



CCC 2018

Proceedings of the Creative Construction Conference (2018)
Edited by: Miroslaw J. Skibniewski & Miklos Hajdu
DOI 10.3311/CCC2018-072

Creative Construction Conference 2018, CCC 2018, 30 June - 3 July 2018, Ljubljana, Slovenia

Improvement measures for the maintenance market through the current status analysis in Korea

Kim, Sangyup^a, Kim, Minju^a, Oh, Sangmin^a, Cho, Hunhee^{a,*}, Kang, Kyung-In^a

^aSchool of Civil, Environmental and Architectural Engineering, Korea University, Anam-Dong, Seongbuk-gu, Seoul, Republic of Korea

Abstract

The construction market in Korea has developed through the quantitative expansion of economic development over the last decades. However, due to recent trends in the decrease in construction volume and shift of paradigm from construction of new facilities to maintenance of old facilities, the number of buildings aged over 30 years in Korea have accelerated rapidly. After the emergence of a construction trade with specialty on facility maintenance and management, policies and regulations related to the roles of a contractor specialized in facility maintenance and management in Korea was created in 1990. However, due to the uncertainty of the scope of work, there still exists conflictive viewpoints among construction stakeholders – mainly the general and specialty contractors – in the market. Furthermore, whilst the number of contractors licensed for facility maintenance and management work is too large compared to its market size, the contract amount per construction project is continuously decreasing. Therefore, this study identifies the problems related to the market structure in the Korean maintenance market. Also, this study suggests improvement measures for the Korean maintenance market and presents a structure for sustainable construction delivery in Korea.

© 2018 The Authors. Published by Diamond Congress Ltd., Budapest University of Technology and Economics
Peer-review under responsibility of the scientific committee of the Creative Construction Conference 2018.

Keywords: Facility maintenance and management, Maintenance market, Institution.

1. Introduction

1.1. Background

After the Korean construction industry has entered a phase of maturity, the paradigm of construction market is expected to shift from new construction to maintenance work related to residential renovation, urban regeneration, maintenance and resumption of Social Overhead Capital(SOC) facilities. As the number of buildings over 31 years old is expected to exceed over 33% in the year 2029 [3], the maintenance market is expected to expand in vast rapidity. Thus, it is required to devise improvement schemes of the construction industry to cope with such environmental changes preemptively.

However, in Korea, the construction projects on facility maintenance and maintenance are ordered based on the work area of general contractors and specialty contractors under the construction production system defined by law several decades ago. Due to the institutional nature of law in the Korean construction industry, a conflict structure in the market has been created among construction stakeholders in relation to the interpretation of the scope of work of the maintenance and management work and the status of participation of construction contractors. First of all, there is a controversy among the construction stakeholders – general contractors and specialty contractors engaged in all types of construction work – regarding the current construction policy on the definition of 'facility maintenance and management' that insinuates as if only those licensed and registered for specialty contract on facility maintenance and management work can participate in the emerging maintenance market. Also, the number of companies registered for

facility maintenance and management work exceeds 5,300 in 2017, which resulted in an intense competition within the market and continuous decrease in the contract amount per construction project.

Therefore, this study proposes improvement measures for devising a rationalization plan on the maintenance market in Korea by diagnosing the issues that need to be improved through the analysis of current situation and the market analysis in the field of facility maintenance under the current construction industry system.

1.2. Scope & Methodology

This study analyzes the current issues in the Korean construction industry for rationalizing the maintenance market by performing an assessment on market concentration through HHI and CR_k index calculation, and an analysis on controversial problems among participants of construction phase in the Korean facility maintenance market.

This study is performed under a fourfold purpose. First, the background of the facility maintenance and management work, which is classified as the scope of work for one of the twenty-five specialty contractors, is analyzed. Second, the market size is examined in terms of registration status and contract performance of facility maintenance and management contractors. Third, by implementing the HHI and CR_k indexes as the market share of contractors, the structure of maintenance market and the resulting controversies among construction stakeholders – mainly the general contractors, twenty-four types of specialty contractors, and the specialty contractor registered for facility maintenance and management work – are derived. Fourth, improvement measures for the Korean maintenance market is proposed through the current status analysis.

