Article

Development of Key Performance Indicators for Measuring the Management Performance of Small Construction Firms in Korea

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Abstract: Large construction firms execute management control in preparation for a fast-paced business environment, but small ones are unable to do so. This is because there is no management control model tailored to them. The current study derived Management Performance Evaluation Indicators (MAPEIs) for small construction firms for measuring the management performance of construction firms with 10 or fewer employees, considering the characteristics of small construction firms. MAPEIs consist of BSC (Balanced Scorecard), performance, and the hierarchy and weighted value of KPIs (Key Performance Indicators). After an interview with an expert, based on the management performance indicators of large construction firms, a final hierarchy of small construction firms was constructed through modification and supplementation. The KPIs of the hierarchy were analyzed through a survey using the AHP (Analytic Hierarchy Process) method to finalize MAPEIs for small construction firms in Korea. The final MAPEIs underwent a feasibility evaluation to apply them to real life. It is expected that they can be used as fundamental resources for system development for small construction firm management performance and control. In addition, further studies to resolve the limitations would improve the competitiveness of small construction firms.

Keywords: management performance evaluation indicators (MAPEIs) for small construction firms; AHP; key performance indicators (KPIs); corporation management; small construction firms

1. Introduction

Recently, the Construction and Economy Research Institute of Korea concluded that the construction industry of Korea has officially been in a depression since the second half of 2018 and anticipated that it would likely continue until the early to mid-2020s. They mentioned that it would be necessary to develop management strategies suitable for the period. The downturn's impact on the construction industry is greater for smaller firms compared to larger firms. Despite radical changes, the number of construction firms registered in Korea increased by about 120% from 10,921 in 2013 to 13,168 in 2020 [1].

Statistics Korea classified the construction firms in Korea into scales based on the number of full-time employees. The number of firms with fewer than 50 employees was 97,314 out of 100,654. This means that small construction firms account for 96.7% of Korea's construction market according to the criteria of the Construction Association of Korea, and most of the construction firms being added to the list are small ones [1,2].

These days, there is not much call for construction work, and the number of projects to bid for is very limited. An increase in the number of small construction firms increases competition and makes the probability of winning a bid very slim. The Construction and Economy Research Institute of Korea released a BSI Report in 2019. The average BSI (Business Survey Index) of small construction firms was 79.5 and did not exceed 100 in 2019, reflecting the overall worsening of the industry and greater burdens on the management of firms [2].

The management difficulties experienced by small construction firms are caused by both external and internal factors. First, there is not a sufficient management control system. Large construction firms analyze management characteristics, along with the external environment and internal capabilities, using an adequate management control system to establish management strategies and plans according to the management characteristics. Management performance is measured to verify whether the objectives have been met. However, small construction firms are incapable of identifying the causes of difficulties due to a lack of management control systems and difficulties in measuring the management performance. Second, it is difficult to respond to and prepare for changes in the external environment. Due to the difficulties in management control, it is difficult to respond to the fast-paced environment of the construction industry, which involves a high rate of unpredictability, and impossible to prepare for the changes that they may encounter. Third, the unorganized structure of firms is a challenge. Unlike large construction firm, small construction firms find it hard to organize because there are only a few members and they lack management expertise. As mentioned above, it is impossible for small construction firms to execute management control due to difficulties in management. Therefore, the first step to take would be to understand the current circumstances of small construction firms. The position and status of each firm shall be identified by analyzing the problems and measuring the management performance. Then, sustainable management control shall be executed. For that purpose, this study was conducted to derive the MAPEIs (Management Performance Evaluation Indicators for Small Construction Firms) to analyze the management characteristics of small construction firms in Korea and measure their management performance.

In order to obtain the performance indicators of small construction firms, experts were interviewed based on the management performance indicators of large construction firms derived from preceding studies. The first expert survey was conducted with the top managers of five small construction firms, and the second survey was conducted with 33 top managers and engineers. The indicators were supplemented and modified to create a final hierarchy suitable for the scope of this study. KPIs (Key Performance Indicators) of the hierarchy were analyzed through a survey using the AHP method to finally derive the MAPEIs of management performance of small construction firms. Finally, the MAPEIs were tested in a real-life environment.

2. Preliminary Study

The balanced scorecard (BSC) of Kaplan and Norton is a strategic management system developed to measure the management performance of companies. BSC measures and controls performance in four balanced perspectives of finances, customers, internal processes, and learning/growth. Various studies have been conducted by companies, organizations within companies, and other areas that require individual competence and strategic systemization since the development of BSC (Balanced Scorecard) [3,4]. Small construction firms also need to manage intangible assets as well as tangible assets. This study applies BSC to measure the management performance of small construction companies.

Kim (2010) interviewed the management officers of companies to develop a model for analyzing the management performance of large Korean construction firms. He adopted a program to feed back on goals, management strategies, management plans, and management performance evaluation to suggest the importance of effective management strategies and efficient management control. Additionally, he identified errors and misses when applied to real life, unlike the preceding studies, and analyzed the findings to suggest the general process of management performance for construction firms and the errors and solutions to consider when measuring performance [5]. Jung (2005) comparatively analyzed the weighted value according to the scale of companies to measure the management performance of construction firms. An AHP analysis was applied to calculate the weighted value of performance indicators and analyze their importance for small/medium versus large companies. The study of Jung is different from other studies in terms of the subject of

analysis, survey method, and findings [6]. Yu (2004) analyzed past cases of other countries to suggest that it is necessary to develop key performance indicators for the construction firms in Korea along with a PMS framework to control them [7]. In other countries, KPIs were applied to the PMS Islam Bank based on BSC and AHP [8], and BSC was used to improve the efficiency of company operations for Luka Koper and d.d. Company [9]. Among the top 1000 companies named by *Fortune*, a U.S. magazine on economics, about 60% are assumed to have adopted the concept of BSC [10–12].

