Determining Criticality of Performance Indicators for a Construction Company

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Abstract. Because of stiff competition in the construction business, it is necessary for construction companies to measure their performance on a regular interval for long-term survival. Therefore, it is imperative for construction companies to determine the parameters critical to the measurement of their performance. This study identifies the performance indicators, financial as well as non-financial, for construction companies to measure their performance. In a previous study, the authors identified a total of 20 performance attributes and applied principal component analysis which extracted six components called performance indicators. These performance indicators are profitability and asset management; key stakeholders' satisfaction; time and cost predictability; environment, health, and safety; quality consciousness; and employee turnover. The present study utilized structural equation modelling (SEM) to determine the criticality of these performance indicators for which a questionnaire survey and structured interview approach were adopted. A total of 106 responses were collected from 90 different construction companies operating in various parts of India. The findings indicate that 'quality consciousness' is the most critical performance indicator whereas the 'employee turnover' is the least critical performance indicator in measuring the performance of a construction company. The performance indicators obtained from this study may help construction companies to measure and compare their performances with their competitors and setting out a strategy to remain competitive in the market.

Keywords: Performance attributes · Performance indicators · Questionnaire survey · Principal component analysis · Construction company

1 Introduction

Performance measurement has been considered fundamental to management planning and control by both academicians and practitioners and hence gained more attention from many researchers (Tsolas 2011). According to Kagioglu *et al.* (2001), it is defined as the process of evaluating how successfully the companies or individuals have been achieving their strategies and objectives. Performance measurement helps the construction companies to concentrate on their long-term strategic view, objectives, and optimization of their operations in the companies.

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To measure the performance of the construction companies, the companies must first identify the appropriate key performance indicators (KPIs). According to Cox *et al.* (2003), "performance indicators can be defined either by quantitative measures ($/unit) or qualitative measures such as worker behaviour on the job". It helps top-level management to watch the performance of the corporate or department in one place. The identification of KPIs is the commencement in developing a correct framework for measurement of a construction company's performance (Lin *et al.* 2011).

Traditionally, performances of the companies were measured in financial terms such as turnover, profit, sales per employee, return on investment, etc. which has been criticized (Love and Holt 2000). It has also been found that financial parameters measure only the short-term performance of the company and ignores the issues related to the long-term sustainability of the company (Kaplan and Norton 1996). The traditional financial measures of performance do not reflect the need of stakeholders, fail to provide information about what customers are getting against what they really wanted and do not identify the performance of the competitors (Isik 2009). Hence, construction companies should use the performance indicators, both financial as well as non-financial to evaluate and compare their performances with others which will enhance the effectiveness and efficiency of the company.

Performance measurement of any construction company in terms of their failure or success is very complex because of the participation of various stakeholders like the clients, project management consultants, contractors, and public etc. For a given company, the objectives of all the stakeholders need not be the same. For one stakeholder, the parameter for measuring the performance of a company may be high profit while for the other stakeholder, it can be client satisfaction. Hence defining the performance in terms of failure or success without defining the objectives of the various stakeholders involved has no meaning (Tripathi and Jha 2018a).

In the present study, the factors based on which the performance of a construction company can be measured, have been described. Researchers have identified various performance indicators for measuring the performance of a construction company. But their research works are basically project specific and in the context of developed countries which may not be applicable in the performance measurement of construction companies in other countries. Very few of them have focused on the performance indicators of construction companies working in developing countries like India (Tripathi and Jha 2018a). Moreover, the performance of projects and the construction companies were measured mainly based on cost, time, and quality achieved on those projects whereas, the performance relative to these three parameters is influenced by some other parameters like environment, health, and safety (EHS), productivity of the employees, and key stakeholders' satisfaction etc. This study attempts to identify all such parameters which measure the performance of a construction company.

2 Literature Review

The purpose of the current study is to determine those indicators that are critical for the measurement of construction company's performance. Very limited studies are available in the literature in this area. These are briefly discussed below.

Mbugua *et al.* (1999) developed a framework which will develop the information and hence give improved construction performance grounded on financial (liquidity, profit, potency etc.) and non-financial (leadership, customer's satisfaction, impact on society, learning and growth, quality etc.) measures. Cox *et al.* (2003) established a correlation between quantitative and qualitative performance measurement parameters to identify the most extensively used parameter. They found that quality control, timely completion, cost, safety, etc. are the extremely vital indicators for the construction profession. But they neither incorporated company level indicators like the company's financial standing, market condition, relationship with external agencies etc. nor evaluated its efficiency.