2. Literature review

2.1. Construction Industry in Korea

Construction contractors in Korea are divided into general and specialty contractors. General contractors are those that construct facilities while performing comprehensive planning, management and coordination, whereas specialty contractors are those that perform construction work for some of the facilities in a specialized field. The current production system in the Korean construction industry has vertical division of contract work between general contractors and specialty contractors and a horizontal division of work among the specialty contractors. General contractors can engage in five types of construction work, whereas specialty contractors can engage in twenty-five types of construction work by registering in each scope work.

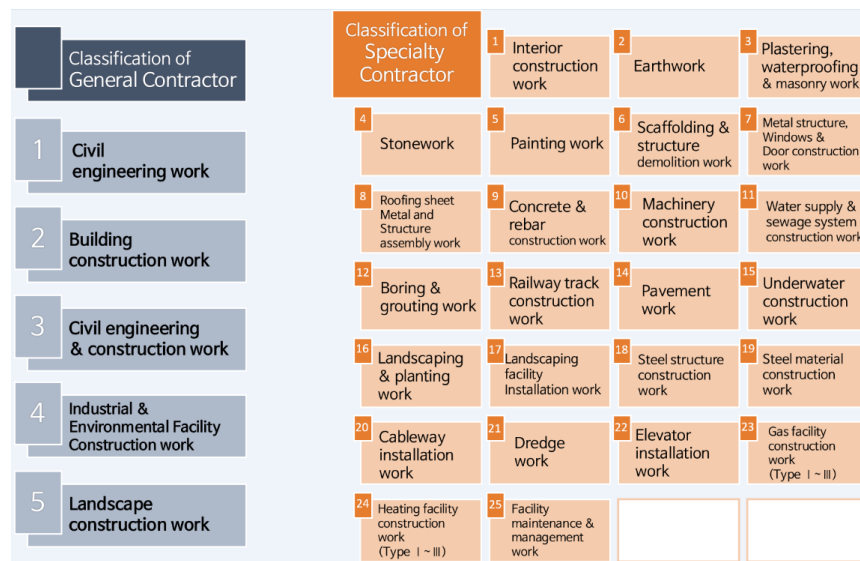


Fig. 1. Classification of construction industry in Korea

The classification of work on facility maintenance and management was first introduced as one of the types of specialty work in 1995 to improve maintenance and safety management of major facilities and to prevent large-scaled safety accidents such as the collapse of Sungsu Bridge and Sampoong Department Store. According to the Framework Act on the Construction Industry, the scope of the facility maintenance and management work includes any construction work after the construction phase while excluding improvement, maintenance, and reinforcement works of buildings that can be performed by a single-type specialty contractor. In other terms, in a construction project where two or more specialized construction works are combined (e.g. interior construction work + painting work after construction phase), only the contractors registered for facility maintenance and management work can participate in the market. Table 1 describes the scope of work for contractors specialized and registered in all fields excluding facility maintenance and management and the contractor registered for facility maintenance and management work within the maintenance market.

Table 1. Scope of work in the Korean maintenance market

Category	Specialty contractor (except facility maintenance And management)	Facility maintenance and management
Single type construction	Possible	Impossible
Multiple type construction	Impossible	Possible

Meanwhile, the current facility maintenance and management companies are mainly engaged in simple repair and reconstruction work in the physical construction aspect rather than the maintenance and safety management expertise. Furthermore, considering the market size and share, the maintenance market has been excessively concentrated and overheated. Currently, there are over 5,300 facility maintenance and management companies registered for the specialized work, accounting for about 8% of the total specialty contractors. Considering the total share within the construction industry, an excessive degree of registration among contractors resulted in a competitive market place. Therefore, quantitatively measuring the market concentration through calculating the major indexes such as Herfindahl-Hirschman Index (HHI) and Concentration Ratio of multiple firms (CR_k) is essential for diagnosing the problems in need of improvement in the maintenance market.

2.2. Herfindahl-Hirschman Index (HHI)

The Herfindahl-Hirschman Index (HHI) is a commonly accepted measure representative of the market share in a particular market, calculated as the weighted sum of market share of each firm. HHI has the advantage of increasing the index value as the share of the higher company increases, because it gives a higher weight to the higher company than the lower company and has the advantage of accurately measuring the concentration of the market accurately. The HHI index is calculated according to Equation (1):

$$HHI = \sum_{i=1}^N S_i^2 \tag{1}$$

2.3. Concentration Ratio of the above business k (CR_k)

Concentration Ratio of the above business k (CR_k) is the ratio of the top k number of firms occupying the share in a market, which is calculated as the cumulative market share of the first k number of firms. Although the randomness of researchers can affect in selecting the firms occupying the kth rankings and the degree of inequality in the market cannot be known, CR_k is a useful indicator for determining the degree of competition among firms in a limited market. The CR_k index is calculated according to Equation (2):

$$CR_k = \sum_{i=1}^K S_i \tag{2}$$

The calculation results of the two indexes can be interpreted as described on Table 2.

