EVALUATION OF KEY METRICS FOR MEASUREMENT OF PROJECT PERFORMANCE

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In the construction industry particularly in developing countries, minimal attention has been given to the application of Performance Measurement Systems [PMS], despite being one of the most important factors for assessment of project success. Consequently, there appears to be always a gap between actual results obtained in relation to delivery of major projects and stakeholder expectations. The application of performance measurement systems in the construction sector has tended to rely on three basic criteria: time, cost and quality, which can be applied to determine the extent of project success. At organisational level, performance measurement systems are largely based on financial measures which are almost always lagging indicators. In response to the Egan Report, the UK construction industry developed specific Key Performance Indicators (KPIs) which include construction cost and time, cost predictability and time predictability, defects, client product and service satisfaction, safety, profitability and productivity. The primary aim of this paper is to evaluate the main project and organisational performance metrics including financial and non-financial measures that have been developed in recent years. Lagging indicators focus on past data and offer little or no opportunity for process improvement. Previous research indicates that credible performance metrics should consider all construction project stages alongside stakeholder needs and expectations. In this work, the fundamental requirements for suitable performance metrics are identified. Finally, it is concluded that the shortcomings of current performance measures utilised by the construction industry can be considered as marketing tools as opposed to tools for process improvement.

Keywords: performance measures, performance metrics, performance measurement systems, construction projects, project performance.

INTRODUCTION

The construction industry is an important contributor to the economy despite its unstable nature and uncertain performance (Chan and Chan, 2004). Many previous studies have concluded that poor performance of industry was related to traditional thinking focussing on product and goals only. Realizing the same, the performance measurement focus has been shifted from product-orientation to process-based measurement systems (Haponava and Al-Jibouri, 2010). However, developing such

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systems would require setting the measurable targets and performance indicators throughout project life and across various stakeholders. To achieve the stated goals of efficiency and quality in construction projects, the very concept of performance measurement must be reconsidered (Egan, 1998). This paper describes the performance measurement practices at project, organization and stakeholders' levels followed by critical valuation of various performance measurement models. After highlighting the limitations of current approaches, a new approach has been introduced based on critical success factors and their measurement across projects stages and various stakeholders.

PMS AT PROJECT LEVEL

Performance measurement as a concept can be traced back to 1970s when financial indicators (lagging indicators) were first applied in the accounting sector (Nudurupati *et al.* 2007). In 1973, the traditional performance measurement system was created by Teague and Eilon for three purposes, namely; (a) to achieve goals; (b) to assess, improve and control processes; and (c) to benchmark the performance (Sapri and Pitt, 2005). However, in the 1990s there was a change in the purpose of measuring the performance towards meeting customer satisfaction and quality (Neely *et al.* 2003). Since then, many systems and frameworks have emerged and developed to include non-financial indicators (subjective indicators) such as quality, customer satisfaction and innovation in these systems. On overall basis, the concept of PMS has been improved in three generations; the first generation designed the measures from financial dimensions only; the second generation considered strategies and success factors and deployed them in the process while the third generation linked the financial and non-financial dimensions to the concept of cash flow (Neely *et al.* 2003).

PMS AT ORGANIZATIONAL LEVEL

Performance measurement was applied in local government organizations during early 1980s for 'improving the efficiency and effectiveness of managers and the organization'. Key performance measures included productivity, effectiveness, efficiency, and quality of delivered service reflecting the organisations' aim, environment and priorities (Ghobadian and Ashworth, 1994).

Kagioglou *et al.* (2001) has likened to view such PMS as the data system used to refine various processes in line with organisation's long-term goals. However, Kennerley *et al.* (2002) has suggested that measurement systems must evolve to avert measurement crises. They identified 'process, people, infrastructure and culture' as the main factors affecting the evolution of measurement systems. In line with the evolutionary school of thought, Amaratunga and Baldry (2002) emphasized that PMS should have the capability to: (1) report changes in organisations' external and internal environments; (2) review and redefine the priorities in lieu of changes; (3) update objectives and translate them to key areas in organization; and (4) maintain and improve the deliverables regularly. Hence, performance measurement at organizational level must answer three key questions: 'How well is an organization performing? Is the organization achieving its objectives? How much has the organization improved from a last period?'(Phusavat *et al.* 2009).

PMS AT STAKEHOLDER LEVEL

Construction project success is influenced by a set of factors, for instance project attributes such as size, cost, environment and other, contract and specifications, the relationship and cooperation between stakeholders, qualification of engineers and

teamwork (Cheung *et al.* 2004). As such, there can be two perspectives of PMS: i.e. macro, which considers the overall all project progresses across phases; and micro, which focuses on results of each project phases treating stakeholders and participants as owners and users (Lim and Mohamed, 1999).

