions and Special Conditions. The Special Conditions were excluded in this study since they contain specialized contents applicable only in certain construction projects. The General Conditions of the FIDIC Red Book are made up of 20 clauses (Table 2).

2.2 Failure Modes and Effects Analysis

The Failure Modes and Effects Analysis (FMEA) is a structured reliability analysis method originally used in the manufacturing industry to identify and prevent problems with products and processes (Robin, 1996). The purpose of FMEA is to discover risk factors within the system before a problem arises to eliminate or reduce the occurrence of the issue, and is further used to prevent risks and minimize the effect of these risks by focusing on the management of several high risk factors (Pyzdek, 2003).

Generally, the FMEA method employs the following criteria: the frequency of failure, which can occur due to potential risk factors (Occurrence); the level of impact when there is a failure (Severity); and the capability to detect the occurred failure (Detection) (Pyzdek, 2003). On the other hand, the target of the present study differs from the case where "detection" is difficult or problematic, as in factory conveyor belts. Here, the outbreak of a problem has a ripple effect and poses a potential risk of becoming a source for another claim or dispute. Therefore, this study selected the following criteria: the occurrence of each dispute factor, the severity indicating the level of damage inflicted upon the occurrence of a corresponding dispute factor, and the effectiveness indicating a connection to the occurrence of other dispute factors. Furthermore, the eventual risk level of FMEA is computed by multiplying each factor, which is referred to as the Risk Priority Number (RPN).

- Occurrence: The frequency or probability that a risk factor can occur
- Severity: The level of damage stemming from the appearance of a certain risk factor
- Effectiveness: The impact that a risk factor has on the occurrence of other risk factors
- Risk Priority Number(RPN) = occurrence × severity × effectiveness

The FMEA method is performed by experts in the system based on a series of assessment forms to obtain objective results. When the final RPN is computed, the priority given to each risk factor is utilized in establishing countermeasures to eliminate or lower the risk factors with the highest priority.

Even though the FMEA has been widely used in manufacturing industries in various phases of the product life cycle, its use and expected effects are very useful in various ways in the field of construction management as well. For example, the FMEA was used to access more important project risks over the construction project life-cycle for establishing corrective actions (Mohammadi *et al*., 2013) and to build a risk management framework for project managers (Tavakolan *et al.*, 2015). The same method was used to identify risk factors in construction safety management and to suggest better safety management strategies (Song *et al*., 2007). Likewise, in cost (Kim *et al*., 2007), schedule (Lee *et al.*, 20112, Hong *et al*., 2004), and quality management (Oh *et al.*, 2012), the FMEA method can be applied to detect and manage the factors that cause excess in construction costs, schedule delays and quality failure respectively.

As above, the FMEA is an efficient tool to evaluate potential risk factors in early stage of various construction management processes. Especially it helps to identify more important or high risk factors to focus when the resources in hand are limited to control or prevent them. Validity of the FMEA is the same in claim and dispute management.

2.3 Related Previous Studies

With regard to overseas construction contracts and disputes, numerous studies highlight the importance of the matter. Earlier studies presented several theses involving the risk factors of claims and disputes. For example, Chan *et al*. (2011) accounted for risk factors by implementing target cost contracts and guaranteed maximum price contracts (TCC/GMP) based on Hong Kong construction contracts, and derived the risk ranking based on agents such as employer, contractor, and consultant. Nieto *et al.* (2011) computed the risk impact and risk probability of every risk factor related to a contract, and suggested a risk assessment model by applying the Fuzzy theory. Ju (2014) suggests a structured contract management system applicable in overseas construction projects using the IDEF0 Model. Kim (2010) analyzed the cause of disputes and dispute resolution processes, and compares the probability for dispute occurrence against dispute solution strategies based on probability values.