Table 2. Interpretation of Indexes

Type	CR_k	HHI	Implementation
No concentration	0%	0.0000 ~ 0.0500	Perfect competition
Low concentration	1% ~ 40%	0.0501 ~ 0.1000	Ranges from perfect competition to an oligopoly
Medium concentration	41% ~ 70%	0.1001 ~ 0.2000	Likely an oligopoly
High concentration	71% ~ 99%	0.2001 ~ 0.9000	Ranges from an oligopoly to a monopoly
Total concentration	100%	0.9001 ~ 1.0000	Total monopoly

2.4. Previous studies

The study on the classification of construction industry in Korea is as follows. According to the study of Lee et al. [3], Korea is expected that that the maintenance market will account for more than 40% of the entire construction market after 2020, as the maintenance demand for existing facilities surges. Lee et al. [4] analyzed the problems caused by the construction industry in Korea and presented cases of the of U.S. construction market structure.

Jeong et al. and Lim, et al. [5, 6, 9] analyzes the overall problems of the classification of construction industry in Korea and suggests ways to revise the classification. However, there was no analysis of facility maintenance and management work in the study of Jeong. Korea Institute of Construction Engineering and Management [7] pointed out that the structure of the domestic construction market does not cope with the global standard and thus lacks competitiveness in the global market. The institute suggests improvement schemes to improve competitiveness of the Korean construction industry.

Although there exist qualitative studies on the problem and maintenance market in Korea, there have been no studies that quantitatively analyzed the maintenance market and suggested improvement measures on the market structure.

3. Market status analysis of facility maintenance and management

3.1. Number of license

As of 2016, the total number of specialty contractor companies in Korea is 62,000, of which 5,200 are facility maintenance and management companies. According to Table 1, facility maintenance and management companies accounted for 2.2% of total specialty contractor companies in 1999 but increased 3.8 times in 2016 to 8.3%. In spite of the fact that specialty contractors are classified into 25 types of work, facility maintenance and management companies account for 8.3% of total specialty contractors and reached that increase within a short period of time.

Table 3. Number of license

	1999	2000	2001	...	2013	2014	2015	2016
Specialty contractors	55,217	60,779	67,703	...	64,654	62,918	62,715	62,444
(A)								
Facility maintenance and management (B)	1,224	1,604	1,982	...	4,496	4,688	4,893	5,159
(C) (=B/A)	2.2%	2.6%	2.9%	...	7.0%	7.5%	7.8%	8.3%

The number of facility maintenance and management registrations analyzed in this study is a number including companies that are registered in multiple works (e.g. Civil engineering work (classified as general contractor) + Facility maintenance and management work (classified as specialty contractor)). In general, one specialty contractor company can acquire two or more licenses.

3.2. Number of works

Table 4 shows the total number of works for specialty contractors registered in all twenty-five types of work and those for contractors classified as a ‘facility maintenance and management company’. The number of works contracted by facility maintenance and management companies has increased by 12.7 times, from 5,696 in 1999 to 72,182 in 2016. During the same period, the number of specialty contractor companies increased only about 2 times.

The proportion of construction projects contracted by facility maintenance and management companies among all companies registered for specialty work accounts for 11% in 2016, a leap from 1.7% in 1999. This means that as the domestic construction market matures, the maintenance business has been growing rapidly.

Table 4. Number of works

	unit: number							
	1999	2000	2001	...	2013	2014	2015	2016
Specialty contractors (A)	328,333	401,407	477,646	...	546,499	531,619	622,814	656,123
Facility maintenance and management (B)	5,696	13,877	20,806	...	62,750	62,632	68,395	72,182
(C) (=B/A)	1.7%	3.5%	4.4%	...	11.5%	11.8%	11.0%	11.0%

3.3. Contract amount

Table 5 shows the total contract amount for specialty contractors registered in all twenty-five types of work and those for contractors classified as a ‘facility maintenance and management company’. Compared to the total contract amount for all specialty contractors, the amount of facility maintenance and management contracts increased by 8.2 times from 511 million dollars in 1999 to 4,187 million dollars in 2016. During the same period, the total amount for all specialty contractors excluding those on the maintenance field increased only about 2.8 times.