Bassioni *et al.* (2004, 2005) proposed a theoretical framework employing a balanced scorecard and business excellence model to evaluate the business performance of construction companies. They divided the framework into performance driving factors (resource management, leadership, strategic management, capital management, risk management, work culture, etc.) and performance results factors (people, partnership and supplier results, project results, customer and society results, organizational business results, etc.). Elyamany *et al.* (2007) developed a performance measurement model based on the financial ratios along with economic and trade factors and concluded that the company with higher financial performance index had better performance. Balatbat *et al.* (2010) measured the performance of Australian publicly listed company with other listed companies in Australia using profitability ratio, market performance, and equity analysis and performance ratio.

Luu *et al.* (2008) performed the strengths, weaknesses, opportunities, and threat (SWOT) analysis to judge the strategic performance of huge contractors in Vietnam. The KPIs known were from four perspectives: money, customer, internal method, and learning and growth. Chan (2009) developed a scientific performance measuring framework for the Malaysian industry to watch their progress towards achieving the goals commenced within the industry master plan 2006–2015. The performance measures known were identical to the ones known by Luu et al. (2008). Tsolas (2011) integrated the data envelopment analysis (DEA) and the ratio analysis while developing a framework to gauge the performance of the construction companies with regards to profit and effectiveness of the construction companies listed on the Athens Exchange.

Ali *et al.* (2013) used 47 indicators for performance evaluation of construction companies in Saudi Arabia via relative importance index (RII). Profitability, cash flow, service and work quality, financial stability, market share, growth, customer satisfaction, safety, business efficiency, and effectiveness of planning were the highest 10 KPIs. Hassaan *et al.* (2013) applied the analytical hierarchy process (AHP) along with a fuzzy set theory for performance evaluation of contractors on 34 quantitative and qualitative criteria during an award of tender in Egypt. According to the respondents, the financial stability and past performance were the foremost significant measures for contractor selection.

The literature review reveals that various frameworks/models were developed by researchers to gauge the performance of construction companies. Most of the researchers administered the research focused on a specific country, however, none of them have administered the research for India. In most of the studies, only contractors were considered by the researchers, but this study has thought about the opinions of

other stakeholders such as the clients and project management consultants along with the contractors. This study also attempts to include all possible performance evaluation parameters pertinent to a construction company. Hence, authors have attempted to fill the gaps in the previous studies with the help of the current study.

3 Research Method

The research method contains a total of four steps. The first two steps were carried out by the authors in their previous study and the remaining two steps are pertaining to the present study. These are described in detail in the subsequent steps.

Step 1: Identification of Performance Attributes and Data Collection
Twenty attributes were extracted from the literature to measure the performance of a construction company. Table 1 shows the list of these attributes along with their sources. Based on the attributes identified, a questionnaire was designed. A five-point Likert scale was used to measure the degree of importance of these attributes in measuring the performance of a construction company. In the Likert scale, the degree of importance of performance attributes ranges from 1 (very low importance) to 5 (very high importance).

A total of 106 completed questionnaires were received from 90 different construction companies. Out of 106 questionnaires, 29 questionnaires were collected via email and 77 questionnaires via personal meeting. The average experience of the respondents was 20 years whereas the average experience of the companies participated in the survey was 21 years.

Table 1. List of performance attributes and their sources

Sl. no.	Performance attributes with id	Sources
1	Size of the organization (PA-1)	Mbugua et al. (1999), Chan (2009)
2	The productivity of employees (PA-2)	Mbugua et al. (1999), Cox et al. (2003), Chan (2009)
3	Good track record of timely completion of the projects (PA-3)	Luu et al. (2008), Skibniewski and Ghosh (2009)
4	Health and safety consciousness (PA-4)	Cox et al. (2003), Chan (2009), Luu et al. (2008)
5	Customer satisfaction in terms of product and services (PA-5)	Rimbalova and Vilcekova (2013), Menches and Hanna (2006)
6	Client satisfaction in terms of product and services (PA-6)	Chan (2009), Skibniewski and Ghosh (2009), Nemcova-Zunana (2009)
7	Cost performance of projects (PA-7)	Menches and Hanna (2006), Bassioni et al. (2004)

(*continued*)

Table 1. (*continued*)

