The 6th International Conference on Construction Engineering and Project Management (ICCEPM 2015)
Oct. 11 (Sun) ~ 14 (Wed) 2015 • Paradise Hotel Busan • Busan, Korea
www.iccepm2015.org

Analysis of Factor Affecting for Improving Construction Engineering Market

Park, Junho[1] and Yu, Jungho[2]

Abstract ***The Construction Engineering Industry (CEI) is construction field based on professional knowledge, staff and information service, and is distinguished by construction activity. The contemporary CEI market has extended globally and diversified construction work classifications. International construction engineering companies now have an important economic and social effect. Over the last five years (2009 to 2013), the top-200 global engineering firms reported global revenue that grew from 54.4 billion to 71.5 billion, about 27% growth (ENR, 2014). Countries such as the U.S.A., Canada, those in Europe (Several developed countries, i.e., United Kingdom, Netherlands, France, Spain, France, Italy, and Spain), Australia, Japan, China, and Korea comprise the bulk of world construction engineering revenue. Although the construction engineering market continues to grow, much of the work is limited to Europe, mid-Asia, and Asia. Additionally, specific construction types are focused on building projects, industrial plants, and refining plants. As such, there are imbalances in the construction engineering market and some market saturation. Further, there is heavy competition and the construction engineering market may shrink in the future. This paper analyzed various factors affecting the construction engineering market, specifically looking at construction classifications and factors related to a global market. To accomplish this, we collected to data from Engineering News Record (ENR) and recast each variable. And we used nonparametric statistics because the number of cases were small, making it difficult to assume a case's population parameter. Then we tested with the Kruskal-Wallis test and drew results. The results indicate that concentration in particular construction types and extending global regional markets will be have a positive effect on the overall global construction engineering market..***

Keywords: Construction Engineering, Kruskal-Wallis Test, Diversification, International Construction Market

I. INTRODUCTION

A. Background and Object

The Construction Engineering Industry (CEI) is construction field based on professional knowledge, staff and information service, and is distinguished by construction activity. The contemporary CEI market has extended globally and diversified construction work classifications. International construction engineering companies now have an important economic and social effect. Over the last five years (2009 to 2013), the top-200 global engineering firms reported global revenue that grew from 54.4 billion to 71.5 billion, about 27% growth [18]. Countries such as the U.S.A., Canada, those in Europe (Several developed countries, i.e., United Kingdom, Netherlands, France, Spain, France, Italy, and Spain), Australia, Japan, China, and Korea comprise the bulk of world construction engineering revenue. Although the construction engineering market continues to grow, much of the work is limited to Europe, mid-Asia, and Asia. Additionally, specific construction types are focused on building projects, industrial plants, and refining plants. As such, there are imbalances in the construction engineering market and some market saturation. Further, there is heavy competition and the construction engineering market may shrink in the future. This paper analyzed various factors affecting the construction engineering market, specifically looking at construction classifications and factors related to a global market. To accomplish this, we collected to data from Engineering News Record (ENR) and recast each variable.

B. Scope and Method

In this study, construction engineering is defined as a type of engineering for construction that includes architects, engineers, engineer-contractors, architect-engineers, environmental service, soil or geotechnical engineers, landscape architects, and planners. This classification of construction engineering comes from ENR. For this research, we collected ENR data from 2010 to 2014. To indicate the construction engineering market, the revenue of each country was set as a group variable. To macroscopically analyze influencing factors, we set test variables as a diversification of construction type and regional market. The research was limited to seven countries that are involved in the international construction engineering market and generate the bulk of the revenue. They were the U.S.A., Canada, Europe (Several developed countries, i.e., United Kingdom, Netherland, France, Spain, France, Italy, and Spain), Australia, Japan, China, and Korea. Considering only seven cases is too small for quantitative statistical methods. The small sample also makes it difficult to assume and test for population parameters. Therefore, we used a Kruskal-Wallis Test, which is a nonparametric statistical method and compared each group's data and drew relationships for each variables.