From a micro perspective, a construction project is a group of activities involving a number of participants seeking to achieve their objectives within the overall project objectives. Such stakeholders are owners, contractors, consultants, designers, mangers, investors, users, suppliers and sub-contractors (Saqib *et al.* 2008). From their point of view, Performance measurement is *''the measurement and monitoring of the project's performance under the criteria defined by the stakeholders as representative of the project performance dimensions''* (Barclay and Osei-Bryson, 2010). Of these stakeholders, the managers are involved at the key stages of project execution and therefore attain a central position. Beathem *et al.* (2004) has identified seven reasons for performance measurement to be added to the manager's list of priorities, i.e. 1) the dynamic nature of work, 2) increasing competition, 3) specific improvement initiatives, 4) national and global quality awards, 5) changing organizational roles, 6) more enlightened consumers and 7) increased use of information technology in construction industry.

KEY PERFORMANCE MEASUREMENT MODELS

The Balanced Scorecard (BSC)

The balanced scorecard was designed in 1992 by Kaplan and Norton as a new method to measure the performance of organizations through four dimensions of financial, customer, business process, and innovation (leading indicators) with focus on financial measures (lagging indicators). This focus on lagging indicators is the key weaknesses of BSC responsible for many problems in its application in the field. Letza (1996) has stated that this method must be integrated with the participants' goals and general strategies, for affective measurement.

European Foundation Quality Management (EFQM)

EFQM business excellence model was formulated by European Foundation of Quality Management in 1989. Its primary focus remains on the results deemed as project success criteria, while organizational characteristics are taken within the critical success factors (Westerveld, 2003). The EFQM model uses nine fundamental concepts of excellence based on the continuous improvement. These are results orientation, people development and involvement, customer focus, continuous learning, innovation and improvement, leadership and constancy of purpose, partnership development, management by process and facts, and public responsibility (Beatham *et al.* 2004).

Malcolm Baldridge Criteria for Performance Excellence (MBNQA)

The Baldridge Award criteria were designed during the 1980s in USA by Public Law to improve organisational competitiveness. It focuses on the outcomes of customer satisfaction and organisation performance in six dimensions of leadership, information and analysis, strategic planning, human resource, quality of products and deliverable service, business results and customer satisfaction (Jacob *et al.* 2004). Traditionally, MBNQA gave more attention to leadership and customer satisfaction; however, there has been a shift towards quality and operational results in recent years (Hodgetts *et al.* 1999). Other weaknesses in the Malcolm Award include high cost in time and money with financial measures also deemed to be poor (Jacob *et al.* 2004).

Key Performance Indicators (KPIs)

The first usage to KPIs was in 1961 in the companies by D. Ronald Daniel to achieve business strategy. The performance measurement indicators theory is driven from the concept of benchmarking (Haponava and Al-Jibouri, 2009). 38 KPIs have been established and improved by government represented in the Movement for Innovation and the Construction Best Practice Programme (CBPP) for the purpose of performance measurement (Egan, 1998). KPIs assess the performance of activities deemed as critical success factors to gain desired organisation goals. The process starts with measurement and then benchmarking to gain information for decision-making related to improvements (Enoma and Allen, 2007). Despite the fact that KPIs have been extensively investigated in research, there are some obstacles such as reservations towards providing financial data, weaknesses in the accuracy of recording accidents and the manner of profit calculation which becomes more complicated in government projects due to the emphasis on supply of services (Chan and Chan, 2004).

CRITICAL EVALUATION OF PMS

The performance measures can be classified into three categories: financial and non-financial, soft and hard, and process and output parameter measures. Historically, financial measures have been the most widely used performance measure (Gautreau and Kleiner, 2001), and net profit and investment reward, time and quality have been the main stay of performance measurement in UK: However, in the current school of thought, the old "hard" measures are combined with the "soft" measures which gives a quality dimension to performance. *''Hard measures are those which are quantifiable, such as profit and market share, while soft measures include innovation and flexibility''* (Ingram, 1996). The process approach considers the measurement as an organized technique to evaluate performance by *''evaluating the inputs, outputs and final project outcomes''* (Ankrah and Proverbs, 2005).

In majority of construction projects, performance is measured through financial indicators. Despite their usefulness, they are considered lagging indicators focused on the past events. Further weaknesses include poor strategy, lack of information on environment, cooperation between partners and quality (Cheung *et al.* 2004). To overcome these weaknesses, two distinct attempts were launched in both Australia and the United Kingdom (Cheung *et al.* 2004).