While many studies emphasize the risk factors of claims or disputes, these risk factors were derived based on subjective experience and insight, and are restricted to discovering explicit management strategies. In particular, when companies or engineers inexperienced in overseas construction projects apply research findings in real business practices or when companies establish strategies to improve capability to cope with claims and disputes at the corporate level, more practical and specific analyses and solutions are necessary.

3. Derivation of Dispute Factors in Overseas Construction

3.1 Dispute Factor Priority Assessment Process

The process of assessing the priority of dispute factors in overseas construction projects comprised four stages (Fig. 1). In Stage 1, each contract condition of the FIDIC Red Book was analyzed, and the items examined during the progression of overseas contracts were derived in the form of 292 questions. Subsequently, 53 factors from Stage 1 were chosen through a literature review including relevant previous studies, cases, and checklists for Korean construction companies. Then, 36 factors from Stage 2 were selected after conducting interviews with three experts on overseas construction contract management in business. Lastly, after similar items were combined and overlapping items excluded, the final 30 dispute factors were used in a questionnaire. During Stage 2, a survey was conducted on personnel who have actual job experience with overseas construction contracts. The purpose of the inquiry was to assess the occurrence, severity, and effectiveness of each dispute factor, as well as individual capabilities and company systems. During Stage 3, RPN was computed based on the survey results, and feedback from appointed experts was received through a second survey regarding the derived result. Based on the final results, the 10 factors with the highest RPN were selected. During Stage 4, strategies to lower the RPN of dispute factors were established.

3.2 FIDIC Contract Clause Analysis

While earlier studies derived risk factors for claims and disputes based largely on subjective and empirical evidence, the present study identifies dispute factors through the analysis of the FIDIC Red Book. In other words, guided by the hypothesis that failure to accomplish the task on any item in the construction contract general conditions leads to claims or disputes, this study derived a set of questions to prevent the appearance of such risk factors. For example, at first glance, people may misconstrue Clause "1.4 Law and Language" as simply containing the relevant laws and the language applicable to the contract. However, the construction company that participates in overseas bidding must identify various facts related to this simple clause. One cannot be satisfied with simply understanding relevant laws applicable to Clause 1.4 in the contract, but should rather also consider the impact of implementing the law in the execution of construction projects, or the impact which future changes in the law might have on construction.

Accordingly, the following three questions were drafted with such crucial points in mind as they relate to contract clause issues as reviewed by experts. Questions 1) and 2) concern laws related to the contract and question 3) concerns the language of the contract.

