A Study on the Conditions of Contract Relationship of FIDIC

Nobuyuki SUZUKI, James R WHORLOW

Abstract—**Japanese contractors have even the most advanced and efficient technologies, such as robot and GPS assisted construction method, however not always succeeded on overseas projects and have historically faced significant contractual difficulties; one example being the reported disputes resolution through arbitration on an over 50-billion-yen mega highway contract in North Africa in August 2016. Understanding the conditions of contracts on international projects is vital, and it is a failure in this regard through misreading and/or misunderstanding that we believe may have significantly impacted Japanese contractor's in the past.**
In this paper, we evaluate the relationships between of each of the FIDIC conditions of contract by applying Text-Mining techniques and Graph theory to develop a conditions network. By analysis of the resultant network we then identify the key and most affective contractual clauses and propose possible strategies for contract management and ideas for dispute resolution.

Index Terms— **FIDIC conditions of contract, contract management, text mining, graph theory, risk management**

I. Introduction

Since 2012 the construction market has been revived due to the decision made in 2013 for Tokyo to host the 2020 Olympic Games, and initiation of a number of reconstruction projects following the huge earth quake in Northeast-Japan in 2011 and in South-Japan in 2016. As a direct result, almost all construction companies have reported their best fiscal year since the suspension of economic growth in 1990s almost 20 years ago (the so-called "lost 20 years").

Although the opportunities for future business investment exist, many companies in the construction sector are cautious to do so as historically the GDP growth of the host Olympic country tends to fall sharply in the following financial year (Figure 1). There have been exceptions however such as Atlanta 1996, and London 2012 [1]. Following the financial (Lehman) crisis in 2008, there was a significant impact on international projects due to the availability of financing. The situation has now improved dramatically with the highest investment amount ever recorded in 2014 (over 180 billion yen). Due to the post-Olympic Game's uncertainty, we fear many local Japanese construction companies, may look to overseas projects post 2020.

Japanese contractors have however not always succeeded on overseas projects and have historically faced significant contractual difficulties; one example being the reported disputes resolution through arbitration on an over 50-billion-yen mega highway contract in North Africa in August 2016 [2]. Understanding the conditions of contracts on international projects is vital, and it is a failure in this regard through misreading and/or misunderstanding that we believe may have significantly impacted Japanese contractor's in the past. Although there are some fluctuations, it is clear there is a growing uptake on overseas projects on a year by year basis.

Considering of this financial background trend, it is unsurprising that many Japanese contractors are looking to enter the overseas construction markets.

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II. Study Purpose

Japanese contractors have highly sought after construction techniques and methodologies widely recognized within the global construction field, however they have not been always succeeded on international projects. Furthermore, Japanese contractors have historically faced significant contractual difficulties; examples of this being the disputes resolution through arbitration on an over 50-billion-yen mega highway contract commenced in 2006 in North Africa (as reported in August 2016) and the contract terminated by the Employer (Drainage Service Department of Hong Kong Government) in 1997.

Although there are many reasons/factors that influence the successful outcome of construction projects, such as: un-known ground conditions, un-expected weather conditions, surrounding social circumstances, political stability and so on; Japanese contractors are successfully managing domestic contracts without resorting to arguments/disputes in the court. Understanding the conditions of contracts on international projects is vital, and it is a failure in this regard through misreading and/or misunderstanding requirements that we believe may have significantly impacted Japanese contractor's in the past.

In this paper, we evaluate the relationships between all texts and each clause of the FIDIC Conditions of Contract [3] for project managers to carry out proper contractual process. For comparison purpose, the Text-Mining technique is applied to all texts of Japanese Standard General Conditions of Contract (SGCC) [4] used for domestic projects.