Management diagnosis refers to hiring an outside management expert to address management issues that cannot be resolved internally or to identify directions for future development. Management diagnosis models are mostly used by consulting firms or individual companies [13]. The management diagnosis model for small construction firms in Korea is still in the theoretical development stage and the only available models are modified forms of generalized models.

The Korea Small Business Institute has suggested a corporate diagnosis model to select businesses for a small business support project. The model suggested indicators of diagnosis for categories including attractiveness, competence, systems, and CEO.

The government of Korea is also developing various evaluation indicators, such as "the Small/Medium Business Healthcare System" and the "INNO-BIZ Evaluation Model," with continued efforts to enhance the management control capabilities of small construction firms. Management performance was analyzed according to the scale of construction firms and characteristics of organization, and a model for management performance evaluation has been developed. Additionally, there have been continued efforts to develop management diagnosis models to enhance the management control capacities of small construction firms to enhance their competitiveness. However, the study of performance evaluation models for small construction firm management control has not been sufficient, as there are many limitations when applying the management diagnosis models developed for small construction firms.

Research has been conducted into the management of small and medium-sized companies in Korea, with differences in the target companies and objectives from this study [14]. We conducted a study to evaluate the management performance of small construction companies with fewer than 10 employees. There are differences between management diagnosis strategies and management performance evaluation models. Management diagnosis is the process of identifying problems with a company's management, identifying the cause of the problem, and deriving improvements to these problems. It is a good tool for improving current management problems and providing future management directions in corporate management. However, this differs in purpose and process from the assessment of management performance. In addition, BSC has been used to develop a framework for small/medium businesses and a performance control system has been constructed by a small nonprofit organization using BSC. As a result, BSC made it possible to search for and correct problems, but there is a limitation in that it cannot be used in many areas [15,16]. It is necessary to continue studying various models suitable for small companies [17,18]. Therefore, the current study suggested KPIs to measure the management performance of small construction firms in order to improve their competitiveness and pursue gradual corporate growth.

Kim proposed MAPEIs to evaluate the management performance of large construction firms. The MAPEIs are composed of the hierarchy and weighted value of BSC, performance, and KPIs to derive the management performance evaluation indicators of small construction firms. Figure 1 shows the basic structure of MAPEIs [19]. In addition, MAPEIs were established as a practical evaluation management system. This study applied the concept of measuring the management performance of construction firms.
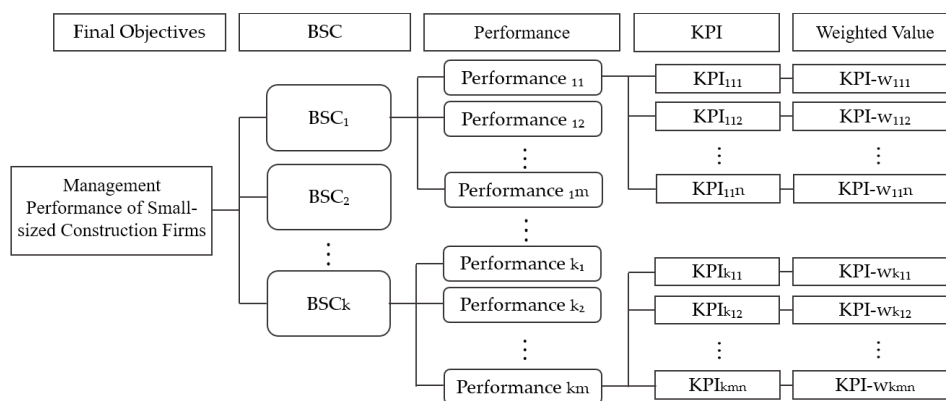
Figure 1. Basic structure of MAPEIs [19].

3. Methodology

Management Performance Evaluation Indicators (MAPEIs) for small firms consist of evaluation indicators with various hierarchies and weighted values for each KPI. The management performance evaluation models for construction firms vary according to each firm's business and scale, knowledge informatization level, brand value in Korea or abroad, and soundness of management control. Therefore, it is necessary to provide appropriate indicators. The current study's MAPEIs, as mentioned above, may be applied to small construction firms in Korea. The study was limited to small construction firms in Korea with no more than 10 full-time employees, no construction projects abroad, and businesses not including civil works and plants.

Construction firms have many factors to consider when measuring performance due to the uncertainties in the market environment. Therefore, the current study applied a Balance Scorecard (BSC). A BSC consists of four areas—finances, customers, internal processes, and learning/growth—and is applied to the management control of firms in good standing in Korea and abroad [19]. The BSC of construction firms is the same as that of other companies, but performance and KPIs differ due to corporate characteristics. Management characteristics also vary according to the size of corporations, even if they are in the same industry. Therefore, the current study considered the characteristics of small construction firms to develop the hierarchy of MAPEIs. KPIs were derived by analyzing the characteristics of small construction firms, and all items for performance evaluation had weighted values. MAPEIs serve as KPIs to measure the management performance of small construction firms.