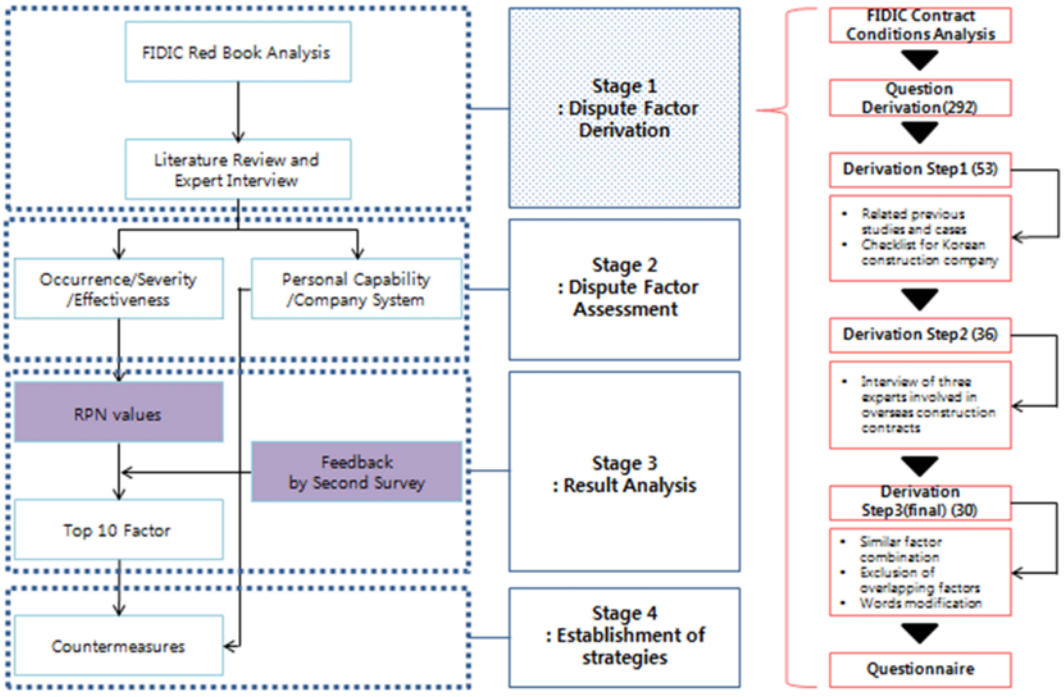

Fig. 1. The Priority Analysis Process of Dispute Risk Factors

Questions
1) Have you checked country-specific laws such as labor and environment laws in advance and have you applied them in the bidding or construction execution process?
2) Are you aware of the impact of law changes on the bidding or construction execution process?
3) Do the employees on your construction sites have the language skills to clearly understand the meaning of contractual language and the terms contained therein?

Another example is Clause "13.4 Payment in Applicable Currencies", which concerns the currency used for paying the agreed remuneration. In order to understand the potential risks involved in the nuances of this clause, any construction project manager applying for a project involving foreign currency must consider exchange risks and changes in foreign exchange policies, as well as strategies to reduce such risks. Based on this, facts that need to be recognized or examined regarding Clause 13.4 were reviewed by experts with four questions framed as follows.

Questions
1) If the payment currency matches the employer's country's currency, have you considered the exchange risk?
2) Have you acquired knowledge of the exchange rate and foreign exchange policy of the employer's country?
3) If more than one currency is used, are you aware of the risks with regard to the processing, time, and expenses that may accrue in exchanging and remitting money?
4) If more than one currency is used, have you established a strategy to reduce such risks?

A total of 292 questions were derived based on all clauses in the contract of the FIDIC Red Book. These questions are vital because they can be used as a checklist in the event of tender and construction executions to prevent claims and disputes based on the simple contract clauses.

3.3 Derivation of Dispute Factors

The Derived questions were reconstructed into dispute factors through a literature review and interviews with experts. Regarding

Table 3. Dispute Risk Factors for FMEA

No.	Dispute Risk Factor	Category
1	Failure to consider exchange risk at the time of tender	X
2	Failure to consider the additional allowance of quantity of actual work at the time of tender and estimation	X
3	Failure to consider utility expenses such as electricity, water, and gas at the time of tender and estimation	X
4	Failure to examine relevant local laws at the time of tender	X
5	Failure to examine contract conditions at the time of tender	X
6	Unclear subsequent adjustment of the contract price involving any Provisional Sum	X
7	Unclear subsequent account of approximate quantity	X
8	Unclear payment condition for returning retention money	X
9	Unclear reduction method of delay damages	X
10	Unclear definition and types of defects	X
11	Unclear definition and limit of liability of force majeure	X
12	Performance security unmatched the agreed conditions	X
13	Ambiguous distinction between permanent and temporary works	X
14	Lack of understanding in contractual language and terms	X
15	Inadequate skills to recognize and handle claim-related clauses	X
16	Disagreement or lack of knowledge on insurance-related clauses	X
17	Disagreement or lack of knowledge on arbitration-related clauses	X
18	Lack of knowledge on payment conditions and application of progress payment	Y
19	Lack of knowledge on application and issuing conditions of taking-over certificate	Y
20	Disagreement on method of measurement	Y
21	Disagreement on payment method due to variation of quantities	Y
22	Extra work or delayed work with unclear excuses	Y
23	Ambiguous liability limit for using materials and equipment provided by the employer	Y
24	Failure to give notice to the engineers or disapproval when working overtime	Y
25	Failure to notify the insurance company of any site changes	Y
26	Failure to obtain a written confirmation of the instructions from the engineer	Y
27	Failure of safe-keep evidence documents	Y
28	Failure to estimate the size of compensation for construction costs and time in case of a claim	Y
29	Disagreement or lack of knowledge on the methods and time requirements for written notice	Y
30	Contractor's failure to fulfill the responsibility to preview the information provided by the employer or lack of basis for reasonable interpretation	Y

