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AN EFFECTIVE APPROACH OF PERFORMANCE MEASUREMENT SYSTEMS (PMS) FOR ADOPTION IN CONSTRUCTION PROJECTS

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Abstract

Performance measurement systems (PMS) is vital for the purposed of improving the project's performance throughout the life cycle of the project. Performance measurement refers to the indicator used to assess the performance of an organisation or a project. A proper PMS is necessary to help the organisation in measuring the performance of a project to achieve value for money (VFM). However, ineffective PMS has been identified as one of the contributing factors associated with poor project performance. Obviously, the absence of an effective PMS in construction projects acts as a trigger for not producing an optimal service quality and performance. Therefore, this paper aims to investigate the types of performance measurement systems commonly used in the Malaysian construction industry. Thus, almost all popular PMSs has been reviewed. Besides, it also attempts to investigate an effective PMS to be adopted for measuring performance in construction projects. It extends to explore the strengths and weaknesses of previous established measurement models, specific techniques and indicators for research justification. The results will be benefited to suggest an effective approach of PMS for the construction project's implementation in accordance to the projects nature and characteristics.

Keywords: Construction Project, Performance, Performance measurement system.

1. Introduction

In the time of globalisation with an increasingly competitive environment, measuring performance has become critical to business and project success. Business and Project success refers to an effective management that depends on the effective measurement of performance and results. However, performance measurement traditionally only focuses on the reasons that explain success or failure from a historical perspective. Although performance measurements have long been used in many industries (i.e., manufacturing, construction, oil & gas, etc.), however, it still received criticism and attention to improve and monitor work performance [1].

Recently, the performance measurement has been realised and implemented in one of the popular industries; that is in the construction industry. However, it has long been criticised for its underperformance [2-4]. Low-performance issues such as defects and low quality in a construction project are among the issues debated contributed to low project performance [5, 6]. This repetition of the problems will continue burning the industry and affecting the quality of the project [6]. In nature, there are several procurements approach implemented in the construction industry that depends on different nature and characteristic of the projects. For instance, conventional, a public-private partnership, turnkey projects and etc. These projects have differences implementation especially in terms of process and activities. Therefore, the performance evaluation method will also vary. It is due to the nature of the projects, complexity and uniqueness of the projects, and projects with the involvement of multiple stakeholders. Hence, many researchers place a strong emphasis on the importance of adopting effective performance measurement methods to improve the current performance of the construction industry [7, 8]. Therefore, it is essential to establish the appropriate PMS for the purposed of monitoring and measuring the project's performance to achieve VFM. The establishment of PMS is crucial in determining the level of the project's performance whether it achieved VFM or not.

Therefore, this paper aims to investigate the different types of performance measurement models particularly implemented in the construction industry through relevant literature reviews. One objective was established in line with this aim, namely to identify effective PMS in measuring the performance of construction projects to suit the nature and characteristic of a project. It is to provide valuable insights on ways or methods to enhance the implementation of an effective performance measurement tool for a specific project in the construction industry particularly to the complex projects that involve multiple stakeholders.

2. Performance Measurement System

Performance measurement system (PMS) is defined as a process or a set of metrics used to quantify and report the effectiveness and efficiency of the action performed towards organisations' objectives [9]. Ittner et al. [10] mentioned that PMS provides information that helps a firm to align its management processes, such as target-setting, decision-making and performance evaluation, with the achievement of chosen strategic objectives. It contradicts with Bassioni et al. [11] that PMS is considered as a system to be implemented by construction organisations for internal management but not an evaluation by clients and stakeholders. However, Love and Holt [12] highlighted that an effective business PMS should enable a construction

company to evaluate and establish its position with respect to the business environment, indicating the principal role of PMS within a construction organisation. Therefore, for this research context, PMS is summarised as the process used to measure the effectiveness and efficiency of action performed in line with the organisation's core business, goals and objectives through performance evaluations. According to Leong and Tilley [13], without the use of appropriate PMS, it becomes difficult for organisations to understand why poor performance continues, or how improvement could be achieved.