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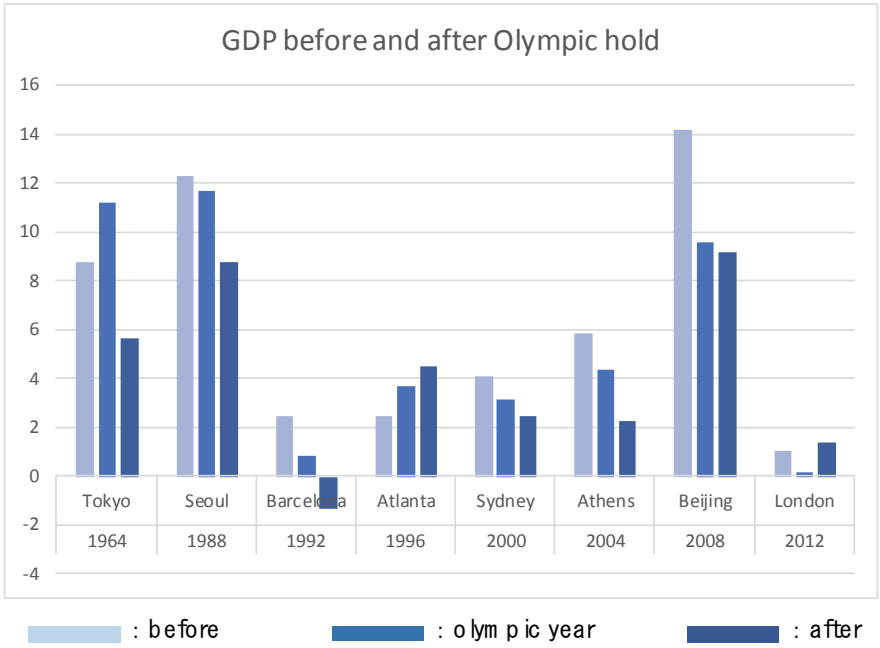

Figure 1. GDP Growth Trend of Olympic Game host countries

III. Methodology of Study

We adopt two techniques for finding the important key words, clauses key contract philosophy described as noted below;

a) text-mining technique,
b) centrality indexes of graph theory.

Text-Mining is a technique to extract valuable information in the form of data from character strings, words and phrases to facilitate subsequent numerical analysis. The data that can extracted through the evaluation of important texts includes: appearance frequency, correlation of appearance, appearance tendency, time related appearance, and others. To facilitate the numerical decision for each text and contractual clause, the centrality indexes, such as the "Between-ness", and the "Eigenvector" are normally applied.

The calculation formulas adopted for this analysis are;

$$Between-ness(i) = \sum_{J=1,I=1}^{N} \frac{Gpaths_{j\to i\to k}}{Gpaths_{j\to k}}$$

Where:

$Gpaths_{j\to k}$ is all possible shortest steps from node j to node i; and $Gpaths_{j\to i\to k}$ is the shortest steps from node j to node k passing through node i.

The higher index of between-ness shows the higher bonding/connecting force between each linked node (text), which means those nodes exist as playing important roles.

For n dimension square matrix$A$, when the constant λ and vector $\vec{x}$ are existing and the formula $A\vec{x} = \lambda\vec{x}$ ($\vec{x} \neq \vec{o}$) consists, then λ is the eigenvalue of matrix$A$ and $\vec{x}$ is the eigenvector belonging to λ.

The eigenvector shows where there are high degree indexed nodes (text) just next to themselves. Determined high eigenvector nodes therefore always represent important or key situations.

The effect of text and data mining techniques are different, where a data mining technique is usually adopted to find the users' aspiration/characteristic, whereas the understanding of providers' conditions are determined through Text-Mining.

In this paper, we intend to provide project managers with some insight into key contract provisions not encountered in Japan to facilitate proper contractual process management when they are working on overseas projects. Therefore the Text-Mining technique adopted is applied to understand the differences of contractual comprehension between FIDIC and Japanese domestic conditions of contract.

By applying Text-Mining techniques and Graph theory to develop a conditions network and analysis of the resultant network, we can identify the key and most affective contractual clauses [5] so as to propose possible strategies for contract management and ideas for dispute resolution.