*X: contract-related factor / Y: construction-related factor

interviews, this study selected three business experts who are in charge of overseas contracts. As a result, with Clause "1.4 Law and Language" serving as an example, three key themes were deduced from the relevant questions based on a literature review: 1) changes in law 2) application of local laws and 3) understanding of contractual language. After experts' reviews, the top factors with relatively high risk were selected and then the dispute factors of relevant clauses were condensed down to two in order to suit the FMEA survey: "Failure to examine relevant local law at the time of tender" and "Lack of understanding in contractual language and terms". With regard to Clause "13.4 Payment in Applicable Currencies", through experts' feedback and literature review, "Failure to consider exchange risk at the time of tender", which was deemed to be the most direct risk related to this clause, was determined as the final dispute factor.

A total of 292 questions were screened through the process described above. As a result, 53 factors during Stage 1, 36 factors during Stage 2, and lastly, 30 factors were determined as final factors by eliminating similar or overlapping factors.

In the meantime, each factor can be categorized into "contract-related factor (X)" and "construction-related factor (Y)" based on the stage of the project. For example, factors that need to be examined and recognized at the time of estimation or tender and factors that need to be recognized or implemented in the stage of contract, such as ambiguity of contract conditions, are categorized under "contract-related factors". On the other hand, factors that need to be recognized or implemented during construction executions, such as progress payment, a take-over certificate, change of contents, and safe-keeping of evidence documentation, are categorized under "construction-related factors" (Table 3).

4. Results Analysis of Dispute Factors in Overseas Construction

4.1 Evaluation Method and Criteria

4.1.1 Survey for FMEA

To evaluate the priority of dispute factors, interviews and surveys were conducted with business experts and contract managers who have rich experience in overseas construction projects. Surveys using the FMEA method and Delphi method were conducted for two months from August 2014 to October 2014; 25 copies were distributed and 19 copies were collected, amounting to a recovery rate of 76% (Table 4). Only a limited number of Korean construction companies have advanced to overseas markets and won contracts. Thus, not many experts are professionally managing overseas contracts working in relevant departments. Therefore, to obtain professional and reliable data, the present study selected a small number of experts instead of collecting a large amount of unsatisfactory samples. The expert group who participated in the survey consisted of contract managers from four large-scale Korean construction companies and QS consulting firms.

4.1.2 Measurement for FMEA

The FMEA in the present study uses three criteria (occurrence, severity, and effectiveness) and the end risk is computed with RPN, which product of the multiplication of all criteria. Since the higher the value, the higher the risk for overseas construction disputes, the priority of the dispute factors can be determined. In addition, the criteria for FMEA generally adopt a 10-point scale but the present study adopted a 5-point scale because specification tends to make criteria more ambiguous (Table 5).

Furthermore, questions concerning the effort needed to reduce the risk derived from the dispute factors were included in the FEMA survey. In short, a 5-point scale was used on each dispute factor to determine which measure is more important – improving the capabilities of the individual engineer who is in charge of the construction project or improving the company system.

4.2 Delphi Analysis of Dispute Factors

The present study analyzes overseas construction dispute factors using various methods: first, using the FMEA survey and RPN value derived by a multiplication of occurrence, severity, and effectiveness; second, feedback was collected through a Delphi survey and final analysis results were derived. Generally, in the Delphi method, the concept of stability is essential because of the need for an objective assessment regarding the necessary count of feedback rounds in order to arrive at a consensus. Therefore, the present study also conducted a stability test, using the arithmetic mean and standard deviation, to verify the reliability of the value of the final result. For the method of stability testing, a coefficient of variation was used – the value of standard deviation divided by the arithmetic mean.