We selected the items used to evaluate performance (Figure 2) and deleted and supplemented items through expert interviews to configure the hierarchy. The survey was performed based on the hierarchy and the weighted values were tabulated by analyzing the importance of each item to derive the MAPEIs of small construction firms.
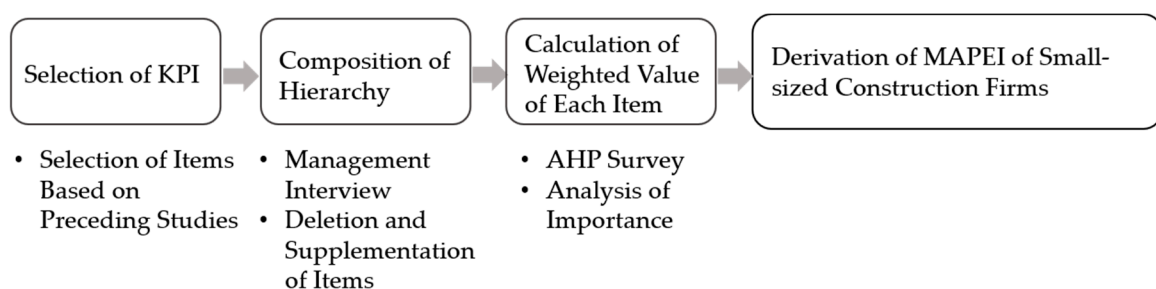

Figure 2. How to derive MAPEIs.

4. MAPEIs of Small Construction Firms

4.1. Selection of Management Performance Evaluation Indicators for Small Construction Firms

The current study was conducted to derive KPIs for the management performance evaluation of small construction firms. Preceding studies analyzed the strategies, plans, and goals of construction companies to configure the performance areas of a subject to identify KPIs. Kim (2010) conducted a survey on managers of large construction companies and derived the following evaluation items and weights by an AHP analysis. This indicated the evaluation items of large construction firms that allow for systemized management control but cannot be KPIs of small construction firms. As shown in Table 1, we used the hierarchy of Kim (2010) as the preliminary indicators to derive MAPEIs [19].

Table 1. Weighted value of factors of MAPEIs [19].

	Weighted Value	Performance Areas	Weighted Value	KPI	Weighted Value
Finance	0.28	Profitability	0.24	ROIC	0.28
				Cost of Sale Ratio	0.37
				Ordinary Profit	0.35
		Growth	0.18	Increase in Revenues in Korea	0.49
				Increase in Revenues Abroad	0.51
		Stability	0.13	Debt Ratio	0.48
				Achievement of Collection Goal	0.52
		Activity	0.13	Turnover Ratio of Total Liabilities and Net Worth	1.00
		Orders	0.32	Number of New Orders	1.00
Customers	0.34	Satisfaction of External Customers	0.38	Awards Won in Competitions	0.15
				Customer Satisfaction	0.28
				Corporate Image	0.38
				Social Contribution	0.19
		Satisfaction of Internal Customers	0.28	Transfer Rate of Employees	0.42
				Work Environment and Corporate Culture	0.58
		Market Share	0.34	Market Share of Orders in Korea	0.49
				Market Share of Orders Abroad	0.51
Internal Process	0.14	Investment in R&D	0.33	R&D Cost to Revenue	0.49
				Effect of New Technology to Cost of Development	0.51
		Technology Capacities	0.38	Application of Internal Technology Development	0.57
				Possession of Intellectual Property Rights	0.43
		Work Efficiency	0.29	Selling and Administrative Expenses to Revenue	0.25
				Compliance with Guidelines	0.21
				Accident rate	0.32
				Reuse/Recycling of Waste	0.22
Learning and Growth	0.24	Manpower training	0.38	Index of Excellent Workforce	0.30
				Cost of Training per Employee	0.33
				Satisfaction of Trainees	0.37
		Organizational Capacity	0.38	Knowledge Sharing	0.40
				Productivity of Employees	0.60
		Informatization	0.24	Informatization Capacity Index	1.00

The primary tier of the hierarchy consists of 14 performance areas and 31 KPIs. These are MAPEIs for large construction firms and cannot be indicators for the management performance evaluation of small construction firms. Therefore, there must be KPIs suitable for small construction firms. In order to configure a hierarchy for the purpose, the top management of five small Korean construction firms were interviewed and the findings are

shown in Table 2. The respondents to this survey were top management who had managed construction companies for a long time.

Table 2. Details of survey subjects.

	Details of Survey
Classification of Firms	Construction Firms in Korea
Scale of Firms	Small (No More than 10 Full-time Employees)
Classification of Industries	Construction of Other Nonresidential Buildings, Office/Commercial Use, Public Organizations
Number of Subjects Surveyed	5 Companies
Position in Organization	Top Management (More than 20 years of experience)

This study removed unnecessary KPIs following interviews. The interviews surveyed the items that realistically reflect the management performance of current companies among the items in the primary hierarchy. Tables 3–6 show the performance evaluation of small construction firms. The respondents selected items necessary for management evaluation. The score is the sum of the choices. For a maximum score of 5, all the respondents of the five companies analyzed deem that KPI is relevant. In fact, it is not easy for small construction firms to analyze management performance in various areas. Therefore, this study deleted items selected by fewer than half of the companies.

Table 3. Reflection of management performance evaluation on finance.

BSC	Performance Areas	KPI	Reflection of Management Performance Evaluation (Point)
Finance	Profitability	ROIC	1
		Cost of Sale Ratio	4
		Ordinary Profit	3
	Growth	Increase in Revenues in Korea	3
		Increase in Revenues Abroad	0
	Stability	Debt Ratio	3
		Achievement of Collection Goals	4
	Activity	Turnover Ratio of Total Liabilities and Net Worth	3
	Orders	Number of New Orders	5

Table 4. Reflection of management performance evaluation on customers.