Text-Mining techniques are normally applied to character strings to extract key words, which govern the circumstances/environment within a business process [6] [7] [8]. In our research, we adopted a Text-Mining computer software called "KH Coder" developed by Prof. Koichi Higuchi [9]; the resultant calculated figures are relatively compared using five colour categories, namely: pink (highest), light pink, white, light blue, blue (lowest).

In our analysis, we have not only considered the text in the Conditions of Contract (hereinafter; CoC) but also, we have reviewed the relationship network of all sub-clauses using graph theory.

IV. Analysis Results

A. Text-Mining for all texts of CoC

All component text of the FIDIC and SGCC forms of Contract were entered as data into the text-mining software to find the stream, strategy and/or the philosophy for each CoC. Calculating the "Between-ness" and "Eigenvector"

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centrality indexes for the developed text network model provides the visualization of key text items (Figures 2, 3, 4, 5).

It can be noted that there are more high interaction pink nodes (such as "The Engineer") in Figure 2 of FICIC (between-ness), compared to similar nodes (such as "contractors") in Figure 3 for the SGCC network. This is due to a lower inter relationship between text requirements within the SGCC.

Similarly, distinct differences are evident between the eigenvector networks for FIDIC and SGCC as shown in Figures 4 and 5. In FIDIC, the "ADJUDICATION", "DISPUTE", and "AGREEMENT" nodes exhibit the highest management, especially in relation to contract completion/closure. It is quite normal in construction to face a lot of problems due to design changes, weather uncertainties, the unexpected geological conditions, and other similar unknowns.

However, as shown by the analysis results of the SGCC network, "fiscal year", "accounting", "planning" and "product" the management of clients' budget expectations should also be considered an important issue. There are words in SGCC (encircled in red in the section of Figure 5), which have similar meanings to the DISPUTE and ADJUDICATION of FIDIC, however these are not inter-related defining key words within the CoC.

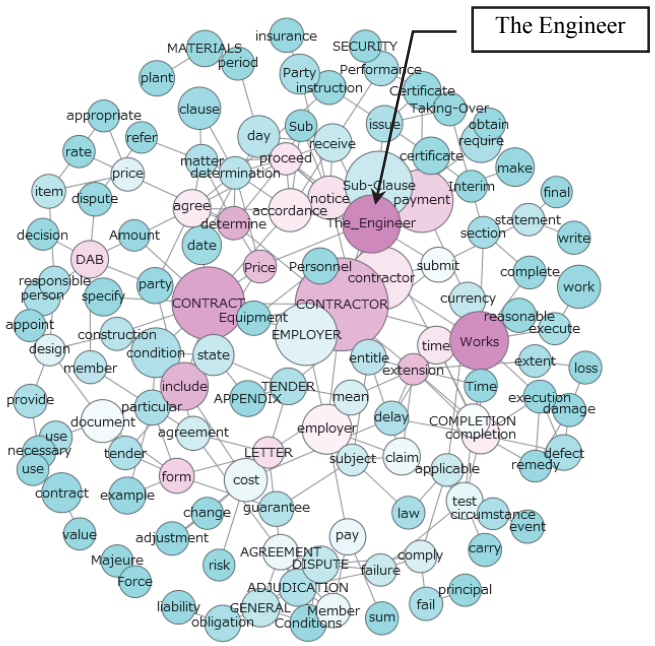

Figure 2. FIDIC (Between-ness)

