Identification and Prioritization of Key Performance Indicators for the Construction Small and Medium Enterprises

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ABSTRACT

Purpose: The central purpose of this study is to propose a set of key performance indicators (KPIs) to measure the performance of construction small and medium enterprises (SMEs) that have been ignored in the performance management literature so far. Secondly, this study aims to determine the most crucial KPIs by using the fuzzy VIKOR method to improve cost-effectiveness in the performance measurement of construction SMEs. At the first stage of this study, KPIs proposed by the existing studies were identified via a literature survey. Then, the KPIs extracted from the literature survey were verified, and eight new KPIs were proposed as a result of focus group discussions with 12 participants who are owners/managers of construction SMEs. Additionally, the Balanced Scorecard (BSC) was modified in line with the needs of construction SMEs, and each KPI was grouped into a BSC perspective. A questionnaire survey followed this grouping to gather data associated with the KPIs. Based on these data, KPIs were prioritized by using the fuzzy VIKOR. It is found out that external indicators such as "effectiveness of monitoring market conditions" are determined as the most important KPIs, in contrast to the findings in the studies about large-scale companies. Furthermore, "Attracting new customers"; "Reliability of financial performance" and, "Competency of managers" are identified as important indicators. Four KPIs proposed by experts during the focus group discussion are placed among the most important KPIs, which highlights the need for a specific performance measurement system (PMS) for construction SMEs.

Keywords: Performance measurement, KPIs, construction SMEs, fuzzy VIKOR, MCDM.

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1. INTRODUCTION

The construction SMEs are essential parts of the construction industry (CI). The Department for Business Innovations and Skills (2012) underlined that 85.1% of employment and 72.9% of total revenue in the UK construction industry is driven by construction SMEs. Construction SMEs contribute to construction projects in diverse ways. They can deliver small and medium-sized projects as main contractors and undertake specialist works as subcontractors in large projects due to the lack of skilled labour force in large construction companies. The industry relies on construction SMEs especially when it comes to off-site manufacturing such as design and procurement, on-site manufacturing, assembly, and supporting services in large construction projects (Rezgui and Miles 2010). Therefore, construction SMEs' performances play a vital role in completing large construction projects successfully (Williams 2016).

Although the CI is considered one of the "locomotive industries", it is often criticized because of its low productivity and underperformance (Cui et al. 2018). Perhaps it is accurate to say that it performs the worst compared to other industries (Institution of Civil Engineering 2018). One of the most critical reasons for the low performance of the industry can be that most construction SMEs, as crucial players in the CI, show mediocre performance and fail to survive in the market. The report published by U.S. Small Business Administration (2012) stated that the survival rate of SMEs in the CI is less than 40% which is the lowest among the industries such as manufacturing, retail trade, food services & hotels. The report of the Institution of Civil Engineers (2018) also underlined the same issue. The report pinpointed that over 90% of construction SMEs experienced financial difficulties due to unfair and overdue payments in the UK. Considering that chronic performance issues of construction SMEs can have a drastic domino effect on the entire industry, more innovative and effective solutions must be developed for the construction SMEs to boost the overall performance of the industry.

Performance measurement could be an effective concept to boost the performance of construction SMEs. Performance measurement plays a crucial role in improving companies' performances since they provide the means to allocate and coordinate the resources (Melnyk et al. 2014). Besides, performance measurement ensures that all departments of an organization working to achieve the same corporate objectives. Therefore, the same performance measures and targets can be specified to measure and analyse the performance of all departments in the organization, which in turn, can lead to feedback loops across the organization (Kolehmainen 2010).

One of the outstanding concepts used for performance measurement is key performance indicators (KPIs), and this concept has been widely used in the CI. KPIs can be used to monitor the financial and non-financial success of a company (Tripathi et al. 2019), since "KPIs are measures that are indicative of the performance of associated process" (Beatham et al. 2004). Prioritization of KPIs is also crucial for effective performance measurement since monitoring all KPIs is not feasible and manageable (Luu et al. 2008b). KPIs in a PMS must be monitored by the management of SMEs to ensure that targets are met. In other words, each KPI must be measured repetitively, and the measurement data should be analysed, reported, and stored in the company periodically (Parmenter 2007). Therefore, the required time for performance measurement increases enormously as the number of KPIs increases. The information necessary to analyze these KPIs may be unavailable inside the organization,

and supplementary financial and human resources must be allocated to measure, analyze and store these KPIs (Kaplan and Norton 1996; Parmenter 2007). Thus, construction companies can save an enormous amount of time and money if they identify which KPIs are suitable for their needs (Ali et al. 2013). Since construction SMEs have limited resources and time compared to large companies, the complex and formalized performance measurement system may eventually become inefficient (Madsen 2015). Consequently, determination, prioritization, and monitoring of KPIs are vital for success in CI (Cox et al. 2003).

Performance measurement is widely known as a critical concept for construction companies. Therefore, multiple studies have been conducted to develop a PMS in the CI (Ali et al. 2013; Chan and Chan 2004; Cox et al. 2003; Luu et al. 2008a; Radujković et al. 2010; Skibniewski and Ghosh 2009; Tripathi and Jha 2018). However, Ciu et al. (2018) stated that this research area is not mature, and there is still some distance to be covered. Deficiencies of the existing body of knowledge from this perspective are continuously criticized by authors such as Liu et al. (2018a) and Okudan et al. (2020). Because most of the existing studies focus on the performance measurement of large construction companies and construction projects and ignore the construction SMEs. The PMSs developed for large construction companies and construction projects are not applicable for the construction SMEs due to their substantial differences which are elaborated within the scope of this study. Thus, the lack of the theoretical basis is a critical roadblock to the implementation of performance measurement practices in construction SMEs, causing the abovementioned issues within the entire industry. Since knowledge on performance measurement of construction SMEs is limited, construction practitioners keep implementing conventional management practices at the expense of their companies' future (Kagioglou et al. 2001; Skibniewski and Ghosh 2009). Therefore, there is still a gap in the performance measurement literature. Consequently, the cornerstone of this research is identifying a set of KPIs meeting the needs of construction SMEs. Additionally, existing studies mostly adopted simple descriptive methods which prioritize the KPIs based on a single criterion (Ali et al. 2013; Chan and Chan 2004; Cox et al. 2003; Luu et al. 2008a; Radujković et al. 2010; Skibniewski and Ghosh 2009; Tripathi and Jha 2018). Since such a prioritization should consider all strategic objectives of the construction SMEs, the multi-criteria decision-making (MCDM) approach becomes an essential need (Rogulj and Jajac 2018).