BSC	Performance Areas	KPI	Reflection of Management Performance Evaluation (Point)
Customers	Satisfaction of External Customers	Awards Won in Competitions	0
		Customer Satisfaction	4
		Corporate Image	5
		Social Contribution	1
	Satisfaction of Internal Customers	Transfer Rate of Employees	4
		Work Environment and Corporate Culture	4
	Market Share	Market Share of Orders in Korea	3
		Market Share of Orders Abroad	0

Table 5. Reflection of management performance evaluation on internal process.

BSC	Performance Areas	KPI	Reflection of Management Performance Evaluation (Point)
Internal Process	Investment in R&D	R&D Cost to Revenue	2
		Effect of New Technology to Cost of Development	0
	Technology Capacities	Application of Internal Technology Development	2
		Possession of Intellectual Property Rights	3
	Work Efficiency	Selling and Administrative Expenses to Revenue	2
		Compliance with Guidelines	3
		Accident rate	4
		Reuse/Recycling of Waste	0

Table 6. Reflection of management performance evaluation on learning and growth.

BSC	Performance Areas	KPI	Reflection of Management Performance Evaluation (Point)
Learning and Growth	Manpower training	Index of Excellent Workforce	3
		Cost of Training per Employee	2
		Satisfaction of Trainees	2
	Organizational Capacity	Knowledge Sharing	2
		Productivity of Employees	4
	Informatization	Informatization Capacity Index	3

In the KPIs of preceding studies, finance consists of five areas, including profitability, growth, stability, activity, and order, as in Table 3. Profitability areas consist of ROIC (Return on Invested Capital), cost of sale ratio, and ordinary profit. Growth consists of an increase in revenue in Korea and increase in revenue abroad. Stability includes the debt ratio and achievement of collection goals, while activity includes the turnover ratio of total liabilities and net worth. Orders consist of amounts of new orders. In each area of performance, the number of new orders was selected as a major KPI by all five companies. Cost of sale ratio and achievement of collection goals were also representative. Achievement of collection goals was widely reflected, as poor collection is likely to lead to poor performance, inactivity, or unprofitability for small companies. On the other hand, ROIC and increase in revenues abroad are rarely representative. ROIC is a return on invested capital and may be evaluated based on the cost of sale ratio or ordinary profit as it is the actual assets invested in projects. This is mostly applied to companies where responsible management is possible, so it is difficult to use with small companies that lack systemized management control. The increase in revenues abroad is unrealistic for small construction firms that receive few orders from abroad.

Customers, as shown in Table 4, account for three performance areas, including satisfaction of external customers, satisfaction of internal customers, and market share. Satisfaction of external customers consists of awards won in competitions, customer satisfaction, corporate image, and social contribution, while satisfaction of internal customers is composed of employee transfer rate, work environment, and corporate culture. In the customer area, corporate image, customer satisfaction, employee transfer rate, work environment, and corporate culture are widely reflected. However, awards won in competitions and social contributions that have an additional impact on corporate image are not reflected

as much and the market share of orders abroad is also rarely reflected as small construction firms receive few orders from abroad, as seen in Table 3.

The internal process consists of three performance areas—investment in R&D, technology capacities, and work efficiency—as shown in Table 5. Investment in R&D consists of the cost of R&D to revenue, and the effect of new technology on the cost of development. Technology capacity consists of the application of internally developed technology and intellectual property rights, while work efficiency consists of selling and administrative expenses to revenue, compliance with guidelines, accident rates, and reuse/recycling of waste. The KPIs of the internal process were generally reflected less frequently than other areas were. On the other hand, the accident rate of efficiency area was widely reflected. This is because construction projects are generally large in scale and the losses related to accidents may be massive. Therefore, the accident rate is frequently applied to small construction firms.

Learning and growth, as shown in Table 6, consist of three performance areas: training, organizational capacity, and informatization. Manpower training includes index of excellent workforce, cost of training per employee, and satisfaction of trainees. Organizational capacity includes the knowledge sharing and productivity of employees, while informatization includes the informatization capacity index. In learning and growth, the productivity of employees was widely reflected. The number of employees is smaller than it is for large construction firms. Therefore, each member has a great impact on the organization, and the productivity of employees is significant. The index of excellent workforce is also frequently reflected because the competence of each individual employee is significant due to the smaller scale of firms. In a fast-paced business environment, informatization knowledge of construction is used as a strategic resource for the construction market and plays a major function. Therefore, the informatization capacity index is widely used for the evaluation of firms.

Based on the preliminary hierarchy, the top managers of firms were interviewed to survey the reflection of KPIs. In order to configure the evaluation indicators suitable for small construction firms based on the surveyed resources, the items that could not be assigned 3 points or more were deleted to configure the hierarchy. The secondary hierarchy of MAPEIs, configured based on the aforementioned standards, consisted of 13 performance areas and 18 KPIs.

However, there are many differences in management methods between large companies and small companies, and different sets of evaluation items apply for appropriate management control. In order to bridge the differences, the items that are considered most important by small construction firms for performance evaluation were assessed in addition to the evaluation indicators of large construction firms. Major MAPEIs of small construction firms included 10 indicators: net profit of construction projects, accident rate, complaint handling capacity, possibility of open bidding, construction performance rate, cost of construction, employees' task-processing capacity, revenue, gain, and accident-free rate.