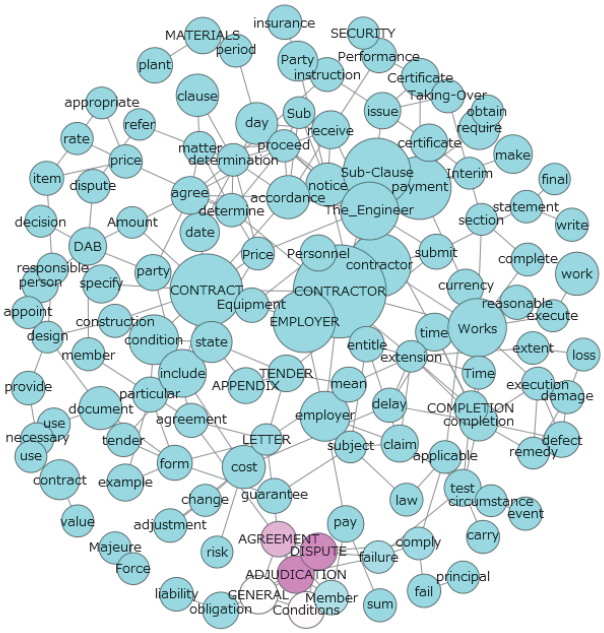

Figure 4. FIDIC (Eigenvector)

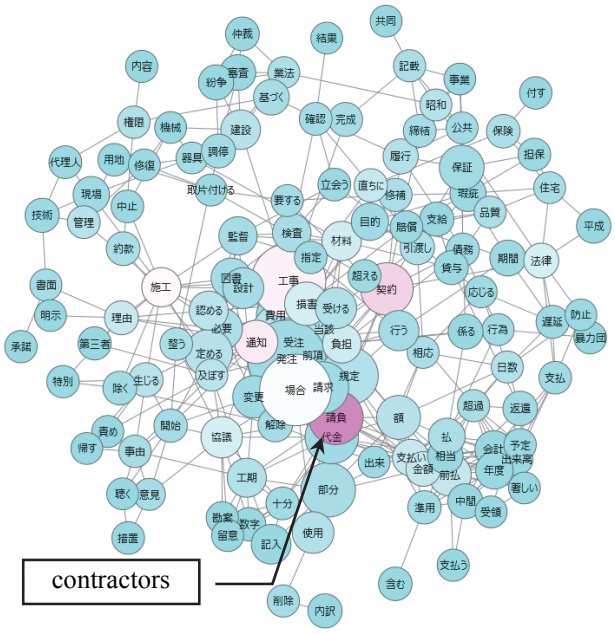

Figure 3. SGCC (Between-ness)

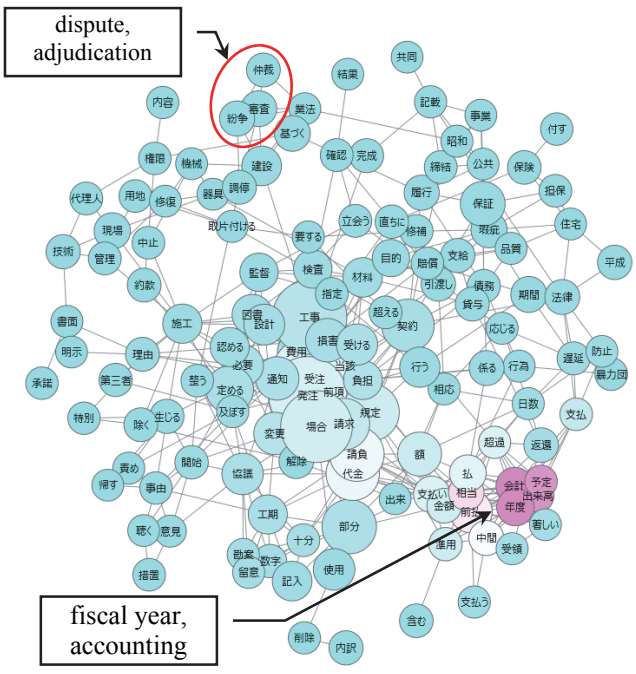

Figure 5. SGCC (Eigenvector)

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B. Self-Organizing Map of FIDIC CoC

For the next stage in our study is that we segmented similar texts by mass and grouped them for better understanding into a self-organizing map as shown in Figure 6. The mass of each text is distributed using Euclidean distances based on the strength of the relation.

When project managers of Japanese contractors manage projects, they will typically rely on their experiences gained on domestic contracts. However, where they are required to manage overseas projects, benefit can also be gained from understanding key contract terminology as also highlighted in Figure 6.

