Study on the First Milestone to Global Engineers
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Abstract
Civil engineers need to cooperate with many project collaborators such as: engineers, operators, technicians, local residents, the general public, government authorities and many others to meet the huge challenges posed when undertaking mega projects. Internationally, there is a broad understanding of the engineering skills, technology and methodologies used to develop and construct large scale projects, though Japanese junior colleagues often find it difficult to establish themselves when joining a multinational team. In this paper, we adopt the Text-Mining techniques to analyze reports provided after overseas training (organized by our University) to determine impacts on students’ thought processes and ways of thinking. Through such exposure, it could be anticipated that all students should cultivate their communication abilities, cultural and religious knowledge and other interpersonal skills associated with the domestic country visited and those of the participating team members. From the results we can conclude that overseas training offers significant benefits and exposure to students in understanding cultural differences and establishing them on the road to developing international careers.

Keywords: Text-Mining, Overseas Training, Awareness of Culture, High and Low Context

1. Introduction
Toyo University has been at the forefront as a leading university in promoting globalize education by MEXT (Ministry of Education, Culture, Sports, Science and Technology) since 2014. Since the policy was established, many global activities/programmes have been provided to support student’s self-development and understanding within an international context. Almost all participating students were from the Faculty of Science and Engineering (especially the Department of Urban Environment Design), which used to be the Civil Engineering Faculty.

The Japanese economy has been revived since the decision made in 2013 for Tokyo to host the 2020 Olympic Games, and initiation of a number of reconstruction projects following the huge earthquake in Northeast-Japan in 2011 and in South-Japan in 2016. Although 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 as experienced following the 1964 Tokyo Olympic Games and 1998 Nagano Winter Olympic Games. Due to these post-Olympic uncertainties, many in the construction sectors will be looking at potential opportunities provided through overseas projects. Within the university, we have seen a recent increase in students interested in joining our overseas training programmes with a view to developing their careers in the international business markets.

Globalization has become a recent buzz word in many industries with the natural attraction of advantages and benefits that can be gained by being successful in the international business area. In the Civil engineering field however, Japanese contractors have been less successful despite excellent skills in advanced ICT (Information and Communication Technology) and other modern construction techniques. Typically, this has been due to facing contractual difficulties such as 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).

There are many reasons/factors that influence the successful/unsuccesful outcome of construction projects, such as: un-known ground conditions, un-expected weather conditions, surrounding social circumstances, political stability to name a few. Japanese contractors need to meet these challenges by employing managerial staff capable to deal with the difficulties presented through understanding, communication and negotiations and minimize the likelihood that arguments/disputes are resolved in court. As an education organization, it is important that engineering students with global ambitions are cultivated and provided the necessary tools from university age.
2. Study Purpose

The reports from participants attending the overseas training programmes typically express their first impressions without over consideration of their own future carrier development as global engineers or potential intercultural impacts. Due to this, some of the opinions provided may be incomplete, underdeveloped or even un-intentionally concealed to some extent.

In this paper, we evaluate the relationships between all texts reported by the students who attended the overseas activity programmes to seek out key thoughts and requirements of potential importance for global engineers. Though this analysis, we seek to find core elements to propose as a basis for establishing an educational system structure that provides a solid foundation to engineers seeking an international career.

3. Methodology of Study

Since the begging of 21st century many devices for detecting and collecting text data of human behavior such as movement, sound and temperature have been developed. The outputs from using text and data mining techniques are different, in that these are usually adopted to find the users’ aspirations or characteristics. Typically, data mining is applied to determine social preferences, such as the train and toll road network used, purchase items in convenience stores; whereas the understanding of providers’ conditions is determined through the Text-Mining.