Consequently, the aims of this study are: (1) proposing a set of KPIs to measure the performance of construction SMEs which have been ignored in the performance management literature so far, (2) and determining the most important KPIs by using the fuzzy VIKOR method to improve cost-effectiveness in performance measurement. The practical implications of this study can be summarized as follows:

- Owners and/or managers of construction SMEs can measure their companies' performance and test outcomes of their managerial processes and decisions on performance by using the PMS developed in this study.

- The decision-makers within the construction SME can revise and refine managerial processes, as well as strategies, to ensure that the objectives of their construction SMEs are met. In this manner, the proposed system could function as a decision support framework by construction SMEs.

2. LITERATURE REVIEW

2.1. Performance Measurement in the Construction Industry

As stated above, there are many studies conducted to develop a PMS in the CI. The summary of these studies is shown in Table 1. Differences between this study and the existing studies in the construction management literature in terms of scope are provided to show the contribution of this study to the overall body of knowledge.

Table 1 - Summary of performance management studies in the construction management literature

Reference	Brief description of the study	Scope of the Study				
		A	B	C	D	E
Cox et al. (2003)	Developed a set of indicators that can be utilized to measure performance at the project level. 14 indicators were extracted from the literature, and analysis showed that 6 indicators were the most useful to measure the performance.		X			
Chan and Chan (2004)	Determined 14 KPIs that can be used for measuring the project performance. The application of the KPIs was demonstrated through case studies.		X			
Luu et al. (2008b)	Proposed 9 KPIs to benchmark construction projects. Later, the validity of KPIs was tested by considering three case studies.		X			
Luu et al. (2008a)	Identified strategic goals of large construction companies in Taiwan. They proposed 30 KPIs from a Balanced Scorecard perspective.			X		
Chan (2009)	Proposed 8 KPIs to measure the performance of the Malaysian construction industry	X				
Skibnewski and Gosh (2009)	Identified 9 KPIs and proposed a framework that uses Enterprise Resource Planning to collect data required to analyse KPIs.			X		
Radujkovic et al. (2010)	Proposed 36 KPIs that can be used to measure the performance of construction companies in Eastern Europe. The study adopted an in-depth literature review and descriptive methods as the research methodology.			X		
Ali et al. (2013)	Proposed KPIs for large construction companies and ranked KPIs by using the Relative Importance Index.			X		
Tripathi and Jha (2018)	Extracted 20 indicators from literature and ranked them using descriptive methods.		X			

Note: **A:** Measuring industries' overall performance; **B:** Measuring project performance; **C:** Measuring the performance of large companies; **D:** Measuring the performance of construction SMEs; **E:** Integrating MCDM to performance management field to link strategic objectives to performance measurement.

Considering the critical evaluation of the literature given in Table 1, there seems to be a clear gap in the literature review in areas related to performance measurement of construction SMEs and integrating MCDM to performance measurement to develop a PMS that is aligned with the construction SMEs' strategic objectives. Accordingly, the following section answers the question of why construction SMEs need their own PMS and KPIs.

2.2. The Reasons for Why Construction SMEs Need Their Own KPIs

Kaplan and Norton (1996) emphasized the essentiality of companies' strategic objectives in performance measurement. The authors also asserted that effective PMS can only be designed when a company's strategic objectives are translated into a coherent set of performance measures (KPIs). Similarly, Garengo et al. (2005) and Nelly et al. (2002) pinpointed that a PMS must be designed and implemented in full accordance with a company's business strategy to link strategy into measurable objectives of functions, groups of people, and individuals. The design process of a PMS should include strategic planning and implementation. The performance measurement, therefore, highlights the gap between the company's current performance and its strategic objectives (Garengo et al. 2005; Garengo and Bititci 2007).

The main difference between construction SMEs, construction projects, and large companies regarding the performance measurement stems from the differences in strategic objectives, corporate governance, and business model (Garengo and Bititci 2007). Construction SMEs have their particular management style and needs compared to large construction companies and construction projects due to the uniqueness of the owner roles, ownership and management, culture and behaviour, processes and procedures, human resources and customers, markets management as well as the availability of resources (Madsen 2015; Sousa and Aspinwall 2010). Therefore, they need a PMS tailored to successfully fulfil their needs. For instance, while construction projects are temporary endeavours whose durations vary generally between 1 to 5 years, the lifespan of construction SMEs are longer than the construction projects. Thus, the managers of construction SMEs certainly have different perspectives than project managers. Due to the construction industry's unique dynamic and turbulent environment, construction SMEs cannot implement any PMS developed peculiarly for SMEs working in other industries. Consequently, an ideal PMS should be discussed and developed based on the perspectives and needs of construction SMEs.