In Australia, Project Performance Evaluation (PPE) framework has been introduced by New South Wales Public Works Department. It is designed to include a variety of conventional performance indicators such as time, cost, quality, safety, contractual and environment while covering new subjective parameters of communication and dispute resolution. In UK, Construction Industry Best Practice Programme came up with KPIs as measurement instruments, implemented in three main steps: identifying what should be measured, data gathering and calculation and analysis of KPIs result. In addition to both, Project Performance Monitoring System (PPMS) has been built on the basis of KPIs and PPE measures consisting of eight groups of performance measures, i.e. people, communication, time, cost, quality, environment, client satisfaction and health & safety (Cheung *et al.* 2004).

LIMITATION OF CURRENT PMS

Traditional measures have been applied to measure financial aspects such as profit and turnover, and thus they are appropriate to businesses. Despite their importance in

strengthening the financial aspects, they do not raise the level of competition and technology. Moreover, they have been criticized for encouraging short-term goals, focusing on minimisation of conflict rather than continuous improvement and being internal focused.

In terms of PMS application, lack of information and insufficient training on how to use them remain the major barriers (Costa *et al.* 2004) whereas Neely *et al.* (2000) identified three obstacles, i.e. non-acceptance of performance measurement, computerised problems and weak commitment of senior managers. In line with their findings, Bracegirdle (2003) has also opined that resistance towards the acceptance and application of PMS from the managers was a vital factor. Pollanen (2005) has taken a broader view and identified four categories of obstacles which prevent performance measurement's acceptance and execution. These are 1) institutional, such as resistance to transparency; 2) technical, for example, lack of specifications and standard; 3) financial, for instance, significant investment of resources and time, and 4) pragmatic, such as insufficient convenience and reliability. The use of performance measurement is thus limited as a consequence of difficulties in measurement, long duration and costly expenditures being needed, and difficulties created in the process of performance measurement by being an inherently project-directed business (Ankrah and Proverbs, 2005).

According to Nudurupati *et al.* (2007) the key restrictions for PMS in the construction industry are resource allocation, record and storage of data and information, and the logistics. Construction projects in both public and private sectors have been facing challenges and obstacles as performance has not been measured due to the lack of methods and approaches to discover the strengths and weaknesses (Luu *et al.* 2008). Other significant potential sources of problems that hinder the construction projects are the lack of consensus on defining the concept of the project success among stakeholders before beginning of the project, thus do not achieve desired goals, accordingly, critical success factors and success criteria must be determined at pre-project phase (Lim and Mohamed, 1999).

To sum up, the challenges of execution and improvement of PMS can be seen clearly in some key areas such as the consumption of time and resources, difficulties in data gathering, enabling the citizen role in using performance measurement output and moreover creating a sense of performance measurement inside the governmental authorities (Bracegirdle, 2003).

A NEW APPROACH TO PERFORMANCE MEASUREMENT

Given the project-based natural of the construction industry, the general measurement systems that are driven from the business market which are based on measures of profitability, are not appropriate for measuring and improving performance of construction projects (Ankrah and Proverbs, 2005). Löfgren and Eriksson (2009) have suggested that construction projects can achieve outstanding costumers' satisfaction, productivity and controlling performance in terms of quality, time and cost through superior partnering and collaboration between stakeholders. Keeping such guides in view, Takim and Akintoye (2002) proposed a new conceptual model based on incorporating and integrating some key success factor of construction project, i.e.: the relationship between success factors, project performance, efficiency, effectiveness, stakeholders' performances, needs and expectations, stakeholders' continual participation. Based on his model, a new approach for performance measurement is proposed where performance indicators are measured in the three phases of project

life cycle: the procurement, the process and the termination. The basic strands of this approach i.e. project phases, critical success factors, characteristics of good measures and criteria for performance measurement has been explained in the following sub sections.

IMPORTANCE OF PROJECT PHASES

A typical construction project is unique; however, processes are generally similar, and have been named in various ways by researchers who have approached the subject at different levels such as feasibility, pre-project stage, pre-design stage, project initiation stage and pre-project planning stage are synonymous. Project construction has two essential phases which are the preparation stage including project plans and design and the execution stage which includes the implementation process. According to Takim and Akintoye (2002) construction projects are practiced in seven complex phases: initiating, planning, financing, designing, approving, implementing and completing a project.