- Coefficient of variation (C.V) = $\frac{\text{Standard deviation}}{\text{Arithmetic mean}}$
- Coefficient of variation (C.V) ≤ 0.5: stable; no need for an additional survey

Table 4. Survey Respondent Distribution

Construction and Overseas Contract Experience	5year under	More than 5year ~10year under	More than 10year ~15year under	More than 15year	Total
	6 persons	6	6	1	19
	31%	32%	32%	5%	100%

FIDIC Contract Experience	Less than 3 times	Over 3 times ~Less than 5 times	Over 5 times	Total
	12 persons	4	3	19
	63%	21%	16%	100%

Table 5. Evaluation Criteria for FMEA and Survey for Resolution Strategies

	Evaluation Items	Rating	Evaluation Criteria
FMEA Measure	Occurrence: A relative criterion which indicates how often claims or disputes occur due to the corresponding factor	5	Very likely
		4	Likely
		3	Medium
		2	Unlikely
		1	Very unlikely
	Severity: A relative criterion which indicates the amount of damage (cost and time) caused by the claims or disputes when the corresponding factor occurs	5	Hazardous
		4	Major
		3	Moderate
		2	Minor
		1	Slight
	Effectiveness: A relative criterion which indicates the effectiveness of the dispute factor on other construction claims and disputes when the corresponding factor occurs	5	Almost certain
		4	High
		3	Medium
		2	Low
		1	Remote
Effort to Reduce the Risk	Personal Capability: An individual person's capability to prevent probable claims or disputes (e.g., comprehension skills, judgment skills, coping skills, cognitive skills, negotiation skills)	5	Very important
		4	Important
		3	Moderate
		2	Unimportant
		1	Very unimportant
	Company System: The various systems that a company needs to prevent probable claims or disputes (e.g., available data, structured process and manuals, computer systems, operation of supporting teams)	5	Very important
		4	Important
		3	Moderate
		2	Unimportant
		1	Very unimportant

- 0.5 < coefficient of variation (C.V) ≤ 0.8: relatively stable; an additional survey may be considered
- 0.8 < coefficient of variation (C.V): unstable; an additional survey is required

When the coefficient of variation is below 0.5, there is no need for additional surveys; a coefficient of variation between 0.5 and 0.8 is deemed relatively stable; and a coefficient of variation over 0.8 is at an unstable level and requires additional surveys (No, 2006). Accordingly, the coefficient of variation for each dispute factor was computed in order to examine the validity of the mean value of the criteria obtained from the experts via surveys. The result values from the second survey were below 0.5 in most cases, with the highest value being 0.57, which indicates that all values belonged to the stable category and did not need an additional survey.

4.3 FMEA of Dispute Factors

The mean value and RPN of the five criteria for the entire 30 dispute factors (occurrence, severity, effectiveness, individual capabilities, and company system) are summarized in Table 6. The results show that the highest value of occurrence is "27) Failure of safe-keeping of evidence documents (occurrence scare = 4.0)", followed by "15) Inadequate skills to recognize and handle claim-related clauses (3.94)", "4) Failure to examine relevant local laws at the time of tender (3.67)", "28) Failure to estimate the size of compensation for construction costs and time in case of a claim (3.61)", and "29) Disagreement or lack of knowledge on the methods and time requirements of written notice (3.50)". On the other hand, the occurrence of the following factors was assessed to be relatively low: "3) Failure to consider utility expenses such as electricity, water, and gas at the time of tender and estimation (1.50)", "13) Ambiguous distinction between permanent and temporary works (1.83)", "17) Disagreement or lack of knowledge on arbitration-related clauses (2.06)", and "23) Ambiguous liability limit for using materials and equipment provided by the employer (2.17)". The severity and effectiveness of these factors were also low, thus putting them in the lower group for RPN ratings.