Table 5. Contract amount

	unit: million dollars							
	1999	2000	2001	...	2013	2014	2015	2016
Specialty contractors (A)	32,082	34,609	39,248	...	73,300	73,138	82,275	90,105
Facility maintenance and management (B)	511	675	966	...	3,266	3,191	3,839	4,187
(C) (=B/A)	1.6%	2.0%	2.5%	...	4.5%	4.4%	4.7%	4.7%

As a result of comparing the maintenance market size with the specialty contractor and the facility maintenance and management, the maintenance market shows that the number of construction works, the number of registrations, and the amount of contract are higher than those of specialty contractor companies in total.

The analysis above verified that the Korean construction market gradually grew mainly in the maintenance market after entering into maturity pace in the late 1990s.

3.4. Analysis of value of construction performance

The CR_k and HHI indexes were obtained through the value of construction performance in 2017 of 5,300 contractors registered for facility maintenance and management work. The top three firms have a market share of 2.09% (CR_3), while the top five facility maintenance and management companies have a market share of 3.11% (CR_5), the top 10 with a market share of 4.73% (CR_{10}), the top 50 with a market share of 12.25% (CR_{50}), and the top 100 with a share of 18.17% (CR_{100}). When analyzing the maintenance market structure, the HHI can be judged to be highly competitive with 0.0007. The analysis of the CR_k and HHI index revealed that the maintenance market is under a low concentration with high competition among construction firms registered for facility maintenance and management work.

Table 6. Facility maintenance and management market concentration

	CR_3	CR_5	CR_{10}	CR_{50}	CR_{100}	HHI
Facility maintenance and management market	2.09%	3.11%	4.73%	12.25%	18.17%	0.0007

4. Disputes with maintenance market.

4.1. Disputes over the scope of maintenance work

Recently, conflict has been arising between specialty contractors (registered for twenty-four types of work except for facility maintenance and management) and those registered for facility maintenance and management in regard to the scope of maintenance market. The current construction industry in Korea distinguishes the role of a facility maintenance and management firm as one of the specialty contractors. However, unlike other types of specialty contractors, the definition of ‘maintenance’ in a construction facility is not distinguished by specific technology corresponding to a professional field of work. The scope of work for facility maintenance and management is not limited to some specific types of work; there must be at least two work areas for a facility maintenance and management contractor to perform its work. For example, in case an owner of a commercial building wants a repair work comprehending 80% of interior construction work (classified as type No. 1 of specialty contractor) and 20% of the painting work (classified as type No. 5 of specialty contractor), the repair work can be only performed by facility maintenance and management firm (classified as type No. 25 of specialty contractor).

As mentioned above, no matter how the portion of each specialty work accounts for, the maintenance project combining two or more types of specialty works can only be done by facility maintenance and management firms. Therefore, in the case of maintenance projects being ordered, other specialty contractors cannot participate in the bid. As a result of these constraints, there inevitable rises a dispute between facility maintenance and management firms and other specialty contractors regarding an authoritative interpretation of the scope of work. The current law and policies in the construction industry allow the facility maintenance and management firms to receive more opportunity to participate in the maintenance market as a prime contractor compared to the other firms registered for specialty contractor. The construction maintenance market legally formed by law and policies serve as an impediment to the selection of a construction firm based on construction capability.

4.2. Excessive competition within the maintenance market

In the Korean maintenance market, the contract amount has increased about 2.8 times while the number of construction firms has increased about 12 times over 20 years. Competition in the Korean maintenance market has also been intensified due to the rapid increase in market share and number of companies in a short period of time.

Table 7 compares the contract amount per construction work or project between those of facility maintenance and management firms and those of other specialty contractors. The contracted amount for specialty contractors excluding those registered in facility maintenance and management work has been over 1.4 million dollars, but the amount for facility maintenance and management contractors has reached only 0.058 million dollars in 2016. Therefore, the maintenance market in Korea signals an overheat due to the competition of more than 5,300 firms.