In particular, key words to note within the self-organizing map are: “DISPUTE”, “ADJUDICATION”, “DAB”, “GENERAL”, “Obligation”, “The Engineer” and “instruction”. It can also be noted, that key words associated with Contract completion appear generally on the left side of Figure 8, whilst those related to Contract commencement are found more on the right. Hence within the map, the Contractual process flow is from Right to left.

Within Figure 7, we have analyzed and presented the result of all texts in context to find the philosophy of the Contract. Texts shown normally at the origin point (0,0) are not distinguishing / nothing special. However, texts such as “DISPUTE”, “AGREEMENT”, “COMPLETION”, “ADJUDICATION” and “DAB” are indicated furthest from the origin in line with our understanding of their functions within the FIDIC CoC. “The Engineer”, “employer” and others are located at coordinate (-2,-2) reflecting the frequency of this term within the FIDIC, which although popular text is not particularly distinguishing.

C. Frequency of Appearance at sub-clause

To understand better the detailed concepts of the FIDIC CoC, we extracted and counted similar texts containing seven key wordings / cording, namely: DAB, The Engineer, GENERAL CONDITION, TENDER, COMPLEION, GUARANTEE. These are presented in Figure 6 against the Contract clauses (1 through 20) within which they appear.

The most frequent wording is “The Engineer” which appear in most clauses, but more frequently within Clauses 2, 3 and 15. “DAB” is the second most frequent wording particularly in Clause 20 related to Claims, Dispute and Arbitration. The Clauses with the most frequent occurrence of key words are highlighted also in Table 1.

D. Network Analysis of Sub-Clause Relationship

The study described in IV.*A* to IV.*C* evaluates the relationships of each key text within the context of the main Clauses in the CoC. In this section, we focus on the relationships at each sub-clause / sub-sub-clause level.

Based on the FIDIC Quick Reference Guide Red Book [10], we constructed the sub-clause network model shown in Figure 9 to analyze relationship concepts. This shows the eigenvector calculated, with the size of each node being indicated relatively. The largest node is Clause 3.1 as shown at the upper-left corner, with the second largest being Clause 20.1 in the upper-right.