With regard to severity, the most severe factors were manifested in the following order: "5) Failure to examine contract conditions at the time of tender (severity score = 4.39), followed by "4) Failure to examine relevant local laws at the time of tender (4.28)", "15. Inadequate skills to recognize and handle claim-related clauses (4.17)", "11) Unclear definition and limit of liability of force majeure (4.06)," and "27) Failure of safe-keeping of evidence documents (4.06)". Although the severity of "1) Failure to consider exchange risk at the time of tender (4.0)" and "9) Unclear reduction method of delay damages (3.72)" was relatively high, they were deemed low for occurrence and placed in the middle rank in the final RPN ranking. The following factors scored low in severity: "24) Failure to give notice to the

Table 6. Summary of FMEA Results

No.	FMEA Results								Resolution Strategies	
	Occurrence		Severity		Effectiveness		RPN	RPN Rank	Personal Capability	Company System
	Score	Rank	Score	Rank	Score	Rank				
1	2.39	20	4.00	6	3.72	7	35.57	13	3.22	4.33
2	2.29	23	3.47	15	2.94	21	23.42	20	4.06	3.44
3	1.50	30	2.56	28	2.35	30	9.02	30	3.28	3.00
4	**3.67**	**4**	**4.28**	**2**	3.71	9	**58.13**	**4**	4.00	4.28
5	3.11	9	**4.39**	**1**	**4.33**	**1**	**59.17**	**3**	4.61	4.39
6	3.00	13	2.89	23	2.67	25	23.11	21	3.50	3.28
7	3.06	12	3.06	20	3.00	20	28.01	16	3.78	3.11
8	2.33	21	3.28	19	2.94	21	22.52	22	3.50	3.61
9	2.33	21	3.72	10	3.11	18	27.02	17	3.28	3.56
10	3.28	7	3.56	14	3.33	15	38.85	11	3.61	3.72
11	3.11	9	**4.06**	**4**	**3.89**	**4**	49.07	8	3.06	3.56
12	2.00	28	3.67	12	3.33	15	24.44	19	3.61	3.83
13	1.83	29	2.50	29	2.56	26	11.71	29	3.56	3.17
14	3.11	9	3.67	12	3.56	12	40.56	10	4.44	3.61
15	**3.94**	**2**	**4.17**	**3**	**4.17**	**2**	**68.48**	1	4.50	4.17
16	2.72	16	3.33	18	3.39	13	30.75	14	3.89	4.00
17	2.06	27	3.06	20	3.06	19	19.19	24	3.67	4.11
18	2.22	24	3.44	16	3.39	13	25.94	18	4.00	3.61
19	2.22	24	2.89	23	2.94	21	18.90	25	3.89	3.50
20	2.50	19	2.61	27	2.56	26	16.68	26	4.00	3.11
21	3.00	13	3.00	22	3.22	17	29.00	15	3.83	3.00
22	**3.78**	**3**	3.72	10	3.72	7	52.34	6	3.83	3.28
23	2.17	26	2.78	26	2.50	28	15.05	27	3.17	3.22
24	2.56	18	2.28	30	2.39	29	13.91	28	4.06	3.28
25	2.67	17	2.83	25	2.78	24	20.99	23	3.72	3.83
26	2.94	15	3.44	16	3.67	10	37.19	12	4.11	3.44
27	**4.00**	**1**	**4.06**	**4**	**4.06**	**3**	**65.79**	**2**	4.61	4.28
28	**3.61**	**5**	3.78	8	**3.89**	**4**	**53.05**	**5**	4.39	4.28
29	3.50	6	3.94	7	3.67	10	50.62	7	4.17	3.78
30	3.17	8	3.78	8	3.78	6	45.19	9	4.06	4.06

engineers or disapproval when working overtime (2.28)", "13) Ambiguous distinction between permanent and temporary works (2.50)", and "3) Failure to consider utility expenses such as electricity, water, and gas at the time of tender and estimation (2.56)".