Sl. no.	Performance attributes with id	Sources
8	Impact on society (PA-8)	Mbugua et al. (1999), Nemcova-Zunana (2009)
9	Impact on the environment (PA-9)	Rimbalova and Vilcekova (2013), Nemcova-Zunana (2009)
10	Optimum liquidity ratio (PA-10)	Elyamany et al. (2007), Balatbat et al. (2010)
11	Higher profitability ratio (PA-11)	Skibniewski and Ghosh (2009), Horta et al. (2010)
12	The higher annual growth rate of the organization (PA-12)	Chan (2009), Luu et al. (2008), Horta et al. (2010), Yu et al. (2007)
13	Predictability of cost in construction (PA-13)	Rimbalova and Vilcekova (2013), Chan (2009)
14	Predictability of time in construction (PA-14)	Nemcova-Zunana (2009), Bassioni et al. (2004)
15	Rework or defect rectification (PA-15)	Menches and Hanna (2006), Kagioglou et al. (2001)
16	Adopting learning and growth culture in the organization (PA-16)	Mbugua et al. (1999), Chan (2009), Luu et al. (2008)
17	Higher wages of the employees (PA-17)	Rimbalova and Vilcekova (2013), Nemcova-Zunana (2009)
18	Employee turnover (PA-18)	Chan (2009), Rimbalova and Vilcekova (2013)
19	A good relationship with the client (PA-19)	Mbugua et al. (1999), Menches and Hanna (2006)
20	Annual construction demand/market share (PA-20)	Chan (2009), Luu et al. (2008), Yu et al. (2007)

Step 2: Identification of Performance Indicators

Performance attributes identified in Step 1 were grouped into six components, called performance indicators when subjected to principal component analysis. The output of the principal component analysis indicated that the Kaiser Meyer Olkin (KMO) value was 0.793 (>0.05) indicating sample adequacy for principal component analysis. The result of the principal component analysis is shown in Table 2. 1. These indicators are profitability and asset management (PI-1), key stakeholders' satisfaction (PI-2), time and cost predictability (PI-3), environment, health, and safety (PI-4), quality consciousness (PI-5), and employee turnover (PI-6) as shown in Table 2 (Adapted from Tripathi and Jha 2018a). The total variance explained by all the indicators accounts for 67.448%.

Table 2. Results of the principal component analysis

Sl. no.	Performance indicators with variance (%)	Performance attributes with factor loading
1	PI-1 Profitability and asset management (13.893%)	PA-12 The higher annual growth rate (0.801)
		PA-11 Higher profitability ratio (0.742)
		PA-10 Optimum liquidity ratio (0.637)
		PA-2 The productivity of employees (0.609)
2	PI-2 Key stakeholders' satisfaction (12.688%)	PA-5 Customer satisfaction (0.830)
		PA-6 Client satisfaction (0.816)
3	PI-3 Time and cost predictability (11.698%)	PA-13 Predictability of cost in construction (0.876)
		PA-14 Predictability of time in construction (0.862)
4	PI-4 Environment, health, and safety (11.161%)	PA-9 Impact on the environment (0.806)
		PA-4 Health and safety consciousness (0.734)
5	PI-5 Quality consciousness (10.581%)	PA-15 Rework or defect rectification (0.769)
		PA-16 Adopting learning and growth culture (0.719)
		PA-20 Annual construction demand/market share (0.525)
6	PI-6 Employee turnover (7.427%)	PA-18 Employee turnover (0.673)

Reliability Test

To ensure the internal consistency within the attributes grouped under components and reliability of the data, Cronbach's alpha (Cα) reliability test was performed using statistical package for social science (SPSS) version 21. The Cα value ranges between 0 and 1. A higher Cα value points towards the greater internal consistency and vice versa. As per Tripathi and Jha 2018b, a Cα value greater than 0.7 is acceptable. In this study, the Cα value is 0.844, which shows a good overall internal consistency among the attributes. Hence, the attributes grouped under the individual performance indicators were considered reliable for further analysis (Chan *et al.* 2014).

Step 3: Development of a Hypothesized Model

After grouping of the performance attributes, a hypothesized SEM model was proposed to test the relationship between performance indicators and performance of a company as shown in Fig. 1.