In this paper, we intend to provide a basis for the development of understanding of university students who have not been abroad but have intentions to develop engineering careers internationally. In our Faculty of Science and Engineering two overseas training programmes are provided to improve English capability and facilitate understanding of international construction projects. These are located in the Pace University, New York, USA and at the Chulalongkorn University, Bangkok, Thai Land. On the surface, the student reports provided give a relatively clear and understandable view of their feelings and opinions, however what is perhaps less obvious is their Internationalization experience due to presentation within the text and external influences by course organizers. Therefore we used the Text-Mining technique to identify the full value and comment relationship from an educational point of view.

By applying the Text-Mining techniques to develop a text network for subsequent analysis, we are able to identify the key and most affective educational factors so as to propose possible strategies for future training programmes. The centrality indexes of Graph theory are also applied in evaluation the detailed network structure.

The Text-Mining techniques are normally applied to character strings to extract valuable key words in the form of data (words and phrases) to facilitate subsequent numerical analysis of elements that govern the circumstances/environment within a business process [1] [2] [3] [4] [5]. In our research, we adopted a Text-Mining computer software called “KH Coder” developed by Prof. Koichi Higuchi [6]; the resultant calculated figures are compared relative to each other using five graded black and white categories.

The data that can extracted through the evaluation of important texts includes: appearance frequency, correlation of appearance, appearance tendency and time related appearance. To facilitate the numerical decision for each text, the centrality indexes known as “Between-ness” (concept established Freeman [7]) and “Eigenvector” are normally applied.

The calculation formulas adopted for this analysis are:

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

Where:

- $Gpaths_{j\rightarrow i\rightarrow k}$ is all possible shortest steps from node $j$ to node $k$; and $Gpaths_{j\rightarrow i\rightarrow k}$ 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 $\lambda$ and vector $\vec{x}$ are existing and the formula $A\vec{x} = \lambda\vec{x}$ ($\vec{x} \neq 0$) consists, then $\lambda$ is the eigenvalue of matrix $A$ and $\vec{x}$ is the eigenvector belonging to $\lambda$. 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.

4. Analysis Results

The basis of our research is training reports at Pace (a) and Chularongkorn (b) Universities with surveys of 1st year (c) and 3rd year (d) students’ career aspirations also analyzed for comparison purposes. The number of reports from (a) was 11, from (b) was 7, from (c) was 89, from (d) was 21, with associated text extractions being (a) 4,482, (b) 8,125, (c) 20,715, and (d) 42,407 respectively. The theme of the free written reports (c) was the reason the student entered our department and their future career intentions, whilst for (d) the theme was the future career plans post-graduation.

We didn’t translate the Japanese reports to English, as in doing so we may have altered meaning and intentions such that subsequent analysis may have been inadvertently influenced. As a result, some of the results are still presented in Japanese.
4-1 Co-occurrences Text Network

Fig. 1 “Between-ness”, and Fig. 2 “Eigenvector” respectively show the co-occurrences text network from the training reports of Pace University. From Fig. 1 the highest between-ness text is “difference” located between “Japan” and “America”. This means that the participants clearly found the differences between Japan and the USA, or as perhaps more commonly described as a ‘culture shock’. Fig.2 shows key interests were in ‘american-museum’, ‘history’ and ‘natural’ (nature), showing a clear desire to accumulated and develop culture.

Fig.3 “Between-ness”, and Fig. 4 “Eigenvector” respectively present similar co-occurrences text networks for the training reports from Chularongkorn University. From Fig. 3 the highest between-ness text is “meet” located between “chance” and “kindness”, also with “Thai” and “Japanese”. This indicates that the participants spent ‘valuable time” and clearly appreciated the differences between Japan and Thailand. Fig.4 shows students had an interest in the Bangkok local transportation system as key words include “Bus”, “Taxi”, “BTS”, “tuk-tuk” and “MRT”, as these are not experienced in Japan it indicates students sights and thoughts were focused on differences in culture.

4-2 Self-Organize Mapping of Text

Next we studied what participants were expressing using a self-organization mapping with Euclidean distances between each text.