2.1. Previous studies on Performance Measurement System

The earliest implementation of performance measurement was started from Business Intelligent to achieve business success [14]. The evolution of the performance measurement has spread to various industries, including the construction industry. The implementation of a systematic way of measuring this performance can influence many construction companies, general government, public and private clients and other project stakeholders. Most PMS in construction focus on project-based, specifically the productivity issue in project management [15], and criteria and factors for the success of the projects [16, 17].

PMS is a diverse research field in construction, and can be generalised into three main purposes, namely; industry purpose, business purpose, and project purpose [18]. Industry purpose is functioned as to assess the performance of the industry, both nationally and internationally [18]. While the business purpose is functioned as to measure the performance of the construction organisation, including both one-time evaluation and continuous measurement [2, 11, 12, 19]. Lastly, project purpose is functioned as to evaluate the performance and success of construction projects [16, 20]. In the context of this research, the construction project is the main focus of investigation in identifying the appropriate of PMS in determining the performance level of a project performance according to the nature and characteristic of the projects.

2.2. Performance Measurement Systems in Construction Industry

The process of measuring performance is usually determined by the metric of a number of indicators, which includes both financial and non-financial indicators [21]. The use of the performance measurement is to judge the project performance, both financial and non-financial aspects, and to compare the performances with others, in order to improve the programme efficiency and the effectiveness of the organisations or projects. In general, there is a lot of research has been conducted on performance measurement. However, only a few studies were reported on PMS specifically in the construction industry. The research on PMS particularly in the construction industry had been initiated since 1989. The construction industry is important for the growth of any nation. In line with Palani [22], the construction industry is enclosed by a variety of challenges together with sub-standard quality, information scarcity, inappropriate contracts, poor planning and lack of vision by the whole industry.

As a result, five types of performance measurement models have been identified that popularly used to measure performance in construction projects, namely; the Balance Scorecard (BSC), the European Foundation Quality Management (EFQM), the Performance PRISM, the Key Performance Indicators (KPIs), and the

Malcolm Baldridge for Performance Excellence (MBNQA). These identified models were listed in Table 1.

Table 1 explains several types of performance measurement models used in measuring the performance, particularly in the construction industry. This investigation on each PMS were then divided into two main variables, namely; (1) level of performance, and (2) objectives. This is essential to highlight the different in purposes and level of performance implemented for each type of model. In construction, performance measurement was initially conducted within the project level. Although a lot of researches have been conducted on the organizational level, however, this research tends to focus on the project level, since the success of a project depends on the performance of the project in achieving VFM.

Table 1. PMS implemented in construction industry.

Authors	Types of Performance Measurement Model	Levels of Performance	Objective
Bassioni et al. [11], Kaplan and Norton [23] and Alsulamy et al. [24]	**Balance Score Card (BSC)**	Organisational Projects	Design a conceptual framework for construction firms
Bassioni et al. [11], Yong [21], Alsulamy et al. [24], European Foundation for Quality Management (EFQM) [25] and Watson and Seng [26]	**European Foundation Quality Management (EFQM)**	Organisational	Design a holistic and conceptual framework for construction firms. Framework to evaluate the company for European Quality Award (EQA)
Neely et. al. [9] and Striteska and Spickova [27]	**The Performance PRISM**	Organisational Projects (Stakeholders)	A comprehensive system that views from different stakeholders
Eagan [7], Alsulamy et al. [24], Haponava and Al-jibouri [28]	**Key Performance Indicators (KPIs)**	Organisational Projects Stakeholders	Review key facets of PMS to design a new one.
Alsulamy et al. [24]	**Malcolm Baldridge for Performance Excellence (MBNQA)**	Organisational	Develop a tool to measure the firm service quality.