The critical evaluation of the literature presented in Section 2.2 revealed that construction management literature lacks an appropriate PMS for construction SMEs. Instead, the existing studies chiefly focus either on construction projects or large companies. Thus, these measurement systems were developed based on the perspectives of the managers in large construction companies or projects. It is widely addressed in the literature that developing a PMS without considering the fundamental differences between construction SMEs, construction projects, and large companies results in poor adoption in practice (Hudson Smith and Smith 2007; Turner et al. 2005; Wiesner et al. 2007). Consequently, a PMS that works in large construction firms is, in many instances, less likely to work in construction SMEs and vice versa (Taylor and Taylor 2013). Therefore, the views of the managers/owners of construction SMEs should also be considered to develop an applicable PMS for them.
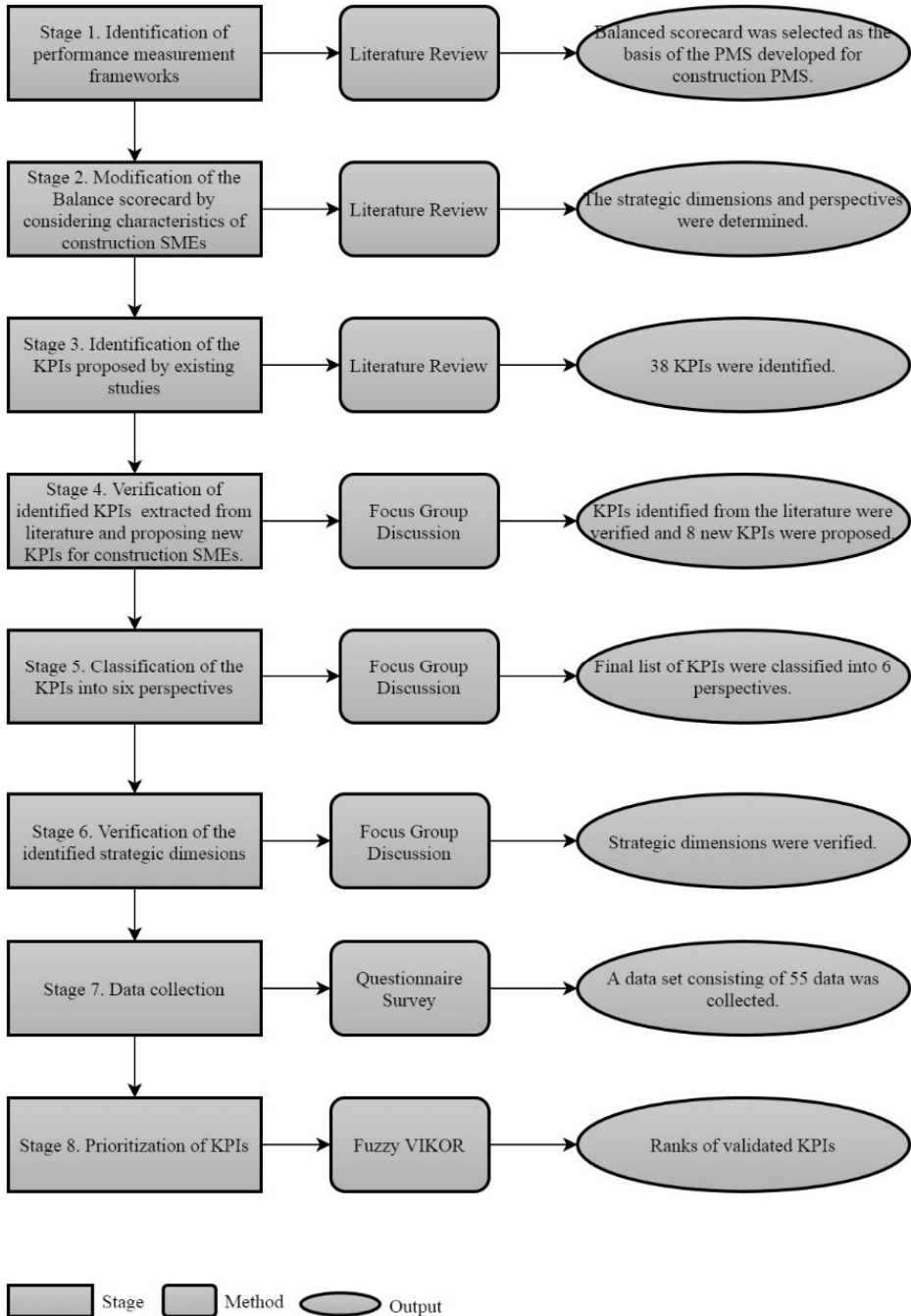
3. RESEARCH METHODOLOGY AND RESULTS

Stage	Method	Output
Stage 1. Identification of performance measurement frameworks	Literature Review	Balanced scorecard was selected as the basis of the PMS developed for construction PMS.
Stage 2. Modification of the Balance scorecard by considering characteristics of construction SMEs	Literature Review	The strategic dimensions and perspectives were determined.
Stage 3. Identification of the KPIs proposed by existing studies	Literature Review	38 KPIs were identified.
Stage 4. Verification of identified KPIs extracted from literature and proposing new KPIs for construction SMEs.	Focus Group Discussion	KPIs identified from the literature were verified and 8 new KPIs were proposed.
Stage 5. Classification of the KPIs into six perspectives	Focus Group Discussion	Final list of KPIs were classified into 6 perspectives.
Stage 6. Verification of the identified strategic dimesions	Focus Group Discussion	Strategic dimensions were verified.
Stage 7. Data collection	Questionnaire Survey	A data set consisting of 55 data was collected.
Stage 8. Prioritization of KPIs	Fuzzy VIKOR	Ranks of validated KPIs

Stage □   Method □   Output ⬭

Figure 1 - Research Process Flowchart

The research methodology followed in this study is illustrated in Figure 1. At the first stage, a conceptual framework was developed by considering the existing performance measurement frameworks. Firstly, these frameworks were evaluated, and the balanced scorecard was selected. The balanced scorecard was revised and modified as in line with the needs of the construction SMEs. Then, a literature survey was conducted to determine KPIs for the construction SMEs. Besides, the strategic dimensions of SMEs were extracted from the survey. Therefore, the first stage of the study was completed.

Although the PMS was developed based on the existing literature, it was verified by conducting focus group sessions at the second stage. Then, a questionnaire was designed to rank the identified KPIs. The final step is the prioritization of KPIs of the construction SMEs by using fuzzy VIKOR analysis.

3.1. Stage 1. Identification of the Performance Management Frameworks

In literature, many different frameworks have been developed to measure the performance of companies. However, in recent years, multidimensional frameworks are preferred to satisfy all strategic objectives of performance measurement. One of the most widely used multidimensional performance measurement frameworks is proposed by Kaplan and Norton (1996), namely the balanced scorecard (BSC) that satisfies a balance between the financial and non-financial indicators. Similarly, different multidimensional performance measurement frameworks, such as result and determinants framework (RDF) (Fitzgerald et al. 1991), performance prism (Neely et al. 2002), and dynamic multi-dimensional performance framework (DMPF) (Neetu and Mahim 2013) are developed. Among these multidimensional performance measurement frameworks, this study adopts the BSC since it is one of the most efficient business ideas (Bassioni et al. 2004). Besides, although there is no BSC-based PMS for construction SMEs yet, BSC has been used widely to develop PMSs for other construction companies. For instance, Yu et al. (2007a) developed a comparable PMS for large construction companies based on BSC. Similarly, Oyewobi et al. (2015) integrated the BSC into the business excellence model to develop a system that measures the strategic performance of construction organizations.

Kagioglou et al. (2001) defined BSC as a performance measurement framework that combines four main perspectives, namely finance, customer, internal business process, and learning and growth. BSC incorporates a wide range of indicators through various sub-measures under these four perspectives. Thus, companies can utilize performance drivers (leading indicators) and outcome measures (lagging indicators), while traditional PMSs only utilize outcome measures. A balance between the lagging and leading indicators should be established to develop an effective PMS (Wu 2012). Thus, by combining these lagging and leading measures, a common language is achieved, aligning top management and employees with the vision of the organization (Kaplan and Norton 1996).

The central purpose of BSC is to convey the mission and strategy of organizations into indicators that facilitate the analysis of results and decision-making processes. Therefore, the strategic objectives are identified according to the strategic priorities of organizations at the initial stage. These strategic objectives are then translated into performance measures.