Ⅱ. PRELIMINARY STUDY

A. International Revenue and Competition

Innovative firm management strategy lead to cost reductions and increased a firm's revenue and lead to

[1] Research assistant, Department of Architectural Engineering, Kwangwoon University, striken12@kw.ac.kr
[2] Professor, Department of Architectural Engineering, Kwangwoon University, myazure@kw.ac.kr (*Corresponding Author)

superior enterprise competiveness [1]. Increasing firm revenue lead to strengthened enterprise competiveness, and through this, a firm can extend the enterprise's size and ability to diversify in the market [3]. Additionally, by increasing a firm's market share, the firm can preoccupy that market due to innovate management and enterprise performance management lead to extending revenue [2]. As such, a firm's revenue effect on enhance competiveness can be applied to international CEI. Construction engineering firms that are executing international project gain revenue from international business and are very competitive globally.

B. Diversification for Business

In business management, there is research that deals with diversification and looks at how it can have a negative effect on enterprise value because the expansion of various branch can have many risks and detract from the "choice and focus" of a business [6][9][10][11]. There is, however, other research that supports an opposite opinion. In such research, the argument is that having diversification in the business structure and revenue can bring increasing competiveness and experience to company, and provide entry into various markets [4][5][7]. These preliminary studies investigated whether a diversified strategy brought a positive or negative effect to and appeared to depend on a firm's environmental situation. Therefore, it is necessary to analyze the effects of diversification on the construction engineering industry.

C. Dependence of International Market

As construction enterprises move into the international market, there is potential for growth along with expansion of potential markets. To enter the international market, a company may enter a high-risk country and must also utilize investment funds. Such markets may have high barriers to entry and be very competitive. Promising markets, such as those in Latin-America, mid-Asia, and Africa involve a considerable amount of risk due to a lack of information and transparency. As such, it is important to what factors are most important for a construction engineering firm to consider.

.

Ⅲ. DEFINITION VARIABLES AND HYPOTHESIS

A. Group Variable

In analyzing factors affecting the construction engineering market, market size is defined as the sum of revenue of a particular market. This variable is treated as a group variable that has a rank value and is then used for nonparametric statistical analysis. Table 1 presents the group variable with rank.

TABLE I. GROUP VARIABLE

Country	Average revenue [a] (mil$)	Rank
Europe [b]	23,683.60	1
U.S.A.	21,642.96	2
Australia	5,610.66	3
Canada	5,033.20	4
China	2,294.62	5
Japan	1,120.84	6
Korea	717.48	7

[a] Average revenue from 2009 to 2013

[b] Sum of European countries average revenue (United Kingdom, France, Netherlands, France, Italy, and Spain)

B. Construction Type Diversification

This factor is the degree to which construction engineering firm execute various construction types. Construction type is comprised of nine types classified by ENR. Table 2 shows the nine construction types. This variables were calculated for each country and how many execute a specific construction type among the nine types, and averaged data from 2009 to 2013.

TABLE 2. Nine Construction Type

Construction type	Definitions
General Building	Includes commercial buildings, offices, stores, educational facilities, government buildings, hospitals, medical facilities, hotels, apartments, housing, etc.
Manufacturing	Includes auto, electronic assembly, textile plants, etc.
Power	Comprises thermal and hydroelectric power plants, waste-to-energy plants, transmission lines, substations, cogeneration plants, etc.
Water Supply	Includes dams, reservoirs, transmission pipelines, distribution mains, irrigation canals, desalination and potability treatment plants, pumping stations, etc.
Sewage & Solid Waste	Includes sanitation and storm sewers, treatment plants, pumping plants, incinerators, industrial waste facilities, etc.
Industrial Process & Petroleum	Includes pulp and paper mills, steel mills, non-ferrous metal refineries, pharmaceutical plants, chemical plants, food and other processing plants, refineries, petrochemical plants, offshore facilities, pipelines, etc.
Transportation	Includes airports, bridges, roads, canals, locks, dredging, marine facilities, piers, railroads, tunnels, etc.
Hazardous Waste	Includes chemical and nuclear-waste treatment, asbestos and lead abatement, etc.
Telecommunication	includes transmission lines and cabling, towers and antennae, data centres, etc.