Majority of the models tend to measure the performance at the project's level. However, KPIs and Performance PRISM has the advantage of measuring performance at stakeholders' level. In construction, the performance can be evaluated through the organisational, projects and stakeholders' level. Principally, the assessment is made according to the type of contracts and the complexity of the project. It is due to the involvement of different contracting parties dealing with the projects. It shows that the relationship between different contracting parties in the construction industry is complicated as it involves multiple projects' stakeholders. Besides, these PMS views that the involvement of multiple stakeholders will contribute to the performance of an organisation or a project. Therefore, the selection of an appropriate PMS is crucial to measure the performance to suits the project's nature and characteristics.

3. Synthesis of Construction Key Performance Measurement Models

A literature review on the existing performance measurement models in Table 2 is adopted from various types of performance measurement that implemented in the construction industry. Those are the BSC, EFQM, MBNQA, the Performance

PRISM, and KPIs. A comparative study of various models was conducted according to six identified variables, namely; levels of performance, who is being measured, parameters or indicators, strengths, weaknesses and gaps identified. The discussion is in section 3.1 to 3.4.

3.1. Balance Score Card (BSC)

Kaplan and Norton [23] developed the BSC in the early 1990s and had been applied to almost all industries including the construction industry, either public or private sector [29]. This system is used to describe, implement, and manage strategies at all levels in an organisation. BSC focuses on four performance metrics or indicators, such as financial, customer, internal process, as well as learning and growth metrics. The project manager can track the progress of work execution and identify the tasks that are behind schedule [30]. It provides a more comprehensive overview of the project compared to the traditional system. However, there is an absence of interest among stakeholders to apply the BSC model in measuring performance [30]. It happens due to the deficiency of long-term commitment and leadership in management. da Silva Pessanha and Prochnik [30] added that BSC is only a conceptual model and it is very difficult to be implemented without a previous thorough practical experience. According to Hermawan et al. [31] the findings contradicted, that, the BSC can measure the performance from multi domain perspective of project management which used to support any stakeholders to manage and improve quality of the projects.

The BSC model is a widely accepted framework, and it was constructed to complement measures of past performance with measures of the drivers of future performance [32]. It links an organisation's strategy through a series of perspectives to KPIs [33]. According to Fraser and Kelly [34], the developed BSC by Kaplan and Norton [23] is more focused on strategy and vision rather than control. As argued by Alsulamy et al. [24], it could be difficult and confusing to integrate with the BSC's strategic and operational level measures. Nonetheless, the lack of social and environmental issues in the BSC model perceived as a gap identified in the model. Therefore, it becomes difficult to be adopted when it involves measuring the project output.

3.2. European foundation for quality management (EFQM) and Malcolm Baldrige national quality award (MBNQA).

EFQM and MBNQA are the most utilised models in the United States and Japan. These models are developed with similar characteristics according to quality-based performance excellence models [14, 24, 26, 34] The EFQM Excellence Model is a non-prescriptive system, proposed to help organisations for assessing their progress towards excellence and for continuous improvement [26]. Meanwhile, MBNQA is developed to improve the organisational competitiveness that focuses on the outcomes of the customers' satisfaction and organisations' performance [24].

The EFQM Excellence Model is a non-prescriptive framework that measures nine fundamental concepts of excellence to assess an organisation's progress towards excellence. This model proves that many approaches can be made to achieve sustainable excellence in all aspects of performance. Therefore, the key strength of this model is to focus on the sense of quality where it can be assessed using a self-assessment approach. However, there are a few limitations reported on

this model such as there is no relation among indicators, therefore it does not fit for a strategic implementation.

Table 2. Implementation of Performance Measurement Models in the Construction Industry