3.2. Stage 2. Modification of the Balanced Scorecard

The practicality of the BSC in construction SMEs has been thoroughly discussed in the literature, and BSC is determined as an efficient framework for measuring the performance of construction SMEs (Malagueño et al. 2018; Monte and Fontenete 2012). However, the BSC had initially been developed for large companies. Therefore, it should be modified by considering the characteristics of construction SMEs. Modified BSC should be faster and less complex so that construction SMEs can implement it with their limited resources and capabilities (Madsen and Stenheim 2014).

As stated above, traditional BSC considers the KPIs under four perspectives, though it is not mandatory. To reflect the organizational strategy, the traditional structure of BSC can be modified by adding divergent perspectives. Besides, Schneiderman (1999) and Neely and Bourne (2000) stated that four main perspectives are insufficient. Primarily due to the complex environment of the CI, new perspectives are proposed for construction companies. For instance, Ali et al. (2013) proposed the environment as a new perspective. Construction Excellence (2017) stated that one of the KPIs perspectives for construction companies should be the environment. The performance of construction SMEs is chiefly affected by factors derived from the outside of the organization (Banham 2010). Therefore, external factors are crucial as well. Consequently, in this study, two new perspectives are included to propose a comprehensive PMS.

BSC includes strategic objectives in the development of performance measurement. However, SMEs have to make frequent changes in strategic objectives since the business environments where they operate are not stable (Madsen 2015). Therefore, to increase the applicability rate of the BSC and to propose a generic PMS for the construction SMEs, the strategic dimensions that show the possible strategic orientations of the organizations are used. A literature review was performed to determine the generic strategic dimensions of construction SMEs for BSC. Fernandes et al. (2006) clustered the strategic objectives into three strategic dimensions while developing a strategy map for an SME based on BSC. Gomes et al. (2009) conducted a factor analysis and determined five strategic dimensions for SMEs. Monte and Fontenete (2012) proposed three dimensions for the small gas stations in Portugal. Likewise, Sofiyabadi et al. (2016) proposed eight research criteria for SMEs in the service business. Consequently, in this study, eight strategic dimensions were identified by combining the strategic dimensions proposed for SMEs in the literature. The strategic dimensions extracted from the literature are then validated through focus group discussion, as shown in Section 3.6.

3.3. Stage 3. KPIs Identification

A comprehensive literature review was conducted via search engine Scopus to extract KPIs. At the end of this search, a total of 68 studies were retrieved. A first-level screening was performed by carefully reading the titles and abstracts. As a result, papers directly related to company performance were filtered, and the studies dealing with project performance were eliminated as projects and construction companies almost have entirely different management systems (Turner and Müller 2003). Based on this research, eleven existing studies related to performance measurement of construction companies proposing KPIs were identified. All the KPIs proposed in these studies were then extracted to prepare an initial

list. To prevent duplicates, these KPIs were re-evaluated to remove, merge, and/or rename some KPIs with similar meanings. Finally, thirty-eight KPIs were identified.

3.4. Stage 4. KPIs Verification

The strategy and vision for the construction SMEs should also be verified since the BSC framework requires strategies as a guideline to develop KPIs. However, the extracted KPIs are proposed mainly for large construction companies. Therefore, they may not be in line with the strategy and vision of the construction SMEs. Besides, KPIs should be determined by considering the perspectives of BSC and classified into these perspectives. Therefore, to filter out irrelevant KPIs, a discussion session led by a moderator (one of the authors of this study) was conducted with a group of 12 experts. There is no determined rule about the size of the focus group. It is important to note that a large sample size such as 20 or even 50 could make the moderation of the session complex and hard to control. On the other hand, few participants may lead to low-reliability and inhibit the extraction of creative ideas from the sessions (Budayan et al. 2020). The experts were selected cautiously by considering their positions to increase the reliability of the group discussion sessions. Therefore, judgment sampling was applied to determine the participants. The following criteria were proposed to select the most appropriate participants. It should be noted that, during the expert selection, project types were not considered as a selection criterion. Unlike the project-specific studies which consider the effect of project types, the project type becomes a negligible criterion for the studies focusing on company performance (Ali et al., 2013; Radujković et al., 2010). Furthermore, when a performance measurement system is developed for a company that focuses on a single project type, it will have a limited practical implication since construction companies have to undertake various project types simultaneously.

1. The respondent should work in a construction SME that identifies itself as a specialist in residential building construction.

2. The respondent has a high-level management role.

3. The respondent's company has survived more than five years in the industry.

4. The respondent has worked for more than one year in a management role.

The profile of the participants and their companies is shown in Table 2. Although the participants were selected from construction SMEs, the total turnover and the total number of employees were also checked and verified. All companies have worked in the CI for at least five years. The experience levels and positions of the participants also show that these participants satisfy the predefined criteria. Consequently, the ideas captured from these participants can be considered reliable.

These KPIs were verified by following a similar methodology as described by Budayan et al. (2020). According to this methodology, firstly, the participants reviewed the suitability of KPIs considering the vision and strategy statement of construction SMEs. The participants assessed the suitability of each KPI based on a 1 to 5 Likert scale without discussion. The scale intervals are interpreted as follows: (1) not suitable; (2) partially suitable; (3) suitable; (4) very suitable; and (5) most suitable. Then, the responses of the participants were evaluated by conducting a descriptive analysis. Since the average of the appropriateness levels of all

KPIs was calculated higher than 3.5, none of the KPIs was eliminated at this stage. Then, these KPIs were discussed by the participants one by one to reach a final decision. At the end of this session, all KPIs were verified by the participants with a consensus. Besides, each of the experts was given an opportunity to propose a new KPI during this stage. Suggestions of each expert were discussed during the session with other participants. The discussion ended when a consensus about the appropriateness of KPIs was reached. At the end of this session, 8 new KPIs were proposed. Consequently, a final list of 46 KPIs was obtained and is shown in Table 3. It should be noted that the "*" mark at the rightest column of Table 3 indicates that this KPI was proposed during the focus group discussion sessions.

Table 2 - Profile of participants participating in group discussion sessions.