Table 7. Contract amount per construction work

	1999	2000	2001	...	2013	2014	2015	2016
Specialty contractors (Except facility maintenance and management work)	1.04	0.92	0.88		1.43	1.47	1.51	1.55
Facility maintenance and management work	0.090	0.049	0.046		0.052	0.051	0.056	0.058

5. Improvement Measures

5.1. Shift to an autonomous maintenance market

In order to devise an improvement schemes on the Korean construction industry in general from a long-term point of view, it is necessary to plan to shift the paradigm of construction industry from a legally ordered to autonomously flowing market, thereby allowing the contractors to enter the market based on their experience and technology of the construction company. The facility maintenance and management market is no exception from this shift; the maintenance projects are being ordered to contractors based on the production system that has been defined by law several decades ago regardless of the actual scope of work. Therefore, any terms defined in law and policies that cause unproductive disputes and hinder an autonomous participation of contractors in the market should be deleted. In other words, any barriers to entry should be removed for all contractors to select the competent and appropriate market to enter.

It is possible to improve the efficiency and productivity of work in the construction site by selecting the maintenance contractors through the method of evaluating the objective construction capability of the company. At present, there is a dispute among stakeholders related to the maintenance market in Korea, so a stepwise long-term plan is needed to solve this problem that has been lasting for several decades.

5.2. Plan for resolving excessive competition

In the maintenance market, the contract amount per construction work in the market has been steadily declining. This leads to decrease in not only to the quality of construction work within the Korean maintenance market but also to the competitiveness of the entire Korean construction industry against the global market. Thus, it is necessary to remove any unnecessary terms in law that serve as irrelevant partitions within construction market and allow the autonomy of construction firms to enter the appropriate market. In addition, through evaluation based on construction capability, contractors – both general and specialty contractors – should focus on improving their construction capabilities and developing high-level technology to seek ways to gain competitiveness and advantages in the global construction markets.

6. Conclusion

In this study, it has been concluded via analysis on the current maintenance market structure that the competition among construction firms has become intense along with the quantitative expansion of the market during the past 20 years. Currently, the Korean production system within the construction industry is serving an obstacle to strengthening the competitiveness of the maintenance market, and the market on maintenance and management will keep its stagnation. In order to solve this problem, it is necessary to allow all construction firms to strengthen the capability in not only construction of new buildings but also maintenance of old buildings, and also to allow them autonomy to operate the maintenance market through a phased long-term plan. In the future, the Korean construction industry will continue expanding its maintenance market as it enters the maturity era. Along with this change throughout the time, specialty contractors registered for all types of work need to improve their own competitiveness after any legal barriers are removed.

Acknowledgements

This research was supported by a grant (17SCIP-C124067-02) from Construction Technology Research Program funded by Ministry of Land, Infrastructure and Transport of Korean Government.

References

- [1] S. Lee, J. Ahn, S. Lee, J. Cho & J. Jo. Improvement measures for the construction industry user in response to the changes in the construction market. Korea Research Institute for Human Settlements, 2017
- [2] J. Lee, J. Yang, Lee, Sangmoo. Market structure share, Korea Development Institute, 2013
- [3] H. Lee, Market structure key features of the paradigm shift in domestic construction market, Construction Economy Research Institute of Korea, 2017

- [4] S-J Lee, K-R Kim, J-K Yun, D-H Kim, Prospects on Changing Business Structure in the Korean Construction Industry, Journal of Korean Institute of Construction Engineering and Management, Vol. 2(2), (2001) 36
- [5] H. Jeong, J. Lee, S. Hong, E. Kim, S. Park, A study on rational re-organization of the specialty construction business sector of the construction industry, Korea Research Institute for Construction Policy, 2007
- [6] S. Lim, S. Kim, S. Park, S. Han, A study on reasonable restructuring method for the system of construction business license within the separated business parts, Proceedings of the Korean Society of Civil Engineers, 2005, 4876-4880
- [7] A study on the revitalization of the construction industry structure for advancement of the Korean construction industry, Korea Institute of Construction Engineering & Management, 2009
- [8] S. Hong, S. Park, Innovative strategies on specialty contractors for sustainable growth, Korea Research Institute for Construction Policy, 2016
- [9] S. Lim, S. Han, Reorganization and consolidation of construction industrial structure in Korea, master's thesis, Yonsei university, Seoul, Korea 2006
- [10] O. Kwon, A Study on Scope Restructuring of General Constructor and Specialty Constructor in Korean Construction Industry, Construction Economy Research Institute of Korea, 2005