With regard to effectiveness, the following factors scored high in descending order: "5) Failure to examine contract conditions at the time of tender (effectiveness score = 4.33)", "15) Inadequate skills to recognize and handle claim-related clauses (4.17)", "27) Failure of safe-keeping of evidence documents (4.06)", "11) Unclear definition and limit of liability of force majeure (3.89)", and "28) Failure to estimate the size of compensation for construction costs and time in case of a claim (3.89)". On the other hand, the following factors scored low: "3) Failure to consider utility expenses such as electricity, water, and gas at the time of tender and estimation (2.35)", "24) Failure to give notice to the engineers or disapproval when working overtime (2.39)", and "23) Ambiguous liability limit for using materials and equipment provided by the employer (2.50)".

Overall, it is difficult to find factors exhibiting drastic gaps between occurrence, severity, and effectiveness. In other words, factors are rarely extremely low in occurrence while extremely high in severity. Similarly, few factors are extremely low in severity and high in effectiveness. The values of these three criteria indicate a proportional tendency.

RPN value is the final result that can assess the risk level of claims or disputes, and the factors with the highest RPN values are as follows: "15) Inadequate skills to recognize and handle claim-related clauses (RPN value = 68.48)", "27) Failure of safe-keeping of evidence documents (65.79)", "5) Failure to examine contract conditions at the time of tender (59.17)", "4) Failure to examine relevant local laws at the time of tender (58.13)", and "28) Failure to estimate the size of compensation for construction costs and time in case of a claim (53.05)". On the other hand, the following factors scored distinctively low and were evaluated to be low level risks: "3) Failure to consider the utility expenses such as electricity, water, and gas at the time of tender and estimation (9.02)", "13) Ambiguous distinction between permanent

Table 7. Resolution Strategies for Top 10 RPN Dispute Risk Factors

RPN Rank	Dispute Risk Factor	Personal Capability		Company System	
		Score	Rank	Score	Rank
1	15) Inadequate skills to recognize and handle claim-related clauses	**4.50**	**3**	**4.17**	**5**
2	27) Failure of safe-keeping of evidence documents	**4.61**	**1**	**4.28**	**2**
3	5) Failure to examine contract conditions at the time of tender	**4.61**	**1**	**4.39**	**1**
4	4) Failure to examine relevant local laws at the time of tender	4.00	8	**4.28**	**2**
5	28) Failure to estimate the size of compensation for construction cost and time in case of claim	**4.39**	**5**	**4.28**	**2**
6	22) Extra work or delayed work with unclear excuses	3.83	9	3.28	9
7	29) Disagreement or lack of knowledge on the methods and time requirement for written notice	4.17	6	3.78	7
9	30) Contractor's failure to fulfill the responsibility to preview the information provided by the employer or lack of basis for reasonable interpretation	4.06	7	4.06	6
10	14) Lack of understanding in contractual language and terms	**4.44**	**4**	3.61	8

and temporary works (11.71)", and "24) Failure to give notice to the engineers or disapproval when working overtime (13.91)".

When categorizing the factors based on the construction phase, "15) Inadequate skills to recognize and handle claim-related clauses" holds the first place among contract-related factors (category X), whereas "27) Failure of safe-keeping of evidence documents scored the highest for risk level in the construction" related category Y.

4.4 Strategies to Resolve the Top 10 RPN Dispute Factors

Based on the top 10 factors with highest RPN values, i.e., dispute factors with high-risk levels, we analyzed which area requires improvement to lower risk levels. If the result shows a high value in "individual capabilities," it signifies that it is more essential to improve individual problem-solving skills through education and training. If the value of "company system" is high, it signifies that a systematic approach is more crucial to prepare and utilize at the corporate level.

Judging by an overview of the 30 dispute factors, personal capabilities were deemed to be crucial in 18 factors, whereas company systems in only 11. The scores were the same for "30) Contractor's failure to fulfill the responsibility to preview the information provided by the employer or lack of basis for reasonable interpretation".