Sample Specifications	Counts and Percentages	
Role of Participants	Owner 7 (58.33%)	Manager 5 (41.66%)
Experience of the Company in CI (Year)	5-10 5 (41.66%)	10-20 7 (58.33%)
Experience of Participants in SMEs (Year)	1-5 5 (41.66%)	5-15 7 (58.33%)
Total Turnover of the Company (Million $)	0-3 6 (50%)	3-5 6 (50%)
Number of Employees in the Company	1-50 6 (50%)	50-250 6 (50%)
Education Level	BSc. 7 (58.33%)	MSc. 5 (41.66%)

3.5. Stage 5. Classification of the KPIs into six perspectives

The second session was conducted with the same participants to classify the KPIs according to the predefined six perspectives. The workflow conducted in this session is illustrated in Figure 2. Consequently, the participants classified the identified KPIs into six perspectives within a consensus, and the classification of KPIs to these six perspectives is illustrated in Table 3 as well.
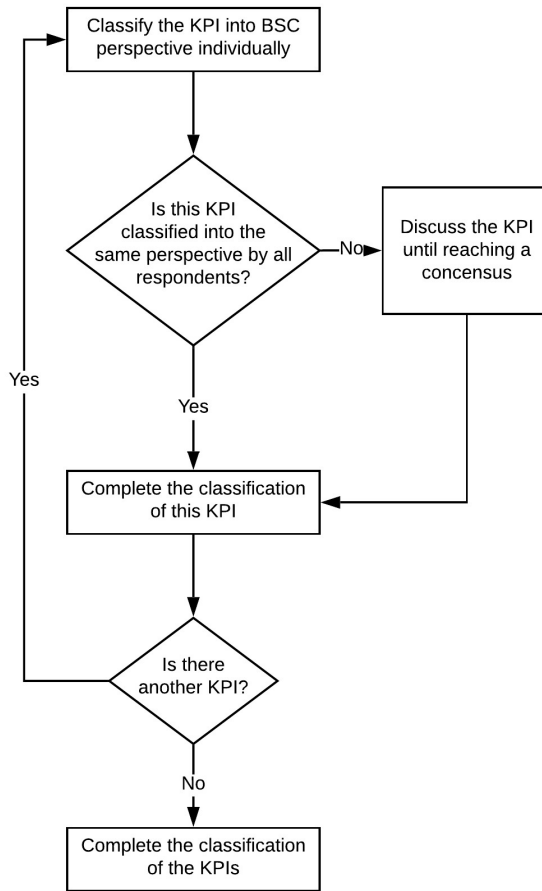
Figure 2 - Workflow of the third session

Table 3 - Perspectives and Sources of Key Performance Indicators

Key Performance Indicators	A	B	C	D	E	F	G	H	I	K	L	Count
Financial												
Profitability	—	X	X	—	X	X	X	X	X	X	X	9
Reliability of financial performance	—	—	—	—	—	—	—	—	—	X	—	1
Growth of organization	—	—	X	—	—	—	—	—	X	X	X	4
Financial stability	—	—	X	—	—	—	—	—	—	X	—	2
Proper cash flow	—	—	—	—	—	—	—	—	—	X	—	1
Percentage of loan interest from profit	—	—	—	—	—	—	—	—	—	X	—	1
Rate of return of an investment	—	—	—	—	—	—	—	—	—	—	—	*
The growth rate of annual revenue	—	—	—	—	—	—	—	—	—	—	—	*

Table 3 - Perspectives and Sources of Key Performance Indicators (continue)

Key Performance Indicators	A	B	C	D	E	F	G	H	I	K	L	Count
Customer												
The satisfaction of the internal customer	—	—	X	—	—	—	—	—	X	X	—	3
Attracting new customers	—	—	—	—	—	—	—	—	—	—	—	*
Good customer relationships	—	—	—	—	—	—	—	—	—	X	X	2
The satisfaction of external customers	—	X	X	—	X	X	X	—	X	X	X	8
Good service or/and product quality	—	—	—	X	X	—	—	—	X	X	—	4
Market share	—	—	X	—	—	X	—	X	—	X	X	5
Value of local currency	—	—	—	—	—	—	—	—	—	—	—	*
Competitive price	—	—	—	—	—	—	—	—	—	X	—	1
Effectiveness of managing contracts and legal disputes	—	—	—	—	—	—	—	—	X	—	—	1
Internal Business Process												
Productivity	X	X	—	—	—	X	X	X	X	X	X	8
Innovation	—	—	—	—	—	—	—	—	X	X	—	2
Healthy and safe working environment	X	X	—	X	X	—	X	X	—	X	X	8
Business productivity	—	—	X	—	—	—	—	—	X	X	—	3
Competency of managers	—	—	—	—	—	—	—	—	—	X	—	1
Effectiveness of planning	X	X	—	X	X	X	X	—	X	X	—	8
Labour force productivity	—	—	—	—	—	X	—	—	—	X	—	2
Effectiveness of resource management	—	—	—	—	—	—	—	—	—	X	—	1
Improving technological capacity	—	—	X	—	X	—	—	—	—	X	—	3
Rate of professional employee	—	—	—	—	X	—	—	—	—	—	—	1
Rework	X	—	—	—	—	—	—	—	X	X	X	4
Defects	—	X	—	—	—	—	—	—	X	X	—	3
Research and development level	—	—	X	—	—	X	—	—	—	X	—	3
Satisfaction of employees	—	—	—	—	—	—	—	—	X	—	X	2
Effectiveness of material planning	—	—	—	—	—	—	—	—	—	—	—	*
Learning and Growth												
Empowered workforce	—	—	—	—	—	—	—	—	—	X	—	1
Appropriateness of informatization	—	—	X	—	—	—	—	—	X	X	—	3
Continuous improvement	—	—	—	—	—	—	—	—	X	X	X	3
Training of personnel	—	—	X	—	X	X	—	—	—	X	—	4
The capability of the HR management team	—	—	—	—	—	—	—	—	—	X	—	1
Motivation	—	—	—	—	—	—	—	—	X	X	—	2

Table 3 - Perspectives and Sources of Key Performance Indicators (continue)

Key Performance Indicators	A	B	C	D	E	F	G	H	I	K	L	Count
Environment												
Impacts on society	—	—	—	—	—	—	—	—	—	X	X	2
Effectiveness of waste management	—	—	—	—	—	—	—	—	—	X	X	2
Optimizing energy use	—	—	—	—	—	—	—	—	—	X	X	2
Conformity to standards	—	—	—	—	—	—	—	—	—	—	—	*
External												
Effectiveness of Risk management	—	—	—	—	—	—	—	—	—	X	—	1
A good relationship with stakeholders	—	—	—	—	—	—	—	—	X	X	—	2
Effectiveness of monitoring and managing changes in policy or law	—	—	—	—	—	—	—	—	—	—	—	*
Effectiveness of monitoring market conditions	—	—	—	—	—	—	—	—	—	—	—	*

Note: A: (Cox et al. 2003)**; B:**(Bassioni et al. 2004)**; C:** (Yu et al. 2007b)**; D**: (Luu et al. 2008b); **E**: (Luu et al. 2008a); **F:**(Chan 2009); **G**: (Skibniewski and Ghosh 2009); **H**: (Horta et al. 2010); **I**: (Radujković et al. 2010); **K**: (Ali et al. 2013); **L**: (Tripathi and Jha 2018)**.**

3.6. Stage 6. Verification of the Identified Strategic Dimensions

The third session of group discussion was determined the strategic dimensions appropriate to the construction SMEs. To verify the identified strategic dimensions, each strategic dimension was discussed by the same participants one by one until they reached a consensus. At the end of this session, two strategic dimensions, namely effective risk management and atonement of HR strategy, were classified as unsuitable for construction SMEs and, consequently, eliminated. The final list of strategic dimensions is illustrated in Table 4.