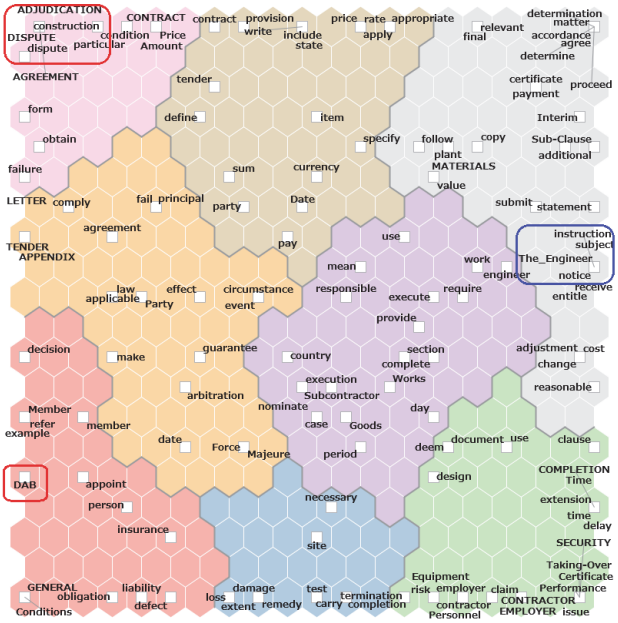

Figure 6. Self-Organizing Map

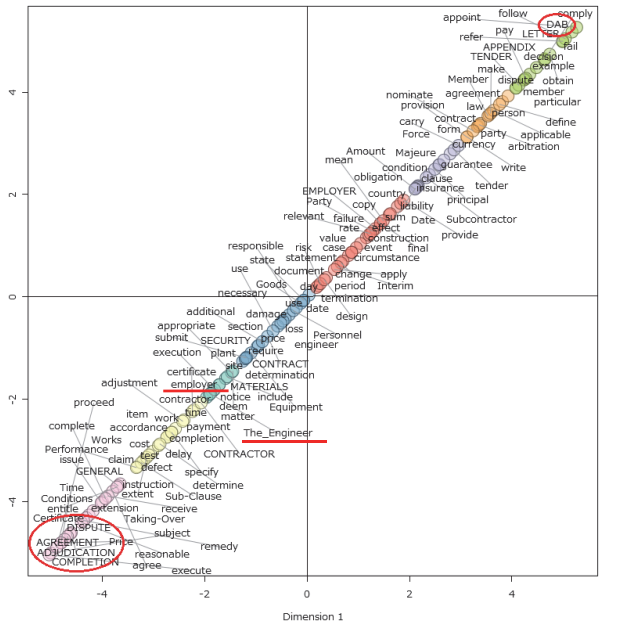

Figure 7. Distinguishing Texts

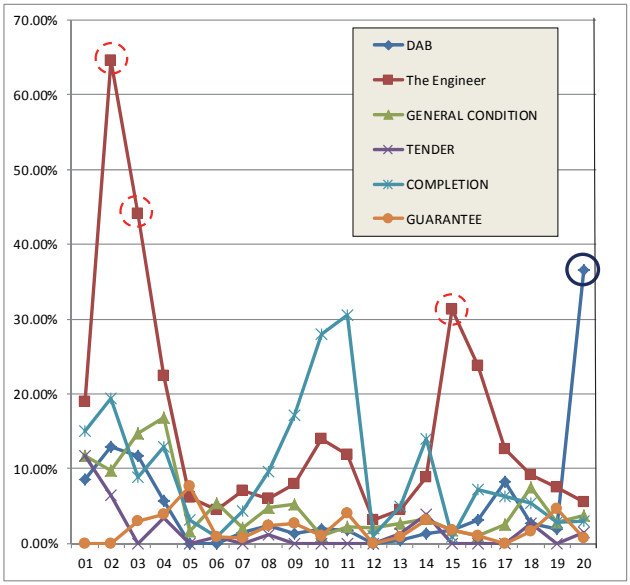

Figure 8. Frequency of Appearance

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TABLE 1. Clause No. and Description

Clause	Description
1	GENERAL PROVISIONS
2	THE EMPLOYER
3	THE ENGINEER
4	THE CONTRACTOR
5	NOMINATED SUBCONTRACTORS
6	STAFF AND LABOUR
7	PLANT, MATERIALS AND WORKMANSHIP
8	COMMENCEMENT, DELAYS AND SUSPENSION
9	TESTS ON COMPLETION
10	EMPLOYER'S TAKING OVER
11	DEFECTS LIABILITY
12	MEASUREMENT AND EVALUATION
13	VARIATIONS AND ADJUSTMENTS
14	CONTRACT PRICE AND PAYMENT
15	TERMINATION BY EMPLOYER
16	SUSPENSION AND TERMINATION BY CONTRACTOR
17	RISK AND RESPONSIBILITY
18	INSURANCE
19	FORCE MAJEURE
20	CLAIMS, DISPUTES AND ARBITRATION