NOTION OF CRITICAL SUCCESS FACTORS

Critical success factors (CSFs) are crucial indicators, whether objective or subjective, which have significant impact on project results. These factors can be used to direct the organizational strategy for optimum use of resources and meet outstanding performance levels (Nguyen *et al.* 2004). Critical success factors have a long list and aim to achieve effective communication, dispute resolution, sufficient resources management, mutual trust and cooperation between all stakeholders, commitment, coordination and inventiveness (Cheung, *et al.* 2004). However, despite the significance of these factors, they cannot fulfil the desired goals if they are not linked properly to each other to serve as the organizations' overall strategy. Thus, establishing relevant and reliable critical success factors is deemed a fundamental requirement to evaluate project success in terms of both objective and subjective measures.

Chan *et al.* (2004) have identified the most important success factors and classified them into five groups of project attributes, procedures, project management, human resources and environmental factors. Within these groups, "quality workmanship, honesty, having good subcontractors, customer communications, reputation, having good employees, and completing projects on time, respectively" were deemed significant success factors by US construction companies, whereas, "employee development, effective risk management, innovation, partnerships with customers, and lean organizational structure" were important for German firms.

CHARACTERISTICS OF GOOD MEASURES

Beatham *et al.* (2004) have suggested that good measures have certain characteristics, which are explained below:

1. A comprehensive overview of the industry should be used to select leading and lagging indicators.
2. Differences between KPIs (leading), KPOs (lagging), and perception measures (individuals' judgements) must be understood and applied.
3. Indicators need to be balanced between the organisations' strategy and interests.
4. The stages of design and execution have to be recognised and clear.

5. They must be used as a fundamental component of the system and the process of execution.
6. The measures should take consideration of processes and sub-processes.
7. There should be active staff participation in the improvement of the measures.
8. The measures could be updated and used by organisation to benchmark their performance internally and externally.
9. The selected measures should support the decision makers with updated information.

RESEARCH METHODOLOGY

The present research is based on the key hypothesis that poor performance of Saudi municipalities' construction projects during various stages of construction projects is primarily associated with the weaknesses in existing performance measurement approaches. These approaches are hampered by the presence of significant barriers and obstacles at both project and organizational levels. Besides that understanding of the critical success factors and their measurement through performance indicators vary among various stakeholders. The challenge of performance improvement has become even more daunting as process improvement measures also vary among stakeholders involved in the construction projects. However, given the fact that an integrated system of performance measurement is supported by various stakeholders (personal knowledge), the researcher has proposed a new model for performance measurement of construction projects in Saudi Arabia building on the previous researchers especially the works of Beatham *et al.* (2004), Chan and Chan (2004), Ankrah and Proverbs (2005) and Haponava and Al-Jibouri, (2009).

CONCLUSIONS

As a result of rapid change and increasing uncertainty in terms of technology, budgets and operation process, the construction industry has become more complicated and dynamic (Albert, 2001). Performance measurement systems are widely applied in the construction industry (Edwards and Thomas, 2005) with main intentions of providing accountability, optimization performance and determining expenditures (Bracegirdle, 2003).

The tradition indicators cost, quality and time (the Iron Triangle) are being utilised by the construction industry to measure its performance despite their insufficiency to measure project successes (Haponava and Al-Jibouri, 2009). However, the need for measuring performance in construction projects has led to the evolution and implementation of key performance indicators related to various aspects of a typical construction project. Within different types of KPIs, shortcomings have persisted related to time, cost and quality; however, by following a process approach and focussing on multiple project stakeholders, their usage in the industry could be continued (Haponava and Al-Jibouri, 2009). Indeed, from the authors' review of literature, it can be found that very few performance indicators are process oriented, which therefore necessitated the authors' study and their attempts at developing process-based KPIs. The author recommended measuring the process of execution and the outcomes as well (Haponava and Al-Jibouri, 2009).

Using a framework in which the construction process has been divided into various stages, the researchers defined process-based KPIs, defining the initiative, feasibility and project definition phases. However, it is important to note that the identification of key performance indicators is not sufficient for the success of performance

measurement, but should be considered carefully in the process of measurement and its application (Enoma and Allen, 2007). The major issue in using the KPIs is that they are concerned with past events (lagging indicators). That is to say, that the performance is not affected by the results of KPIs. On the contrary, the leading measures deal with the current activities which are being performed. As a result, these measures offer little chance to the change in future.

In summary, most of the measurement approaches mentioned in the paper, do not focus on measuring project performance through financial and non-financial factors at each project phase. The majority of frameworks that have been proposed are developed theoretically based than empirically. While suggesting a new approach to performance measurement based on critical success factors applicable to various project phases and stakeholders, we shall remind ourselves what Phusavat *et al.* (2009) have stated that in the past, performance measurement was a critical management instrument that enhanced responsibility and quality management systems, whereas, in the future, it will be as a driver to increase government capability, transparency and accountability.

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