Table 4 - The final list of strategic dimensions

Abbreviation	Criteria	Abbreviation	Criteria
C1	Ability to Run	C4	Key Results
C2	Business continuity	C5	Company Sales and Earnings
C3	Competitive Advantage	C6	Coordinated Strategy with the Enterprise Architecture

3.7. Stage 7. Data Collection

In this stage, a questionnaire was prepared by including the strategic dimensions and KPIs. The questionnaire consisted of three parts. In the first part, respondents provided information about themselves and their companies. In the second part, the respondents rated the KPIs with respect to each strategic dimension (given in Table 4) based on seven linguistic variables shown in Table 5. Fuzzy linguistic variables were used rather than numbers in this study

since the experts can reflect their opinions about the identified KPIs more precisely and ambiguity can be eliminated (Karwowski and Mital 1986). In this study, fuzzy membership function and fuzzy numbers suggested by Lin et al. (2006) were followed. In the third part of the questionnaire, the respondents also rated the importance of strategic dimensions for the construction SMEs using the same linguistic variables.

Table 5 - Linguistic variables and fuzzy numbers

Linguistic variables	Fuzzy numbers	Linguistic variables	Fuzzy numbers
Extremely low	(0,0.05,0.15)	Fairly high	(0.5,0.65,0.8)
Low	(0.1,0.2,0.3)	High	(0.7,0.8,0.9)
Fairly low	(0.2,0.35,0.5)	Extremely high	(0.85,0.95,1)
Medium	(0.3,0.5,0.7)		

This questionnaire study was conducted with 55 respondents who were selected by using judgment sampling, as shown in Section 3.4. The profile of the respondents and their companies are shown in Table 6.

Table 6 - Profile of respondents and their companies

Sample Specifications	Counts and Percentages			
Role of respondents	Owner 35 (63.63%)		Manager 20 (36.36%)	
Experience of the company in CI (year)	5-10 14(25.45%)	10-20 24(43.63%)	20-25 11(20%)	25-30 6(10.90%)
Experience of respondents in SMEs (year)	1-10 17(30.90%)	10-20 16(29.09%)	20-25 7(12.72%)	25-45 15 (27.27%)
Total Turnover of the Company (Million $)	0-3 37(62.27%)		3-5 18(32.72%)	
Number of employees in the company	1-50 41(74.54%)		50-250 14(25.45%)	
Education Level	BSc. 35 (63.63%)	MSc. 11(20%)	Other 9(16.36%)	

Based on this table, the experiences of respondents who are top-level managers satisfy the experience level criterion. Also, their companies survive longer than the criterion. Consequently, the positions of the respondents, their experience levels, and their companies' experiences satisfy all the predefined criteria. Finally, to avoid misunderstandings and increase the reliability of the study, all questionnaires were completed through face-to-face interviews.

3.8. Stage 8. Fuzzy VIKOR Analysis

To determine the effectiveness of the KPIs in measuring the performance of the companies in achieving the determined strategic dimensions, a multiple-criteria decision making (MCDM) perspective was used. As an MCDM method, VIKOR analysis was selected, and all the processes were formulated accordingly. VIKOR is developed to determine a compromise solution for a discrete decision-making problem with conflicting criteria. The method is a convenient tool to use when decision-makers cannot select or do not know how to decide on the most suitable alternatives. VIKOR was selected because it has several advantages compared to other MCDM methods such as TOPSIS (Rostamzadeh et al. 2015). Unlike the TOPSIS that considers only group utility maximization and individual regret minimization, VIKOR also can fully reflect the experts' subjective preferences (Liu and Wu 2012; Opricovic and Tzeng 2004). The VIKOR method is used in various fields many times in the literature, such as performance management (Sofiyabadi et al. 2016) and risk management (Gul et al. 2019).

As stated above, the fuzzy theory was considered a viable alternative. The decision-makers make decisions under vague and uncertain conditions, leading to numerous uncertainties. Therefore, the scientific methods should be selected in the decision-making process carefully to reduce the risk of any uncertain decision environment (Sofiyabadi et al. 2016), and the fuzzy theory is an effective method for dealing with vague and risky problems. VIKOR method is also redesigned by using fuzzy theory and named as fuzzy VIKOR. Thus, the fuzzy VIKOR was used in this study.

3.8.1. Appropriateness of the Collected Data for Fuzzy VIKOR Analysis

Before performing the fuzzy VIKOR analysis, the appropriateness of the sample for this analysis was checked. Firstly, the sample size was considered. In the MCDM studies, the size of the sample is a quite subjective and contextual measure. Therefore, there is no strict rule for minimum sample size. However, MCDM methods such as VIKOR and TOPSIS do not require a large sample size for the analysis (Gupta 2018; Volmohammadi 2010). Consequently, the fundamental advantage of these methods is that they give reliable results with a small sample size (Bacalan et al. 2019). A large sample size may even cause unreliability due to *cold-called* respondents (Cheng and Li 2002), especially when the questionnaire takes a long time to complete the questionnaire used in this study. Besides, many authors pinpointed that MCDM techniques can offer reliable results with a small sample size of 10 or lower experts, stating that the findings of these techniques might be unrealistic with a large sample size since a large sample size can lead to a high degree of inconsistency (Pun and Hui 2001). Therefore, many researchers, such as Suganthi (2018) (3

experts), Liu et al. (2019) (6 experts), Liu et al. (2018b) (7 experts), Sofiyabadi et al. (2016) (8 experts), performed either VIKOR or fuzzy VIKOR methods with small sample size. Nonetheless, this study was conducted with 55 experts to maximize the reliability of the results. In this manner, the sample size used in this study is way above the sample size of similar studies as shown above.

Secondly, the reliability of this data set was reviewed. All questionnaires were collected via face-to-face interviews to increase the reliability of the data. For this reason, the data collection methodology used in this study is extremely reliable compared to studies collecting the data via e-mails (Lee and Yang 2018). Namely, this study maximized the quality of the data rather than the quantity.