C. Dependence of Construction Type

This variable reflects construction type rate, which is the largest rate of among the nine types. This variable shows the extent that each country depends on one construction type.

D. Concentrate of Construction Type

This variable lists the nine construction types in order of portion, and the minimum where the sum of a portion is over 50%.

E. Dependence of Religion Market

This variable reflects the regional market rate. This variable shows the extent that each country depends on one regional market.

F. Concentrate of Religion Market

This variable reflects concentration in a regional market, and the minimum number of where the sum of a portion is over 50%.

G. Hypothesis

We set the hypothesis for nonparametric statistical analysis, next Table 3 shown the hypothesis and variables.

TABLE 3. Research Hypothesis and Variables

	Hypothesis
H_0	International revenue and each variable's distribution do not have any distinctive relationship
H_D	International revenue and variable D distribution have a distinctive relation
H_{T1}	International revenue and variable D distribution have a distinctive relation
H_{T2}	International revenue and variable D distribution have a distinctive relation
H_{M1}	International revenue and variable D distribution have a distinctive relation
H_{M2}	International revenue and variable D distribution have a distinctive relation
	Variables
D1	Construction Type Diversification
T1	Dependence of Construction Type
T2	Concentration of Construction Type
M1	Dependence on Regional Market
M2	Concentrate in Regional Market

Ⅳ. Research Methodology and Result Analysis

A. Methodology

This study have 7 cases which is small-N so difficult to assume distribution of population group. Because of this, it is difficult to use correlation analysis and regression analysis which using large-N, and hard to know population. This problem can be solved by using nonparametric statistics which are not based on parameterized families of probability distributions. Because of this research have 7 groups that is over 3 groups, we choose Kruskal-Wallis Test method. For this method, we can found that what relationship the international revenue and each variable's distribution.

B. Result Analysis

Through the Kruskal-Wallis Test, we derivate the result shown Table 4.

TABLE 4. Analysis of Kruskal-Wallis Test

Variable	Group	Group Rank	N	Average Rank
D	Europe	1	5	25.00
	U.S.A.	2	5	25.00
	Australia	3	5	25.00
	Canada	4	5	22.20
	China	5	5	6.70
	Japan	6	5	16.60
	Korea	7	5	5.50
		Sum	35	
T_1	Europe	1	5	20.80
	U.S.A.	2	5	27.70
	Australia	3	5	11.60
	Canada	4	5	20.70
	China	5	5	16.80
	Japan	6	5	9.00
	Korea	7	5	19.40
		Sum	35	
T_2	Europe	1	5	16.90
	U.S.A.	2	5	13.50
	Australia	3	5	21.20
	Canada	4	5	16.90
	China	5	5	13.50
	Japan	6	5	23.70
	Korea	7	5	20.30
		Sum	35	
M_1	Europe	1	5	31.00
	U.S.A.	2	5	29.90
	Australia	3	5	17.40
	Canada	4	5	21.30
	China	5	5	15.40
	Japan	6	5	7.80
	Korea	7	5	3.20
		Sum	35	
M_2	Europe	1	5	18.20
	U.S.A.	2	5	15.00
	Australia	3	5	31.00
	Canada	4	5	24.60
	China	5	5	9.80
	Japan	6	5	12.40
	Korea	7	5	15.00
		Sum	35	

And test statistic result is shown Table 5, significance level of variable D, M1, M2 are shown less 0.05. As a result, hypothesis H_D, H_{M1}, H_{M2} is adopted and H_0, H_{T1}, H_{T2} is rejected by test.