Types of Performance Measurement	*Balance Score Card (BSC)* *Alsulamy et al., (2012); Bassioni et al., (2004); Kaplan & Norton (1992)*	*European Foundation Quality Management (EFQM)* *Alsulamy et al., (2012); Bassioni et al., (2004); Watson & Seng, (2001); EFQM (2003), Dong Y.K (2010)*	*Malcolm Baldridge for Performance Excellence (MBNQA)* *Alsulamy et al., (2012)*
Level of Performance	Organisational Projects	Organisational	Organisational
Who is Being Measured	Companies, Projects, Stakeholders	People, Employees (Companies)	People, Employees (Companies)
Parameters / Indicators	Financial, Customers, the Internal Process and Learning & Growth.	People development and involvement, customer focus, continuous learning, innovation and improvement, leadership and constancy of purpose, partnership development, management by process and facts, public responsibility.	Leadership, Information and analysis, Strategic planning, Human resource, Quality of products and deliverable service, Business results and customer satisfaction.
Strength	1. Clarity of vision and strategy adopted. 2. Consistent monitoring of strategy 3. Concentration on strategic 4. Cross disciplinary and hierarchy traversing communication process 5. Integration of performance measures for operational objectives at an appropriate level 6. Cause/effect relationships as an instrument for management	1. Systematic and non-prescription model. 2. Using of self-assessment approach to organisation excellence. 3. Strengthen the sense of quality. 4. Recognition of strong and weakness points of organisation. 5. Consist of a criteria hierarchy. 6. Allow shortlist of indicators based on "Good example" of practice. 7. Creating conditions for comparative analysis of business processes with external business. 8. Feedback from results helps to improve enablers.	1. Focuses on the outcomes of customer satisfaction and organisation performance.
Weakness	1. Does not express the interest of all stakeholders. 2. Lack of long term commitment and leadership for management. 3. Too many / few metrics - development of unattainable metrics. 4. Lack of employee awareness or a failure to communicate information to all employees. 5. Constructed as a controlling tool rather than an improvement tool.	1. No focus / priorities - no links. 2 Criteria are not specific within the company. 3. Is not a strategic management tool (systematic setting and achieving goals) - therefore, is not an instrument for strategy implementation. 4. Not suitable for enterprise communication 5. Tendency to bureaucracy. 6. Did not give guideline how to design and conduct effective performance measurement.	1. High cost in time and money with financial measures also deemed to be poor. 2. Only gave more attention to leadership and customer satisfaction.
Gaps	Lack of social and environmental issues in the BSC model. Difficult to be adopted when it focuses on project output.	Lack of a strategic direction specifically to focus on process improvement activity.	Only limited to the organisational performance that assists the leader to maintain high performing organisations. Lack of criteria considered for measuring the performance at the project level.

Table 2. Implementation of Performance Measurement Models in the Construction Industry (Cont'd)

Types of Performance Measurement	***The Performance PRISM*** *Neely & Adam (2001, 2002); Striteska & Spickova, (2012)*	***Key Performance Indicators (KPIs)*** *Alsulamy et al., (2012); Haponava & Al-jibouri, (2012);Eagan (1998)*
Level of Performance	Organisational, Projects	Organisational, Projects (different phases)
Who is Being Measured	Stakeholders *(projects)*	Client, Contractor, Management Team, End-Users *(projects)*
Parameters / Indicators	Stakeholder's satisfaction, Strategies, Process, Capabilities, Stakeholder contribution.	Construction cost, Construction time, Predictability-cost, Predictability - time, Defects, Clients satisfaction-product, Clients satisfaction-service.
Strength	1. Reflect new stakeholders. 2. Considers the stakeholders' contribution to performance. 3. Ensures that the performance measures have a strong foundation. 4. Can deals with multiple-stakeholder complexity. 5. It also calls as dynamic process-based performance measurement can provide the impetus.	1. KPIs is competent in highlighting organisation and project weakness. 2. KPIs can link employee rewards and sanctions to performance measured against the standard established. 3. Overall concept is easily understood and easily implemented. 4. KPIs are available as the project progresses and be able to see the performance level on the particular phase. 5. KPIs are proven as the most reliable and accurate tool in monitoring performance. 6. KPIs focus the improvement efforts on related issues critical to the success of a particular project or organisation. 7. KPIs provide an assurance that the best value is being achieved. 8. Key performance indicators can be used to identify the strength and weakness of projects partnership, and they are useful tools for effective project performance management. 9. KPI beneficial to be used as a project-phased base KPI.
Weakness	1. Offers little about how the performance measures are going to be implemented. 2. Some measures are not effective in practice. 3. Short of logic among the measures, the insufficient link between the results and drivers.	1. KPI being non-comprehensive and focusing more on the project rather than organisational performance. 2. KPI not give insight into the means of improving performance and therefore have limited use for internal management decision making.
Gaps	The Performance Prism tends to neglect issues such as how the performance measures are going to be realized, hence, lack of concentration is given to the processes of designing the system. Little application for construction especially at the project level.	KPIs are often used at the project level in different project phases. However, there is lack of a study conducted on the implementation of KPIs in measuring project performance at the operational phase. Besides, Decision-making approaches can be integrated with the development of KPIs to improve effectiveness in measuring performance and assist organisations in making decisions.