3.8.2. Application of Fuzzy VIKOR Analysis

Although various software is available to perform fuzzy VIKOR analysis, an excel sheet was developed in-house by following the fuzzy VIKOR method proposed by Opricovic (2011) to have a broader knowledge about the method and its mechanism. The computational accuracy was tested by using the data presented in Sofiyabadi et al. (2016).

In this study, first, a decision matrix was prepared for each participant, and 55 decision matrices were obtained at the end. Later, these 55 matrices were merged to form an aggregated decision matrix before applying the fuzzy VIKOR analysis. By following the remaining steps of the fuzzy VIKOR, crisp Q values were obtained. Ranks of the KPIs were obtained by sorting Crisp Q values (given in Table 7) in descending order. A KPI with the smallest crisp Q value is the most important KPI, as understood from Table 7.

Table 7 - Outputs of Fuzzy VIKOR

KPIs	Crisp Q	KPIs	Crisp Q	KPIs	Crisp Q	KPIs	Crisp Q
A1	0,0610	A13	0,0332	A24	0,0381	A36	0,0873
A2	0,0304	A14	0,0450	A25	0,0497	A37	0,0726
A3	0,0575	A15	0,0671	A26	0,0709	A38	0,0527
A4	0,0636	A16	0,0779	A27	0,0665	A39	0,1267
A5	0,0343	A17	0,0645	A28	0,0689	A40	0,1274
A6	0,1209	A18	0,0879	A29	0,0700	A41	0,1287
A7	0,0795	A19	0,0566	A30	0,0673	A42	0,0345
A8	0,0730	A20	0,0893	A31	0,0647	A43	0,1288
A9	0,0586	A21	0,0704	A32	0,0724	A44	0,0918
A10	0,0182	A22	0,0316	A33	0,0616	A45	0,0396
A11	0,0398	A23	0,0517	A34	0,0618	A46	0,0163
A12	0,0424			A35	0,0606		

4. RESULTS AND DISCUSSION OF FINDINGS

4.1. The Top KPIs

The top ten KPIs shown in Table 8 are discussed in this section since the number of KPIs should be limited to eight to twelve while developing a PMS to improve its applicability (Kaplan and Norton 1996; Parmenter 2007).

According to Table 8, eight KPIs are non-financial indicators. Therefore, a PMS that involves only financial indicators such as conventional financial measurement systems is not accurate and applicable in practice. For this reason, a broader perspective is necessary to evaluate the performance of these companies. Additionally, "effectiveness of monitoring market conditions" and "effectiveness of monitoring and managing changes in policy or law" obtained very high scores as measures of external perspective. These results show that external factors play crucial roles in the performance of construction SMEs. The intensive dependence of construction SMEs on the external environment is also stated in the literature (Li et al. 2011).

Furthermore, four KPIs proposed by experts during the focus group discussion sessions obtained very high scores, highlighting the differences of construction SMEs. It is important to note that these KPIs had been neglected in the existing studies focusing on large construction companies and projects. Thus, the results verified that the perceptions of the managers in large construction companies are different from the construction SMEs. Due to this reason, construction SMEs need a PMS tailored according to their specific needs.

Table 8 - Top ten KPIs

KPIs	S	R	Q	Rank
Effectiveness of monitoring market conditions	1.127	0.245	0.0162	1
Attracting new customers	1.169	0.242	0.0182	2
Reliability of financial performance	1.233	0.259	0.0304	3
Competency of managers	1.314	0.248	0.0315	4
Good service and/or product quality	1.199	0.270	0.0332	5
Proper cash flow	1.235	0.267	0.0343	6
Conformity to standards	1.183	0.275	0.0344	7
Labour force productivity	1.282	0.267	0.0380	8
Effectiveness of monitoring and managing changes in policy or law	1.260	0.274	0.0396	9
Good customer relationship	1.271	0.273	0.0398	10

Another notable point is that three indicators placed in the top ten KPIs are customer-oriented, namely "attracting new customers", "good service and product quality" and "good customer relationships". Construction SMEs should develop good relationships with their customers since they generally utilize personal networks and rely on personal

recommendations to attract new customers. Most construction SMEs consider the most efficient marketing approach "word of mouth" (Buser and Carlsson 2014). Similarly, qualities of end products and satisfaction of external customers are also acknowledged as important KPIs for large construction companies (Ali et al. 2013; Radujković et al. 2010; Tripathi and Jha 2018)

"Effectiveness of monitoring market conditions" was presented as the most important KPI in this study. Construction SMEs should earn money as soon as possible after an investment; otherwise, they will be out of business. However, especially during an economic crisis, the money circulation in the market decreases, and these companies can confront difficulties in getting their payments. Hence, market imperfections, such as financial distress, affect construction SMEs severely (Belghitar and Khan 2013). Therefore, the owners or managers of construction SMEs should continuously monitor and control market conditions to forecast any fluctuations and should take precautions to keep their enterprises financially balanced. In this way, they can have a chance to establish more sustainable management.

Additionally, Ulubeyli et al. (2018) asserted that construction SMEs are more vulnerable to adverse market conditions than larger firms due to their relatively limited resources. However, in the study of Radujkovic et al. (2010), "effectiveness of monitoring market conditions" is not determined as one of the most significant KPIs since large construction companies can maintain a strong stance against the fluctuations in the market, unlike construction SMEs (Smallbone et al. 2012). This conclusion can also support the hypothesis of this study, stating that large construction companies and construction SMEs have different dynamics and strategic objectives, and therefore, a different PMS should be developed for construction SMEs.

"Competency of managers" was considered as the fourth most significant performance indicator by the respondents. Due to their economies of scale and limited resources, construction SMEs confront with more difficulties compared to large companies. However, they are more flexible and open to changes due to their simple internal management processes (Aragón-Sánchez and Sánchez-Marín 2005). In construction SMEs, most of the internal management processes are conducted by the CEO/entrepreneur or a small group of managers. Therefore, to gain an advantage of construction SMEs' flexible nature, the managers should have competence, capabilities, and strong personality traits. Their capabilities and other features are crucial in the performance of construction SMEs (McAuley 2010). Consequently, the competency of managers must be measured both before and after the recruitment continuously.