However, in all the top 10 RPN factors except two, "4) Failure to examine relevant local laws at the time of tender" and "30) Contractor's failure to fulfill the responsibility to preview the information provided by the employer or lack of basis for reasonable interpretation", improving individual capabilities was relatively more important than improving company systems (Table 7).

This result does not imply that improvement of company systems is unimportant. Although the improvement of personal capabilities appears to be more critical than that of the company system, there is a demonstrable tendency indicating that improving the company system becomes more relevant as RPN value increases. The tendency is formulated by an analysis of the aforementioned factors. Of the top 10 factors that support individual capabilities, seven were included in the top 10 RPN values while six that support company system were included in the top 10 RPN values.

The factors that are not included in the top 10 RPN values but support the importance of improving individual capabilities are as follows: "26) Failure to obtain a written confirmation of the instructions from the engineer (the importance score for personal capabilities=4.11), "2) Failure to consider the additional allowance on quantity of actual work/net actual quantity at the time of tender and estimation (4.06)", and "24) Failure to give notice to the engineers or disapproval when working overtime (4.06)". Regarding the company system, the following factors supported the importance of its improvement: "1) Failure to consider exchange risk at the time of tender (the importance score for company system = 4.33)", "17) Disagreement or lack of knowledge on arbitration-related clauses (4.11)", "16) Disagreement or lack of knowledge on insurance-related clauses (4.00)", and "25) Failure to notify the insurance company of any site changes (3.83)".

Summing up these findings supports the establishing of strategic directions for the highest risk factor in terms of claims and disputes in overseas construction projects based on the contract documents, and the area the company should focus its effort on in order to handle such factors.

5. Conclusions

While Korean construction companies are expanding to foreign countries as a result of the construction market's globalization, they need to resolve the problems they encounter in the resolution process of claims or disputes in order to make due profits. To this end, the present study has derived probable risks for claims or disputes in overseas construction projects based on contract documents and selected dispute factors based on a literature review and interviews with experts. More specifically, the FMEA method, one of the top reliability analysis methods, was applied to interpret the significance of the factors.

As a result, factor 27, "Failure of safe-keeping of evidence documents" had the highest occurrence value; with regard to severity and effectiveness, factor 5, "Failures to examine contract

conditions at the time of tender" was placed in the highest rank. Factor 15, "Inadequate skills to recognize and handle claim-related clauses", scored equally high in occurrence, severity, and effectiveness indicates the highest risk with the highest RPN value. Regarding the top 10 factors with high RPN values representing high-risk dispute factors, we were able to evaluate the area that demands foremost improvement. All top 10 factors except two supported the idea that improving individual capabilities is more relevant than improving the company systems. Nonetheless, the improvement of company systems must also be supported because its importance tends to be high as RPN values increase. Therefore, training through education and feedback must be implemented to increase individual capabilities, and companies should be well-informed on how to handle probable claims or disputes by establishing strategies for enterprise risk management, thus identifying and focusing their effort on the area that requires most improvement.

Above all, in order to accomplish reasonable contract practices, it is crucial to discuss which party (employer or contractor) should take on the responsibility of minimizing the risk of potential construction disputes, and to share the burden appropriately. Therefore, contract managers who represent their construction companies need appropriate skills to persuade employers to distribute the risks reasonably.

Based on the priority of dispute factors in overseas construction, identified in this study, it is expected that Korean construction companies will establish strategies to handle overseas construction disputes at a corporate level and will contribute toward increasing their competitiveness in the overseas construction market. It should be noted that the FMEA method, which the present study has adopted, is flexible when it comes to adding new factors at a later stage. Thus the FMEA method reflects the overall characteristics of any project, providing a useful tool for the improvement of actual business practices. In addition, future studies should perform further reviews based on case analyses of the effects that can be achieved by improving on the derived key factors.

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