In contrast to EFQM, MBNQA mainly focuses on the outcomes of the customers' satisfaction and organisations' performance using six indicators [24]. However higher weightage is given to the business results and customers' satisfaction, human resources, and process management factors. Despite having the strength of the customers' satisfaction and organisations' performance, it still lacks in a certain factor. Both of these models have no strategic direction and specific criteria, especially to improve the processes and activities.

3.3. The performance PRISM

Performance PRISM is a more comprehensive measurement system. It addresses the business issues of organisations. The Performance PRISM is a comprehensive system that considers the views of different stakeholders (e.g., investors, customers, employees, regulators, and suppliers). This model was developed by Neely et al. [9] to measure the performance, namely, stakeholders' satisfaction, strategies, processes, capabilities, and stakeholder contributions. It also considers the stakeholder contributions towards performance. By considering this dimension, the Performance PRISM can completely capture the satisfactory level of the stakeholders for the success of projects. Liu et al. [35] developed a new Performance PRISM which would resolve the problematic issues in the existing performance evaluation system. For example, ineffective performance measurement for the project's procurement, design and construction and operation and maintenance. Even though many approaches have been proposed by the previous researchers on the improvement of the systems, however, there is insufficient of information on how to implement this model, and some of the dimensions are identified not effective in practice [9, 27]. The performance Prism is more likely to ignore issues such as how achievement measures will be realized. In addition, this model is less focused on system design processes. At the same time, this model has been identified between the less-applied models in measuring performance at the project level.

3.4. Key Performance Indicators (KPIs)

KPIs were established and introduced as one of the performance measurement tools, and it has become the most popular performance measurement metric in the construction sector, particularly after "Rethinking Construction" [10]. KPIs assess the performance of activities deemed as a critical success factor to gain the desired organisational goals. Among the indicators used to assess the project performance are construction cost, construction time, predictability-cost, predictability-time, defects, client satisfaction-product, and client satisfaction-services [7, 24, 28]. Adding into these KPIs does not only score the organisational or project performance; it also detects changed conditions, perceives potential problems, and designates a change from the preliminary strategy of a particular project or organisation. Thus, it can be considered as a useful tool in achieving VFM.

The strengths of utilising KPIs in measuring project performance are being competent in highlighting organisational and project weaknesses, easy to understand, and implemented by multiple stakeholders. Thus, KPIs are proven as the most reliable tool in monitoring and measuring performance even though for the complex project that involved multiple stakeholders. An important benefit in adopting KPIs is the ability to identify the strength and weakness of a project's partnership. Furthermore, KPIs was a focus on process and key stakeholders'

expectations throughout the life cycle of projects. It can be achieved at different project phase, namely; project-phase based KPI (procurement, construction, and operation and FM) [35]. Even though, KPI is frequently used at the project level for the different project phase. Despite this, KPIs also have several limitations such as it does not give an insight into the means of improving performance and has limited use for internal management decision making [7, 24, 28]. As initiated by Saaty [36], this limitation can be overcome by integrating the decision-making approach using Analytical Hierarchy Process for enhancing the effectiveness of the KPIs in measuring the performance. Concurrently, the research gap on the implementation of KPIs in measuring project performance, particularly in the operational phase has also been identified.