"Proper cash flow" was ranked in the sixth order. Comparatively, construction SMEs rely on networking capital more than larger firms. Strictly speaking, the percentage of current assets and liabilities to total assets and total liabilities are higher in construction SMEs than larger companies (Padachi 2006). However, high investment in working capital can be one of the fundamental reasons for bankruptcy (Soenen 1993) due to the requirement of external finance which is more expensive for construction SMEs because of the asymmetric information (Belghitar and Khan 2013). However, the availability of cash flow can help companies to avoid the need for expensive external finance (Baños-Caballero et al. 2014). Companies having proper cash flow can exploit the advantages of high investment in working capital without dealing with expensive external finance. This advantage makes the availability of cash flow crucial for construction SMEs. Besides, since construction SMEs have relatively

higher transaction costs than larger companies due to the economies of scale, proper cash flow is profoundly demanded by construction SMEs (Tauringana and Adjapong Afrifa 2013). Indeed, Navon (1996) emphasized the importance of cash flow for the construction companies and indicated that most construction companies fail due to a lack of proper cash flow. For this reason, construction SMEs should continuously control this KPI.

The ninth most significant indicator is determined as "Effectiveness of monitoring and managing changes in policy or law". Governments, together with their policies and laws, are the key factors affecting the development and success of SMEs in all industries (Smallbone and Welter 2001). Therefore, policies or regulations might act as enabling and/or constraining forces for SMEs. Bannock and Peacock (1989) explained the costs resulted from the changes in policy or law and defined the types of costs as direct costs and compliance costs. They argued that these costs are relatively higher for SMEs than larger companies due to small enterprises' limited resources. Therefore, studies conducted for large construction companies generally neglected these KPIs in their PMSs. Consequently, owners or managers of construction SMEs must be aware of the significance of the changes in policies and laws and monitor this KPI.

4.2. The Least Rated KPIs

According to Table 7, all KPIs related to environmental issues except "conformity to standards" were considered as the least significant KPIs by the respondents. However, conformity to standards is determined as the seventh most important KPI. Two possible reasons can explain this conflict. The first reason might be that construction SMEs do not pay enough attention to examining their impact on the environment and stay passive in the face of sustainable development (Loucks et al. 2010). The second reason might be that respondents may not be thinking of environmental issues, which could help them improve their enterprise performance. The most possible perception is that they consider environmental issues as all about achieving laws and some standards.

Another interesting finding is that the KPIs related to human resource management are ranked in the list of least important KPIs. Although the positive relationship between the human resource management practices and organizational performance of SMEs is stated in the literature (Ogunyomi and Bruning 2016), most construction SMEs consider that the training of employees is expensive and the return of the investment from it is insignificant (Dainty et al. 2005) due to the high employee turnover and low retention rate in construction SMEs compared to large construction companies.

5. CONCLUSIONS AND RECOMMENDATIONS

Although the importance of the performance of the construction SMEs for the CI and the whole economy is widely recognized, they do not perform the expected performance. Therefore, performance measurement is critical for these companies to improve their performance. This research attempted to determine the KPIs that can be used to measure the construction SMEs performances.

This research has shown that construction SMEs are vulnerable to external factors. Construction SMEs generally perform their operations with their limited resources. They do not have sufficient abilities and resources to adapt to the changes and resist crises in the market compared to the large construction companies. Therefore, these external factors affect construction SMEs in achieving their strategic objectives. In other words, there is a relationship between the performance of these companies and the external factors. Consequently, they should measure the effectiveness of their procedures to monitor market conditions and their performances.

This study also highlighted that the cash flow and the reliability of financial performance are more important than profitability. The construction SMEs prefer permanent earnings to high profitability since they conduct their operations based on working capital. This preference means that these companies do not hold a capital buffer for their immediate financial obligations required to survive in the market. Therefore, they should measure the reliability and stability of their cash flow and financial performance.

On the other hand, the least rated ten KPIs also provide crucial insights into the tendency of the respondents. Results show that all environmental indicators, except for conformity to standards, were ranked among the lowest-ranked indicators for measuring the performance of the construction SMEs. This finding reflects the general view of the CI. Construction companies consider making extra efforts for having good environmental performance as insignificant. The respondents regard that conformity to standards is adequate since they can avoid fines.

This study also hypothesizes that there are perspective differences between the managers and/or owners of construction SMEs, projects, and large construction companies. As stated before, the manager preferences on the implementation of the PMSs are as crucial as the structure of PMSs itself. The results of this study verified this hypothesis. For instance, although owners or managers of construction SMEs think that external factors have significant effects on their enterprises, the results of other performance measurement-related studies conducted for larger companies have opposite results. Consequently, the preferences and perspectives of the managers of construction SMEs should be revealed to develop a PMS specific to construction SMEs.

This study provides vital contributions to the literature. The applicability of BSC is in question due to the complexity of the BSC. However, this study develops a faster and more flexible PMS based on BSC by identifying the most significant KPIs and using the strategic dimensions. Therefore, owners and/or managers of construction SMEs who want to improve the performance of their enterprises can use the KPIs proposed in this study. Besides, they can develop a strategic map for their organizations by utilizing the findings of this study and revise their managerial processes to ensure that strategic objectives are met.

Although the validation is a substantial part of studies that used an MCDM approach, the validation of the findings of this study was not performed. However, to run this study, two different research methods, namely questionnaires and focus group discussions, were used with two separate groups. Similarities between the obtained results and the past studies are observed, which can be considered as a support for the findings of this study. In addition, one purpose of this study was to increase the practical application of BSC in SMEs. However, to improve the reliability of this study, a validation session should be conducted, which is also

planned as a case study in the future. On the other hand, the participants of the questionnaire survey and focus group discussions are all located in Turkey so that the results derived from their judgements are likely to be affected by their experience in the Turkish CI. Thus, although the list of KPIs can be considered generic, the ranking of the KPIs may change concerning a different group of participants experienced in other countries. For instance, as elaborated above, external KPIs related to macroeconomic conditions were given top priority by the participants. The fluctuating economic conditions of Turkey can be one of the reasons for this conclusion, however, in a more stable economy, the macroeconomic conditions can be considered uncritical. Contrarily, although environment related KPIs are considered among the least important KPIs, in a country where stricter environmental regulations are applied, these indicators can be ranked at the top level. Thus, the performance measurement framework proposed in this study should be perceived as a generic framework so that minimal modifications might be necessary based on the needs and conditions of a country.

In this study, the fuzzy VIKOR was selected due to its aforementioned benefits. However, in performance management literature, the effects of MCDM methods over the ranks of KPIs were not thoroughly investigated. However, there is a possibility that the ranks of the KPIs can vary among different MCDM methods. Consequently, the forthcoming studies should investigate this issue. Another essential step for improving the developed PMS is to determine how to measure KPIs within the system. For this purpose, future studies can promote a performance index based on the findings of this study. Furthermore, the differences between various industries can also be investigated to reveal how the characteristics of the industries affect the preferences of the managers on performance measurement in these industries.

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