The items' similarity to the pre-existing evaluation indicators was analyzed through interviews with experts. Net profit of construction projects, cost of construction, revenue, and gain refer to the profitability of companies and overlap with the cost of sale ratio and the ordinary profit of profitability area under finance heading. The possibility of open bidding and construction performance rate are items that evaluate the profitability, growth, and number of orders of companies and are similar to the detailed items of finance. The accident rate was similar to the accident rate of the internal process area, while employees' task-processing capacity was similar to the index of excellent workforce in learning and growth. However, the complaint handling capacity, although it may be considered part of corporate image, was judged to be a new item for evaluating the management performance of small construction firms based on corporate characteristics.

The corporate image of large construction firms includes quality, brand, customer service, market reputation, stock prices, corporate value, and defects, as in Figure 3. These

are auxiliary factors of corporate image for management performance evaluation and do not have a significant impact on performance evaluation. However, they may have a significant impact on small construction firms. In other words, the factors of corporate image can be a significant indicator for small construction firms. Therefore, complaint-processing capacity was included in the work efficiency area of internal process as an indicator of performance evaluation.
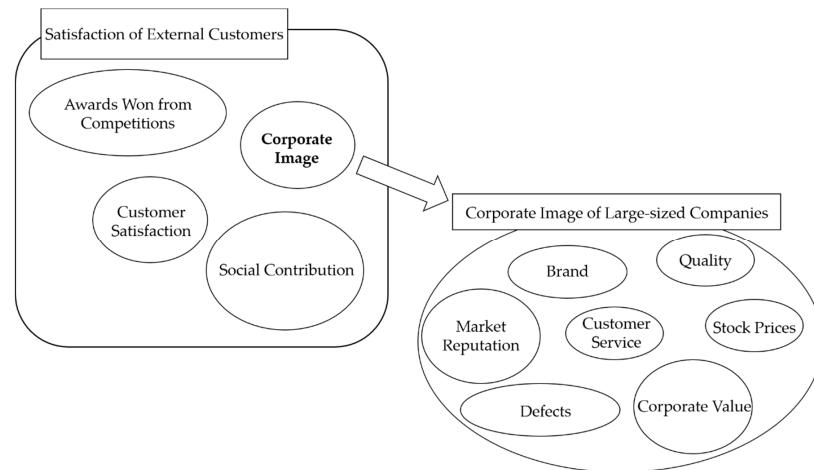

Figure 3. Corporate image of large companies.

As mentioned above, the performance evaluation indicators were analyzed for deletion, modification, and supplementation. Then, the findings were used to derive the final hierarchy. The final hierarchy became the hierarchy of MAPEIs and consisted of 13 performance areas and 19 KPIs, as in Figure 4.
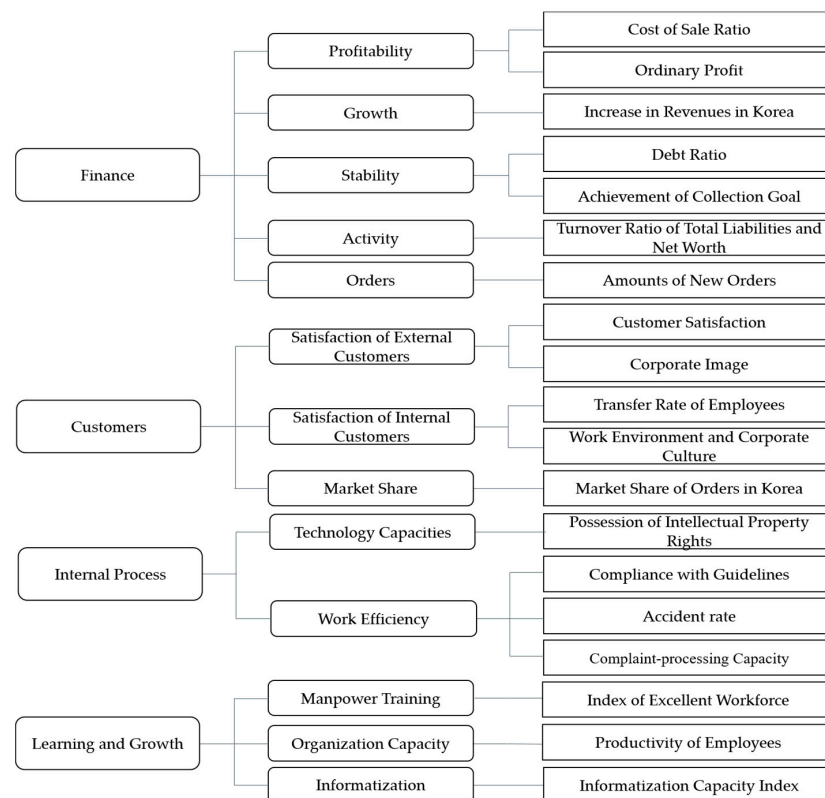

Figure 4. Hierarchy of MAPEIs.

4.2. Tabulation of Weighted Values

Each item comprising the hierarchy of MAPEIs becomes an indicator for the management performance evaluation. However, not all performance areas and evaluation indicators have equal weight. Therefore, each item shall be assigned a weighted value to evaluate management performance by considering the weight of each indicator.

An AHP survey was performed to assign a weighted value to each item. The survey was comprised of an importance analysis of each BSC area, an importance analysis of the performance of each BSC area, and an importance analysis of KPIs of each performance area, and the overview of the survey is as shown in Table 7.