4. Findings and Discussion

As explained in section 3.1 to 3.4, most of the performance measurement models approach focused on the project level, organisation level, and stakeholder level. To identify an effective performance measurement model that can fulfil the characteristics and nature of the different types of projects is very challenging. Therefore, the selection of an appropriate PMS is vital to ensure the actual performance level of the project can be determined. It is supported by Lantelme and Formoso [37] that the selection of appropriate measures has a major influence on the implementation of strategies and is essential for the continuous development of improvement programmes.

Construction projects are generally complex and unique as they involve various stakeholders. Therefore, the assessment of this project is different in evaluating project processes and activities for each stage of project implementation. Thus, some factors need to be considered in determining effective measurement systems, particularly those that involve different types of procurement where it refers to the nature, characteristic, and complexity of each project. For example; traditional projects; public, private and partnership (PPP); privatisation and turnkey projects. These projects have their own characteristics and uniqueness, as well as process and activities, therefore, measuring the performance of the projects becomes more challenging. It is supported by Bassioni et al. [15] that performance measurement models, in general, indicate that they have one or more of the following shortcomings. For example, determination of performance criteria, determination of relations among the performance criteria, lack of a systematic measurement design, lack of implementation guidelines for performance measurement system in practice, and adaptation of the framework according to the changing environment in the long run.

Table 3 present the appropriate PMS to suit with the types of project. The justification for each types of PMS has been explained in the table. KPIs by Eagan [7], among the models that have been discussed before, appear to be more applicable and effective to be adopted and used in the construction industry and appropriate to the several types of contracts. It is because KPIs have the strength to be one of the effective measurement tools that can be applied for most types of construction projects and can be adopted in a different stage of the projects. Furthermore, the adoption of KPI in measuring the performance can be applied in all three levels, namely: project level, organisational level and stakeholder level. It also can be functioning in monitoring the performance particularly at different project phases. Most important, KPIs can be applied to identify the strengths and

weaknesses in project partnership in achieving the best VFM. The results revealed by Sarhan and Fox [38] that professionals rely heavily on results-based KPIs as opposed to process performance measures. As compare to EFQM, MBNQA and BSC model, these models are the most frequently applied to the organisational level. While, the Performance PRISM are often to measure the performance at the stakeholder's level. Therefore, this study highlights that KPIs offer an effective approach towards completing successful project at different levels and project phases, particularly for performance monitoring and evaluation.

Table 3. Appropriate PMS to suit with the types of projects.

Types of Performance Measurement Model	Mostly suited for		*Justification*
	Type of projects	Level of performance	
Balance Score Card (BSC)	• Conventional project, • Public Private Partnership	• Organisational	Focused on achieving strategic goals. Only focus on management/organisational level rather than the projects.
European Foundation Quality Management (EFQM)	• Conventional project, • Public Private Partnership	• Organisational	More suitable for benchmarking because the model is less focus and unclear criteria of assessment.
The Performance PRISM	• Conventional project, • Public Private Partnership	• Stakeholders	This is the newest model that constructed based on BSC and generally focus on stakeholder's level.
Key Performance Indicators (KPIs)	• Conventional project, • Public Private Partnership • Turnkey project	• Project • Organisational • Stakeholders	Can be used at all level. KPI also can be implemented according to the project-phase-based (procurement, construction, operational). KPI also suitable for out-come based performance.
Malcolm Baldridge For Performance Excellence (MBNQA)	• Conventional project	• Organisational	More suitable for benchmarking because the model is less focus and unclear criteria of assessment.

5. Conclusions

This paper anticipates synthesising various established performance measurement models for effective use in the construction industry. It also intends to investigate the strengths and weaknesses of previously established measurement models, specific techniques, and indicators. It can be concluded that all models have their own strengths and weaknesses. However, KPIs is identified as a more useful model to be implemented due to its uniqueness. Furthermore, it can be tailored for various types of projects at a specific level. Moreover, KPI can be used to measure the performance at different phases of the projects. Based on the findings and discussions of this paper, future researchers or construction practitioners can easily choose appropriate PMS for their further studies to establish a more comprehensive and applicable performance measurement methods for a specific type of projects.

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