Fig.5 Pace Uni. Area-I shows the local culture with words “history” and “American-museum”, Area-II shows daily living through words “restaurant”, “delicious” and “movie”, Area-III is related to “health” and “insurance”, Area-IV shows the time spending at a home stay, and Area-V is related to the overseas training programmes generally.
Fig. 6 Chularongkorn Uni. Area-1 shows the general feelings and findings during stay, Area-2 shows the local and classic transportation experienced, Area-3 is related to the daily living, Area-4 shows the latest transportation system, and Area-5 shows the training requirements.

As the result of the self-organization mapping, it can be noted that the overall training activity programmes of Pace and Chularongkorn Universities provide a general foundation experience for students as an initiation to being global engineers. Area-1 and Area-2 of Fig. 5 and Fig. 6 indicate differences of culture in both country’s which were appreciated by the participants.

4-3 Comparison of career intentions of 1st year and 3rd year students

We also analyzed survey reports from 1st year (a) students who had just joined the University which asked them (1) why they came to the Department of Civil and Environmental Engineering, and (2) the future career intentions post-graduation; and from 3rd year (b) students before the commencement of job search activities about their future career intentions.

Fig. 7 shows key words identified as “civil engineering”, “railway” and “urban area” which are expected due to the name & function of our University department. It is worthy of note that key words such as “international” or “overseas” are not evident. In Fig. 8, the highest index of Between-ness was “management” relating also to “international” and also to “development” and “construction”. Based on these network results, it is clear that even at the university stage some students are already looking to opportunities overseas. Through overseas training activities such as those reviewed in this paper, we believe the potential number of global engineers will increase.
5. Discussion

As a result of our Text-Mining it is evident that all participants were impressed by the differences between Japanese culture and that of the study countries, USA and Thailand. These activities provide the first steps to becoming Global Engineers, however the fundamental essence of obtaining professional knowledge may be overlooked by some participants due to the culture shock impacts of visiting an overseas country for the first time. Global engineers must be able to work with all nationalities irrespective of any different values or cultures. It is clearly therefore important to review culture from a perspective of its role and function in construction management.

5-1 High and Low Context

In Japan, we use the word “service” as meaning something that is free of charge, or something that should be included in the original products without extra cost. In English on the other hand, any benefit/convenience/advantage would be expected to be provided at a price. This means that we (Japanese) are usually utilizing the word “service” with a totally opposite meaning. This does not only apply to “service”, but also “purchase” which is almost equal to “buying”, “shopping” and “procurement” in English. Another example would be “guarantee” which in Japan would cover several English words, namely: “guarantee”, “warrantee” and “indemnity” respectively.

It is also important to not only understand individual words, but also the sentences and context in which they are used. When communicating with Japanese business colleagues it is vital they understand the meaning of the words in English so requirements and intentions can be clearly understood. These phenomena are studied and published in 1976 by Edward. T. Hall [8], the so called “High and Low Context Culture”. Based on his study, the Japanese language is classified as a high context culture where the communication with colleagues depends on the context, in English however there is a greater need to rely on the detailed information/words being a low context culture [9].

Japanese students with aspirations to be global engineers of the future, should master basic English conversation and understand the differences of the context culture. Japanese engineering staffs belonging to the high context culture find it relatively easy to understand what the other party requires or is thinking, though they often find it difficult to receive or accept alternative opinions.

5-2 Key Word in Context

Acknowledging participants appreciation of the differences of social culture, we extracted the sentences which contained the key word “culture” to better understand its utilization and the context it is used within the sentences. Table 1 shows all sentences which contained the key word “culture”. From the 12 sentences extracted, it seems that the students understanding of the word “culture” based on the direct meaning and not context associated. The mutual understanding of all team members’ personalities and cultural backgrounds within a management team is necessary to achieve successful project completion. In establishing a global project management organization, Japanese engineers should understand we are accustomed to the high context culture where we can communicate in essence without speaking.