Table 7. Details of subjects for tabulation of weighted values.

	Details of Survey
Subject of Survey	Importance Analysis of MAPEIs for Small Construction Firms
Survey Period	10 February–4 March 2020
Survey Members	33
Subjects of Survey	Top Management and Engineers of Small Construction Firms
Method of Application	AHP

The survey took about one month and the subjects were 33 members of top management or engineers of small construction firms. As the AHP survey was conducted, the consistency of responses was verified. The validity range of the consistency index was limited to 0.1 and the number of questions satisfying the consistency index was identified. The survey results satisfying the consistency index were analyzed for relative importance through a paired comparison analysis.

Figure 5 shows the weighted value of performance areas of BSC. The weighted value of the finance area was the highest at 0.379 and for the customer area it was 0.217. A weighted value of 0.198 was assigned to internal process and 0.206 to learning and growth. The importance of BSC of small construction firms was in the following order: finance, customers, learning and growth, and internal process. The highest weighted value of performance in finance was 0.115, assigned to profitability, followed by stability, orders, growth, and activity. Performance in the customers area assigned the highest value of 0.089 to satisfaction of external customers, followed by satisfaction of external customers, market share, and satisfaction of internal customers. Performance in the internal process area assigned 0.100 to work efficiency, which was a weighted value greater than that of technological capacity. The highest weighted value of 0.078 was assigned to the organizational capacity area in terms of performance on learning and growth, followed by manpower training and informatization. Table 8 lists the weighted values of all items tabulated through an importance analysis with AHP.

As mentioned above, the weighted value of finance was highest in BSC. In detail, profitability was assigned to the highest weighted value in finance, satisfaction of external customers in customers, work efficiency in internal process, and organizational capacity in learning and growth.

MAPEIs were compared between Tables 1 and 8. The importance of items for large construction firms is different from that for small construction firms. For large construction firms, the weighted value of customers was 0.34 and highest in BSC, followed by finance and learning and growth. However, the highest weighted value was 0.379 for finance, followed by customers, learning and growth, and internal process, for small construction firms. In the performance area of finance, the importance of orders and profitability was high for large construction firms, whereas the importance of profitability and stability was high for small construction firms. Unlike large construction firms, where orders are considered important with a weighted value of 0.32, small construction firms assigned greater importance to stability with a weighted value of 0.246 when the value of orders is

0.184. This is because stability is considered a very important indicator due to the constantly decreasing orders for small construction firms. This shows that the priority of performance evaluation indicators varies even for companies within the construction industry, according to their scale, management environment, and management characteristics.
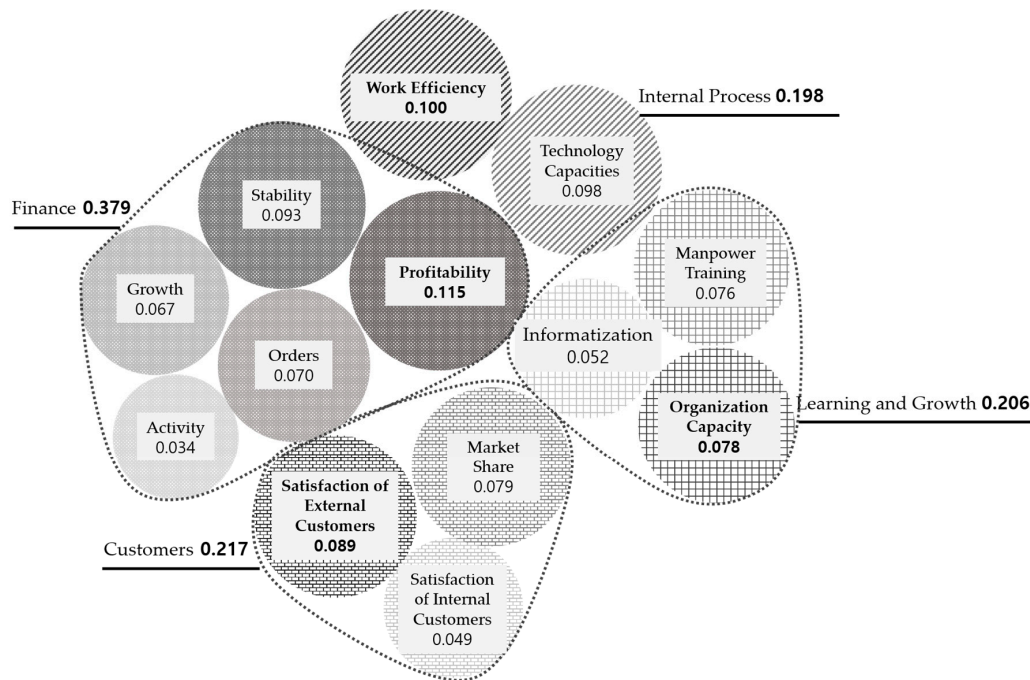

Figure 5. Performance areas.

Table 8. Weighted values of all MAPEIs.