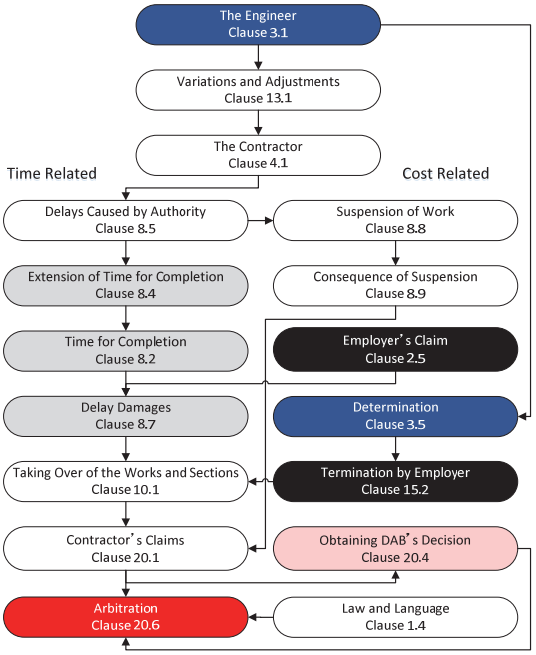

Figure 10. An Example of Sub-Clause Relationship

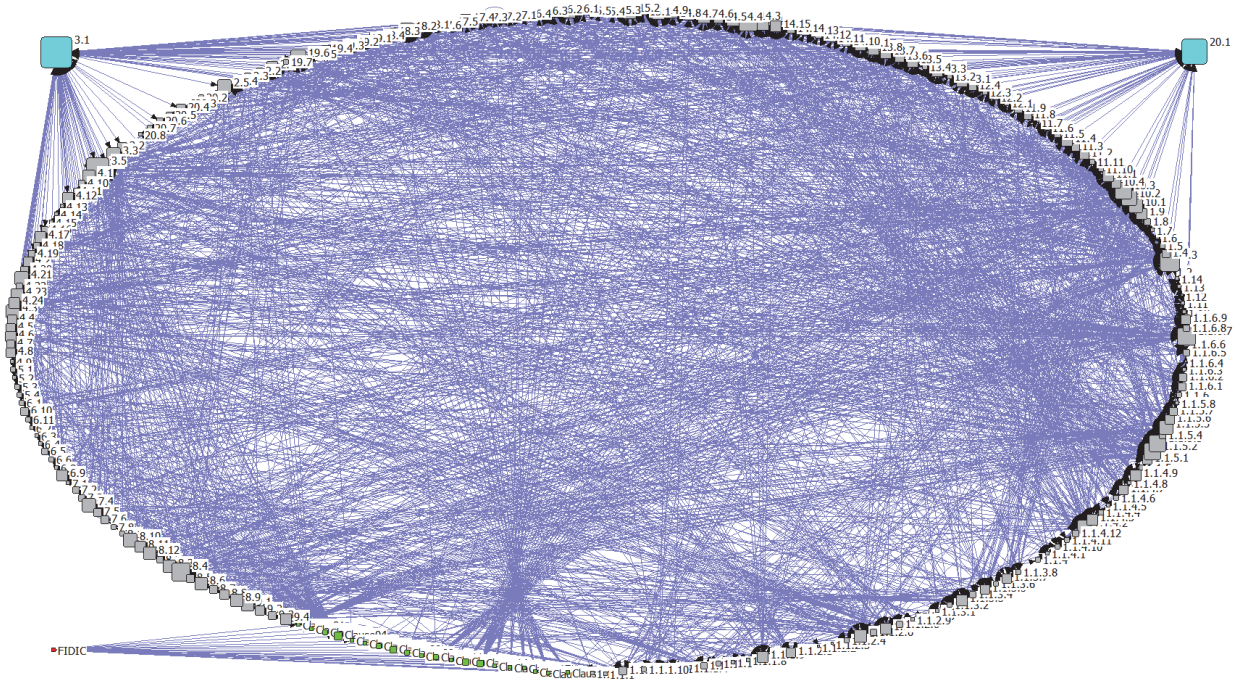

Figure 9. Relationship Network of All Sub-Clauses (Eigenvector)

In addition, we calculated the between-ness centrality for the same model with results similar to those given by the eigenvector, whereby nodes related to Clauses 3.1 and 20.1 were also dominant (the presentation of these results is therefore omitted in this paper).

Based on these findings, it is clear to understand that Clause 3.1 "The Engineer", and Clause 20.1 "Contractor's Claim" play an important role in Contract management for construction projects using FIDIC.

V. Discussion

We show in Figure 10 a management process based on the sub-clause relationship when The Engineer requires to issue a variation order to Contractor.