<table>
<thead>
<tr>
<th>Table 1 Before and After the key word “culture”</th>
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</thead>
<tbody>
<tr>
<td><strong>Key Word before</strong></td>
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<tr>
<td>this study abroad were to improve my English skills, understand cultures in America and to use this experience to do job hunting. Through</td>
</tr>
<tr>
<td>Through home stay, I could spend a great time in different cultures from a perspective of its role and function in construction management.</td>
</tr>
<tr>
<td>study abroad were to improve my English skills, understand cultures in America and know some differences between the US and Japan.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>University</strong></td>
</tr>
<tr>
<td>Pace University, New York, USA</td>
</tr>
<tr>
<td>Chulalongkorn University, Bangkok, Thailand</td>
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<tr>
<td>Toyo University, Kawagoe City, Saitama Prefecture</td>
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</tbody>
</table>

5-3 Education of Cross-Cultural Communication

The two overseas training programmes discussed provide excellent activities for students aiming to develop as global engineers, however we believe from our study the these can be further enhanced to better cultivate cross-cultural communication.

A University provides a good base for such training as there are some international students who can assist to organize and participate in activities. These resources can be utilized for activities which may include; (a) a small member discussion group, (b) group discussions on pre-planned set themes, (c) cross-cultural riddle tests with assumed roles, (d) role playing using different scenarios, (e) workshop style participations [10]. These activities would likely be most effective if they are organized periodically (or on an ad-hoc basis) just before the students are due to visit the foreign country.
Overseas training programmes should also consider the benefits to be gained from not just visiting the country, but also social and/or volunteer activities that can be done if students stay longer in private homes or take up short term internships at local businesses as possible options.

Although there are challenges associated with cost, collaborators, and governance faced by an educational organization, these issues can and should be overcome so we can best educate and cultivate many students capable of great success as international engineers.

6. Conclusion

In this paper, we adopted the Text-Mining technique for the analyzing of contexture. Although sometimes not clear and directly indicated the written reports, we were able to identify important facets required to provide a solid foundation to university students intent on becoming global engineers.

As the numbers of participants on both training programmes was relatively small, it should be easy to evaluate the improvement in the students’ abilities after joining. However the reports if just taken at face value include external influences/bias and record responses which at first glance do not directly relate to the needs and expectations for global engineers. Partly this may also be a result of the excitement of being overseas for the first time and without detailed proper analysis could lead to incorrect conclusions and consequential deficiencies in educational programmes.

The Text-Mining technique was adopted on the reports for extracting the key underlying elements necessary without any prejudice. From the analysis, we are certainly able to confirm benefits were received by the students who participated in the overseas training programmes. Furthermore, all participants of both courses expressed deep satisfaction at their achievements, which confirms interaction with overseas universities and/or educational organizations should be an essential part in cultivating junior engineers and preparing them for their future. Based on the initial analysis in this paper, we believe that the international educational collaborations should be continued and extended widely.

We need to bear in mind that civil engineers need to communicate with many stakeholders, such as the client, subcontractors, people who are living around the project site, the police, fire services, utility and transport providers amongst many. To achieve this, a good communication ability with the mutual understanding of context culture must be a fundamental requirement for engineers, especially those with desires to work internationally.

References

Biography
Nobuyuki Suzuki:
In 1978 Master Degree of Science given from Waseda University. Specialty is a Mineral Mining.
In 2013 Doctor Degree of Science given from Waseda University. Specialty is a Construction Management.
For 24 years, since 1978 to 2002 the Oversea Project experienced, for later 15 years as a Site Agent and a Project Manager.
Since 2002 to 2013, a chief researcher of JACIC research foundation organization of MLIT (Ministry of Land, Infrastructure, Transport and Tourism).
Since 2013 working for Faculty of Science and Engineering, Toyo University, as a Professor.

James Whorlow:
Worked in senior management positions on major railway and civil infrastructure projects with over 30 year’s post qualification experience. Major projects undertaken include the Channel Tunnel in England, reclamation and road/rail infrastructure projects in Hong Kong, Dubai Metro project in the UAE, underground sections for KVMRT rail projects in Malaysia.