TABLE 4. Test Statistics

	D	T1	T2	M1	M2
Chi-square test	27.736	11.172	7.485	31.038	22.421
degree of freedom	6	6	6	6	6
significant probability	.000	.083	.278	.000	.001

As null hypothesis is rejected, result explained construction engineering revenue is related to dependence construction type and concentrate construction type. So it is need to construction engineering firms try to concentrate small construction type and spread out and find promising market than with diversity construction type and narrow global market.

Ⅴ. Conclution

In this research, analyzed factor affecting construction engineering market for balancing development and enhancing competiveness of construction engineering firms. For this, we used Kruskal-Wallis Test of nonparametric statistics. As a result, construction

engineering revenue is related to dependence of construction type and concentrate of construction type. Thus, if construction engineering firms want to improve competency of international business, they should have to professional type's engineering staff and promoting them with this, it enable to "choose and focus" strategy and concentrating several kind of construction type. Aspect of construction engineering market, it is not to need focus on saturation market and advance and pioneer to promising market i.e. mid-America, Oceania, Central Asia. But this study used construction type and countries data from ENR that is limited for analysis entire construction engineering market, it may overlook other significant factor. Thus, hereafter research need to more various view and factor affecting construction engineering market.

Ⅵ. ACKNOWLEDGEMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF – 2014 R1A2A2A05006437)

REFERENCES

[1] Choi Seong Wook, "The Strategic Management for Innovation and Competition of Small and Medium Firms", Management Information Systems Review, Vol.7 pp169-186, 2001.
[2] Lee Sang Sik, Kim Bok Ku, "A Study on the Relationships Between Competitive Strategies, Business Innovation, and Performance", Korea Journal of Business Administration, Vol.36, pp321-343, 2003.
[3] Lim Jin Sik, Yu Seung Kyu, Kim Ju Hyung, Kim Jae Jun, "Study on the Impact of Construction Company Work Diversification on Firm Value - Focusing on Insolvent Companies",The Journal of Korean Architecture, Vol.30, No.3, pp123-130, 2014.03
[4] Ku Mang Hoe, Kim Byung Kon, Park Sang Hyun, "Is companies Diversification effect on enterprises value?", Korea Journal of Financial Studies, Vol.29, No.1, 2001
[5] Lee Mi Sun, "Correlation of Structural of possession, business diversification, enterpriese value", Master's degree in dissertation of Seokang University, 2002
[6] Yoon Yung Sup, Kim Sung Pyo, "Effect on enterprises value : business diversification and agent problem " Finance the Journal of Korea, Vol.12, No.1, 1999
[7] Jeon Sang Kyung, "Change of enterprises value with extending size and diversification : Focus on restructuring", Vol.32, No.1, 2003
[8] Kim Jong Hyun, "International Construction for Vitallization of Construction Economics ", V.69, pp74-79, 2012
[9] Berger, Philip G., Eli Ofek, "Diversification's effect on firm value", Journal of Financial Economics, Vol.37, 1995
[10] Lang, Larry H. P., Rene M. Stulz, Tobin's q, "Cooporate diversification and firm performance", Journal of Political Economy, Vol.102, 1999
[11] Servaes, Henri, " The value of diversification during the conglomerate merger wave", Journal of Finance, Vol.51, 1996
[12] Kim Min Hyung. "Sugget enhancing method and analysis of advance to international construction market of small and medium industry " Construction & Economy Research Institute of Korea, Vol.12, 2005.
[13] ENR, "ENR TOP 225 International Design Firms 2009"
[14] ENR, "ENR TOP 225 International Design Firms 2010"
[15] ENR, "ENR TOP 225 International Design Firms 2011"
[16] ENR, "ENR TOP 225 International Design Firms 2012"
[17] ENR, "ENR TOP 225 International Design Firms 2013"
[18] ENR, "ENR TOP 225 International Design Firms 2014"