BSC	Weighted Value	Performance Areas	Weighted Value	KPI	Weighted Value
Finance	0.379	Profitability	0.303	Cost of Sale Ratio Ordinary Profit	0.541 0.459
		Growth	0.177	Increase in Revenues in Korea	1.000
		Stability	0.246	Debt Ratio Achievement of Collection Goal	0.428 0.572
		Activity	0.090	Turnover Ratio of Total Liabilities and Net Worth	1.000
		Orders	0.184	Amounts of New Orders	1.000
Customers	0.217	Satisfaction of External Customers	0.412	Customer Satisfaction Corporate Image	0.661 0.339
		Satisfaction of Internal Customers	0.223	Transfer Rate of Employees Work Environment and Corporate Culture	0.415 0.585
		Market Share	0.365	Market Share of Orders in Korea	1.000
Internal Process	0.198	Technology Capacities	0.494	Possession of Intellectual Property Rights	1.000
		Work Efficiency	0.506	Compliance with Guidelines Accident rate Complaint-processing Capacity	0.329 0.379 0.292
Learning and Growth	0.206	Manpower training	0.370	Index of Excellent Workforce	1.000
		Organizational Capacity	0.377	Productivity of Employees	1.000
		Informatization	0.253	Informatization Capacity Index	1.000

4.3. Derivation of MAPEIs for Small Construction Firms

MAPEIs are the KPIs for management performance evaluation of small construction firms and consist of the hierarchy and weighted value of BSC, performance areas, and KPIs. There are four BSC areas, 13 performance areas, and 19 KPIs, and the weighted value of each item is as follows.

BSC-W refers to the weighted value of BSC, and the sum of BSC-W assigned to finance, customers, internal process, and learning and growth is 1. Performance-W refers to the weighted value of performance and is the product of BSC-W and the weighted value of performance, as in Equation (1). The sum of all weighted values of Performance-W is 1. KPI-W refers to the weighted values of KPI and is the product of Performance-W and the weighted value of KPIs, as in Equation (2). The sum of all weighted values of 'KPI-W' is 1.

$$\text{Performance} - W \ = \ \text{Weighted Value of Performance of BSC} - W \qquad (1)$$

$$\text{KPI} - W \ = \ \text{Weighted Value of KPI of Performance} - W \qquad (2)$$

MAPEIs are the most detailed items and the key indicators of management performance. Generally, BSC-W and Performance-W were highest in finance and profitability, so KPI-W would be highest for the items of finance. However, KPI-W was highest for possession of intellectual property rights in technology capacity at 0.098, as in Table 9. As KPI is applied to the hierarchy of performance, however, the items evaluating profitability were further categorized to reduce the weight of each item. The KPI of technology capacity applies to the possession of intellectual property rights only, whereas profitability was divided into two items of cost of sale ratio and ordinary profit. This implies that finance is important for evaluating the management performance of companies and the many evaluation indicators allow for accurate evaluation.

Table 9. Reflection of management performance evaluation on internal process.

BSC	BSC-W	Performance Areas	Weighted Values of Performance Areas	Performance Areas -W	KPI	Weighted Values of KPI	KPI-W
Finance	0.379	Profitability	0.303	0.115	Cost of Sale Ratio	0.541	0.062
					Ordinary Profit	0.459	0.053
		Growth	0.177	0.067	Increase in Revenues in Korea	1.000	0.067
		Stability	0.246	0.093	Debt Ratio	0.428	0.040
					Achievement of Collection Goal	0.572	0.053
		Activity	0.090	0.034	Turnover Ratio of Total Liabilities and Net Worth	1.000	0.034
		Orders	0.184	0.070	Number of New Orders	1.000	0.070
Customers	0.217	Satisfaction of External Customers	0.412	0.089	Customer Satisfaction	0.661	0.059
					Corporate Image	0.339	0.030
		Satisfaction of Internal Customers	0.223	0.049	Transfer Rate of Employees	0.415	0.020
					Work Environment and Corporate Culture	0.585	0.029
		Market Share	0.365	0.079	Market Share of Orders in Korea	1.000	0.079
Internal Process	0.198	Technology Capacities	0.494	0.098	Possession of Intellectual Property Rights	1.000	0.098
		Work Efficiency	0.506	0.100	Compliance with Guidelines	0.329	0.033
					Accident rate	0.379	0.038
					Complaint-processing Capacity	0.292	0.029
Learning and Growth	0.206	Manpower training	0.370	0.076	Index of Excellent Workforce	1.000	0.076
		Capacity	0.377	0.078	Productivity of Employees	1.000	0.078
		Informatization	0.253	0.052	Informatization Capacity Index	1.000	0.052
Total	1.000	Total		1.000	Total		1.000