The Engineer has a power delegated from The Employer enabling him to issue variations to the original scope of Contract if/where necessary, though he is not able to change the contract itself. He also has the powers to recommend the termination of the contract to the Employer where he determines this to be a necessary course of action.

There are principally two lines within the management process relating to Time and Cost respectively. Disputes related Cost will not affect contract termination, whereas time disputes on the other hand may result in Contract closure in a worst-case scenario. As disputes and disagreements are normal and generally expected within the life of construction projects, FIDIC CoC Clause 20 specifically sets out the procedure and contractual processes to be followed for solution/resolution.

From the Text Mining analysis presented in Figure 5, the conditions related to dispute, adjudication and arbitration do

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not play important roles in the contract. It is very clear why these conditions are downplayed in Japan, which is also supported by the number of court cases per year (typically around ten cases for every ten thousand contracts tendered out). Although local construction projects issue more or less variations orders to accommodate changes required, most of these are resolved through negotiation and/or discussion with the Client. As long as Japanese contract managers are accustomed the domestic contract management process, they are likely to experience difficulty in understanding and complying with international contract requirements and conditions.

Based on the FIDIC Quick Reference Guide Red Book, we constructed the sub-clause network model shown in Figure 9 to analyze relationship concepts. This shows the eigenvector calculated, with the size of each node being indicated relatively. The largest node is Clause 3.1 as shown at the upper-left corner, with the second largest being Clause 20.1 in the upper-right.

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Based on these findings, it is clear to understand that Clause 3.1 "The Engineer", and Clause 20.1 "Contractor's Claim" play an important role in Contract management for construction projects using FIDIC.

Many types/kinds of construction contract are adopted by Employers worldwide. In many cases the core requirements may follow the FIDIC framework with specific modifications and adaptions to suit local needs and the needs of the party concerned for its own use. The importance for managing risk is inherent in the relationship between sub-clauses and the Contract time limits specified for each stage; so it is important to understand Contractual flows such as that depicted in Figure 10 from the very beginning of a project.

VI. Conclusion

There are many kinds of Conditions of Contract specified for construction of projects overseas. Japanese contractors are innovative, creative and are keen to use advanced ICT (information and communication technology) to produce complicated structures under difficult circumstances. Even with the detailed experience and know how, Japanese contractors have faced difficulties in delivering overseas projects in line with expectations. There is always un-certainty for construction businesses in both the domestic and overseas markets, however the SGCC typically used in Japan is incomplete (or at least falls short) in specifying arrangements to deal with unexpected risks/problems encountered during the project.

As a result of this study, we understand that the fundamental concept and principles encapsulated within FIDIC are clearly different. The construction business is complicated with many interactions that must be mastered to be successful which require not only an understanding of concept, but also the circumstances, surroundings and environments that prevail. Contractual risks can be minimized or at least reduced. From our study and analysis it is clear having a good understanding of the processes and relationships associated with Clauses 3.1 & 20.1 ("The Engineer" and "Contractor's Claim") is a fundamental starting point. At the end of each overseas contract, the provision of lessons-learned to establish and develop a data-base open to all stakeholders and interested parties may be of great value.

It is also the un-certainty that un-expected risks evolve and develop larger impacts that seriously challenge contractual management. Japanese contractual procedures do not facilitate for contractors to include the cost for risk preparation within their pricing. Consequently, as long as the actual costs resulting from problems faced can be justified they will only be fairly compensated through negotiation with the Employer. It is very rare for Japanese contractors to quarrel with the Employer in the court, because there is a Clause 18 Mutual Trust in the Construction Act.

As a result of this study, it is highly recommended that Japanese contractors should not only understand the differences between the constitution of the Contract, but also the process of Contract management. Furthermore, FIDIC (or other reference forms of contract) are typically carefully adapted from contract to contract, and within each organization or Country, thus care must be taken to ensure requirements and expectations are fully understood. The old saying "when in Rome, do as the Romans do" is very pertinent and worth remembering.

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