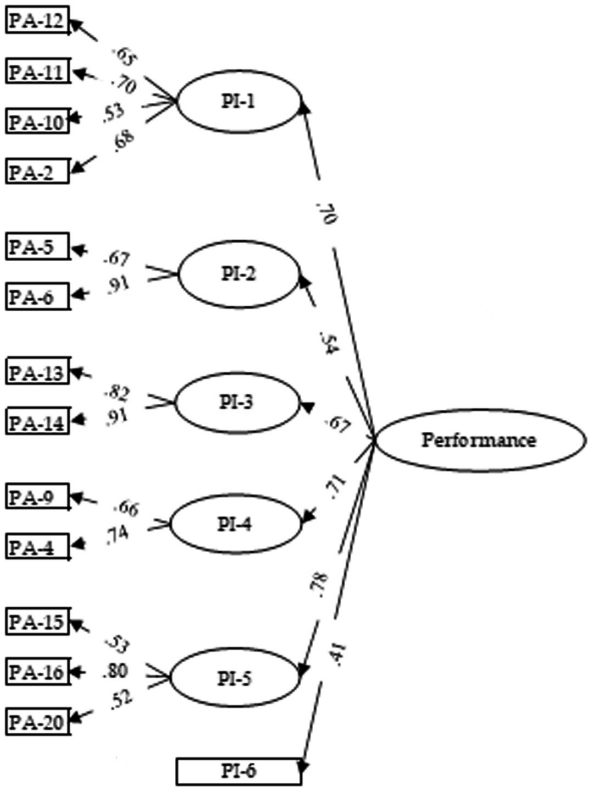

Fig. 1. Hypothesized and final model

Based on the model proposed, the hypothesis that performance indicators measure the construction company's performance was tested as follows:

1. Null hypothesis (H0): Path coefficient between performance indicators and the construction company's performance is not significantly different from zero.
2. Alternate hypothesis (Ha): Performance indicators measure the performance of a construction company.

Step 4: Validation of the Hypothesized Model

The adequacy of the SEM model is established by assessing the results of the covariance structural analysis, which is shown by the various goodness-of-fit (GOF) indices suggested by different researchers. If the model is not adequate to interpret, it needs to be revised. Different GOF indices evaluate the adequacy of a model from different aspects. From the many GOF indices available within the SEM literature, following GOF indices were proposed in this study for validating the hypothesized model (Tripathi and Jha 2018b).

(1) The ratio of chi-square ($\chi 2$) to the degree of freedom (df), (2) Incremental fit index (IFI), (3) Tucker-Lewis index (TLI), (4) Comparative fit index (CFI), and (5) The root-mean-square error of approximation (RMSEA).

The recommended level of these indices is given in Table 3 (Tripathi and Jha 2018b). The hypothesized model was analysed using an analysis of moment structure (AMOS) version 21.

Table 3. GOF measures (Adapted from Tripathi and Jha 2018b)

Sl. no.	The goodness of fit (GOF) indices	Recommended level of GOF indices	Values of GOF indices obtained in the final model
1	Chi-square/degree of freedom ($\chi 2$/df)	1 to 2	1.171
2	Incremental fit index (IFI)	0 (no fit) −1 (perfect fit)	0.969
3	Tucker-Lewis index (TLI)	0 (no fit) −1 (perfect fit)	0.952
4	Comparative fit index (CFI)	0 (no fit) −1 (perfect fit)	0.967
5	Root mean square error of approximation (RMSEA)	<0.05 (very good) - 0.1 (threshold)	0.041

Table 3 shows the GOF indices of the hypothesized SEM model. The values of GOF indices indicate that the hypothesized SEM model was adequate to explain the interrelationships between performance indicators and the construction company's performance. Hence, the hypothesized SEM model was not revised and was acceptable for interpretation.

All the standardized path coefficients shown on the arrow lines in the Fig. 1 were positive and statistically significant which indicate that there is a relationship between the construction company's performance and performance indicators. The larger path coefficient indicates that the attributes or indicators are more critical for measuring the construction company's performance. Accordingly, 'quality consciousness' emerged as the most critical performance indicator whereas the 'employee turnover' emerged as the least important performance indicator. The hypothesis H1, which assumes that the performance indicators measure the performance of the construction company is found to be supported because the path coefficients were significant at the 0.05 significance level.

4 Result and Discussion

The results of the study reveal that the quality consciousness (PI-5) is the most critical performance indicator with a path coefficient of 0.78. Quality consciousness is an important area for good quality construction and its integration in the company. Nowadays, clients are more worried about the quality rather than the cost. Also,

correcting a work of poor quality involves an investment of time and money and creates an obstruction in the construction. Hence, quality consciousness is considered as a significant indicator for the measurement of the performance of a construction company. Construction companies can increase their market by enhancing client satisfaction with a superior product.