4.4. Evaluation of Applicability of MAPEIs (Small Construction Firms)

The current study evaluated management performance to verify the applicability and necessity of MAPEIs. The subject applying MAPEIs was one small construction firm within the scope of study and three years' management performance was evaluated using a five-point scale. Figure 6 gives the MAPEI scores applying the weighted values and the MAPEI scores not applying the weighted values based on the evaluation results of the firm.
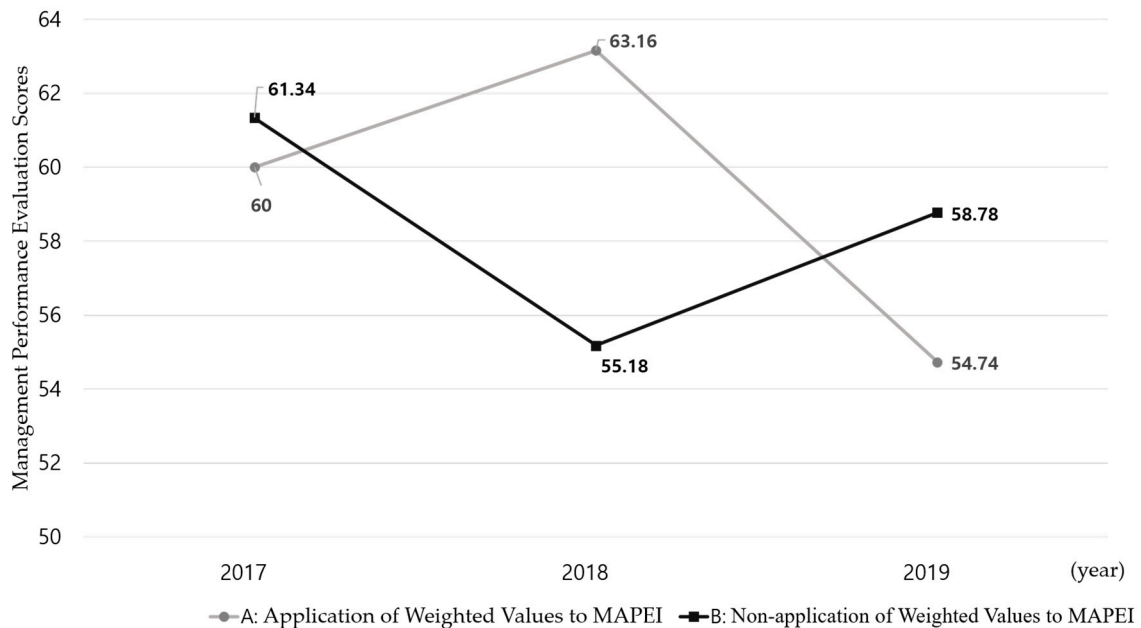
Figure 6. Results of management performance evaluation with/without weighted values of MAPEIs. (A) Results when not applying the weighted values to MAPEIs and assigning 60 points to 2017, 63.16 points to 2018, and 58.78 points to 2019; (B) results applying the weighted values to MAPEIs and assigning 61.34 points to 2017, 55.18 points to 2018, and 54.74 points to 2019. In (A), the management performance evaluation score of 2018 was 6.16%P lower than the previous year and showed a worsening of performance. The evaluation in (A) could not reflect the decline in management that was identified when analyzed by KPIs and importance (B). The management performance evaluation score of 2019 decreased by 8.42%P compared to the previous year in (A) but increased by 3.60%P with (B).

The management performance of companies varied greatly according to the application of weighted values to MAPEIs. This is because the results are distorted by applying the same weight value to all items affecting the management of firms. When the same weight is applied to all items, the performance of items with minimal impact is exaggerated and the performance of items with greater impact is lessened, which can cause errors. In other words, critical situations that may have a negative impact on management may be misinterpreted as an improvement in management. Therefore, it is important to apply weighted values to the evaluation items for the accurate evaluation of management performance.

5. Conclusions

The construction market in Korea is constantly being depressed due to the poor management of construction firms in Korea, and this has a significant impact on management performance. However, most firms in the construction market are small and the impact on management performance is tremendous. Additionally, small construction firms lack sufficient management control systems, response to and preparation for changes in the management environment, and structure of organization to improve the management. Therefore, the current study derived the MAPEIs (Management Performance Evaluation Indicators) for small construction firms for management performance evaluation.

The current study applied the management performance evaluation indicators of large construction firms from preceding studies as preliminary indicators to derive MAPEIs. Five

small construction firms in Korea were selected, and we interviewed the top management about the items that are realistically adopted by companies for management performance evaluation. A secondary hierarchy was created by analyzing the items surveyed, and items besides preliminary indicators were surveyed to finalize the hierarchy through deletion and supplementation. Complaint-handling capacity was added to the final hierarchy. This was derived from the corporate characteristics of small construction firms. The final hierarchy of MAPEIs consisted of 13 performance areas and 19 KPIs.

Not all performance areas and evaluation items of the final hierarchy have equal weight values. When the same weight value is applied to all items, the management performance of companies may be distorted. Therefore, the weight values of items shall be tabulated for accurate evaluation. An AHP survey was conducted for top management and engineers and the weight values of items were tabulated through a paired comparison. The survey involved analysis of BSC and performance areas of BSC and analysis of importance of KPIs of each performance area. As a result of the importance analysis, the highest values were applied to finance of BSC, profitability of performance, and possession of intellectual property rights of KPIs. This shows that a performance evaluation based on financial factors is more important than customer-centered performance for small construction firms.

MAPEIs are KPIs for the management performance evaluation of small construction firms and consist of the hierarchy and weighted values of BSC, performance areas, and KPIs. In order to verify the feasibility of MAPEIs, one small construction firm in Korea was selected for the applicability evaluation. The evaluation results varied according to the application of weighted values to MAPEIs and the need to apply weighted values to MAPEIs was confirmed as the management performance evaluation scores were distorted when the same weighted value was applied to all indicators.

The current study analyzed the characteristics of small construction firms and selected the evaluation items through an actual corporate survey to derive a weighted value for each item. Additionally, applicability was evaluated to verify the feasibility and applicability of MAPEIs. MAPEIs are fundamental to the study of management control in small construction firms; KPIs can be applied to construction companies with no more than 10 full-time employees. However, the items can be modified and supplemented to fit the characteristics of each company, and further studies and the development of performance evaluation systems for the performance evaluation of small construction firms to resolve the limitations would improve their management evaluation and achieve competitive management control. Therefore, the results of this study can be used as basic data not only for measuring management performance, but also for developing a system for the management of small construction firms. In addition, this study has limitations because it was conducted for construction companies in Korea. This study used the MEPAI model, which is the result of existing research on the management performance of construction companies. Not applying various models can be another limitation of this study.

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