Environment, health, and safety (PI-4) is the second most critical performance indicator with a path coefficient of 0.71. It must be an environmental responsibility for both an individual as well as the company. Much of the earth's resources are controlled by the construction companies which diminish environmental nuisance. In addition, the cost of construction can also be reduced by environment-friendly construction using energy-efficient construction materials and techniques. Inefficient health and safety management on construction sites results in the loss of life and wastage of construction materials and hence increases the associated costs. Therefore, construction companies must be held responsible for the society as well as the environment because they interfere in various areas of our life.

Profitability and asset management (PI-1) received a path coefficient of 0.70 and was placed in the third position. Asset management can be defined as the technique of managing assets for the companies through cash, bonds, and stocks. A company's performance is gauged by the profitability and assets of the company. Profitability is one of the most significant parameters for measuring the performance of a construction company (Yu *et al.* 2007).

Time and cost predictability (PI-3) received a path coefficient of 0.67 and was placed in the fourth position. Predictability is very important for any construction company because it psychologically influences client. If clients are confident that their project will be handed over by the company within the cost and within the scheduled time, then it is most likely that they can deal with the company. The lack of predictability in the company negatively influences the clients and reduces the chances of doing business with the company. Therefore, all companies must possess predictability otherwise its number of clients will decrease affecting its overall profits.

Key stakeholders' satisfaction (PI-2) received a path coefficient of 0.54 and was placed in the fifth position. Key stakeholders' satisfaction is a significant indicator for measuring the construction company performance. Client satisfaction is found to be fundamental to the success of the business. Construction companies always attempt to maximize the Key stakeholders' satisfaction through good quality of products and services rendered by them. They manage their resources in such a way that their client's objectives are achieved to have repeat business.

Employees turnover (PI-6) was placed at the last position with a very low path coefficient of 0.41. It is expressed as the percentage of the staff leaving the company for one year. For any company, the objective should be to have employee turnover as low as possible to maintain a consistent workforce and to grow more skilled staff. High employee turnover results in higher cost to the company because additional time and resources are required to fill the vacant position and to train a new employee. Low employee turnover permits the company to concentrate on its business rather than preparing the new employee, adapting them to the company's needs. Therefore, low employee turnover is an indicator of the company performing well in the industry.

The above results show that the respondents have given more weight to the performance indicators 'quality consciousness' and 'environment, health, and safety' when compared to the performance indicator 'profitability and asset management'. It indicates that the construction companies apprehend that the traditional financial parameters are no longer a comprehensive measure of company performance. The insufficiency of the traditional financial performance indicators has drawn the attention of construction companies in non-financial performance indicators. Several construction companies have a long-term strategy that focuses on the satisfaction of the stakeholders, good quality of the work, time and cost predictability etc. Hence, the company performance from the perspective of their key stakeholders has become a priority for construction companies.

The results of this study recommend that these indicators could be considered as a yardstick for the Indian construction companies while measuring their performance with their competitors. Most of these indicators are the prerequisite of the award of the tender. Clients prefer the above criteria to be satisfied by the construction companies to decrease the risk of budget and time overruns, low-quality work and workmanship and so forth. Construction companies can enhance their performance by meeting these criteria and increase the chances of getting increased business despite the competition in the market.

5 Conclusion

This study tries to find performance indicators that can measure the performance of the construction companies executing real estate projects. This study utilised a questionnaire survey and an SEM approach to analyse the causal relationship between performance indicators and company's performance. The results enable a construction company to understand and formulate a strategy to perform well with their competitors. The SEM supports the hypothesized positive relationships between performance indicators and the performance of a construction company with very strong path coefficients at the significance level of 0.05.

The SEM model reveals that the quality consciousness (PI-5) is the most critical indicator for the measurement of construction company's performance followed by environment, health, and safety (PI-4), profitability and asset management (PI-1), time and cost predictability (PI-3), key stakeholders' satisfaction (PI-2), and employees turnover (PI-6). Due to rapid changes and challenges in the construction business, the traditional parameters of performance measurement may not be enough in developing adequate results for the various stakeholders. It has been found that high financial performance is essential but not enough for satisfactory performance of a company. All these indicators contribute to enhancing the performance of a construction company leading to sustainable growth. The probability of getting the increased business of a construction company will increase if proper attention is drawn towards improvement in these areas. The clients select a construction company which fulfils the above criteria to ensure enhanced value for money and overall satisfactory results in construction.

The scope of this study was limited to the construction companies associated only with the real estate business operating in India. Hence, the result of this study may or

may not be applicable to the construction companies in other countries. However, despite various limitations, this study may be beneficial for neighboring countries like Bangladesh, Nepal, Sri Lanka, Pakistan, Afghanistan etc. and other developing countries because of resemblance in working conditions.

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