Construction Projects' Key Performance Indicators: A case of the South Africa Construction Industry

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ABSTRACT

Key Performance Indicators (KPIs) are one of the factors that constitute construction project success criteria which is the reason while performance measurement on construction projects are usually carried out by establishing KPIs which offer objective criteria to measure project success. An assumption is made that if a project is completed on time, within the agreed budget and set quality, also referred to as the 'golden/ iron triangle', then the project is deemed successful. Evidence suggests that this is far from the truth. Hence, the construction industry needs to pay attention to critical success factors, besides the golden/iron triangle. Hence, this paper explores the most significant construction projects' KPIs in the Gauteng province of South Africa. A questionnaire survey was used to collect the data for this study as a primary source in order to establish the most significant key performance indicators for construction projects in Gauteng, South Africa. Professionals such as architects, quantity surveyors, electrical engineers, mechanical engineers, structural engineers, civil engineers, construction managers, project managers and construction project manager, were randomly selected as the target population for the survey. The secondary data was collected from a thorough review of related literature; it is through this thorough literature review that the key performance indicators for construction projects in Gauteng, South Africa, were identified which were further tested via the questionnaire survey. Findings from the questionnaire survey revealed that the most significant construction projects KPIs are: construction time, profitability, project management, material ordering, handling and management, risk management, quality assurance, client satisfaction (product), safety, time predictability (project, design, construction), productivity, client satisfaction (service). The study contributes to the body of knowledge on the subject of construction projects' key performance indicators in the Gauteng Province of South Africa.

INTRODUCTION

Projects had clearly become a central activity in most organizations and companies and they are rapidly increasing their investment resources in projects such as new product development, process improvement, or building new services (Humaidi & Said 2011:27). However, many studies indicated that most projects do not meet time and budget goals, or fail to satisfy customer and company expectation. Notwithstanding, other factors also contributed to the failure of projects such as weaknesses in project mission and planning, lack of project knowledge, communications breakdown, lack of resources, political issue, control issues, lack of top management support, lack of technical expertise, etc (Sauser & Eigbe 2009, Humaidi & Said 2011:27) . Therefore the establishment of KPIs plays an important role in project delivery.

Project performance can be measured and evaluated using a large number of performance indicators that could be related to various dimensions (groups) such as time cost, quality, client satisfaction, client changes, business performance, health and safety (DETR 2000; Cheung et al. 2004; Enshassi et al, 2009: 270). Time, cost and quality are, however, the three predominant performance evaluation dimensions in the construction industry, also known as the "iron triangle". However on the contrary Garbharran et al (2013:91) states that an assumption is made that if a project is completed on time, within the agreed budget and set quality, also referred to as the 'golden/ iron triangle', then the project is deemed successful. Evidence suggests that this is far from the truth. Hence, the construction industry needs to pay attention to critical success factors, besides the golden/iron triangle (Toor & Ogunlana, 2005: 154; Garbharran et al, 2013: 91). Ogunsanmi (2013:29) states that KPIs can also be referred to as Key success indicators, measuring a project's success is more than making sure it's completed. Traditionally, success is defined as the degree to which project goals and expectations are met (Elattar, 2009; Garbharran et al, 2013: 91). It should be viewed from different perspectives of individuals and the goals related to a variety of elements, including technical, financial, education, social, and professional issues. Indeed, measuring project success is a complex task since success is intangible and can hardly be agreed upon. Such a phenomenon also exists in the construction industry where different parties are involved, including the client, the architect, the contractor, and various surveyors and engineers. Each project participant will have his or her own view of success.

Al-Tmeemy et al (2010) and Garbharran et al, (2013: 91) identified 13 critical success factors for building projects in Malaysia from the contractors' perspective. These criteria included: cost, time, quality, safety, achieving scope, customer satisfaction, technical specifications, functional requirements, market share, competitive advantage, reputation, revenue and profits, and benefit to stakeholder. This paper will therefore investigate the most significant construction projects' key performance indicators.

KEY PERFORMANCE INDICATORS

The construction industry KPIs were first published in 1999, and are updated annually, by the UK working group. The Headline KPIs are derived from the 5-4-7 model first put forward in the UK's Egan Report (1998) "Rethinking Construction". These improvement targets formed the basis for the national Headline KPIs in the UK, which were designed to show how improvement would be demonstrated. These KPIs are now widely used within the construction industry to measure performance and drive improvement (Swan & Kyng, 2004:8).

Performance measurement is the process of quantifying the efficiency and effectiveness of actions. For a performance measurement system to be regarded as a useful management process, it should act as a mechanism that enables assessment to be made, provides useful information and detects problems, allowing judgment against certain predetermined criteria to be performed (Neely, 2005;Basheka & Tumutegyereize, 2011:3766).

KPIs are one of the factors that constitute the project success criteria. Swan and Kyng (2004:11) view KPIs as the measure of a process that is critical to the success of an organisation and/or project. According to a publication by Price Waterhouse Coopers (PWC) (2007:6), KPIs means actors by reference to which the development, performance or position of the business of the company can be measured effectively. Thoor & Ogunlana (2010), together with Humaidi & Said (2011:27), suggested that KPIs are helpful to compare the actual and estimated project performance in terms of effectiveness, efficiency, and quality of workmanship and product. KPIs can be used to measure the performance of project operation and are usually used in construction projects. Moreover, performance measurement can be carried out by establishing KPIs which offer objective criteria to measure project success. The formal definition for KPIs according to Public Record Office Victoria (2010:6) is Key Performance Indicators (KPIs) are quantitative and qualitative measures used to review an organisation's progress against its goals. These are broken down and set as targets for achievement by departments and individuals. The achievements of these targets are reviewed at regular intervals.

Takin and Akintoye (2002:546), informs that the UK working groups on KPIs have identified 10 parameters for benchmarking projects in order to achieve a good performance in response to Egan's report (1998). These parameters are also defined in the "Rethinking Construction" in the 5-6-10 model as headline KPIs and they are as follows; Construction cost, construction time, predictability cost, predictability time client satisfaction (product), client satisfaction (service), Defects, productivity, profitability, safety. Most of these indicators, such as construction cost, construction time, defects, client satisfaction with the product and service, profitability and productivity, promote result-orientated thinking, whereas predictability of design cost and time, and predictability of construction cost and time, and safety can be regarded as process-orientated thinking. (Takin & Akintoye, 2002:546).

There are also secondary indicators, which are classified into the following categories; a) operational indicators, which bear on specific aspects of a firm's activities and enable management to identify and focus on specific areas for improvement; and b) diagnostic indicators, which provide information on why

certain changes may have occurred in the headline or operational indicators and are useful in analysing areas for improvement in more detail (KPI, 2001; Costa et al). These secondary indicators therefore play a vital role in improving both project and organisation overall performance.

METHODOLODGY

A questionnaire survey was used to collect the data for this study as a primary source, to establish the most significant key performance indicators for construction projects in Gauteng, South Africa. Professionals such as architects, quantity surveyors, electrical engineers, mechanical engineers, structural engineers, civil engineers, construction managers, project managers and construction project manager, were selected as the target population for the survey. Questionnaires were distributed randomly to respondents in both the private and public sector. The secondary data was collected from a thorough review of related literature; it is through this thorough literature review that the key performance indicators for construction projects in Gauteng, South Africa, were identified. Using a five point Likert scale, the respondents were asked to rate the most significant construction industry KPI's, the studied factors were ranked based on the mean item score.

Mean item score. The five-point scale was transformed to mean item score (MIS) for each of the factors of causes and effects as assessed by the respondents. The indices were then used to determine the rank of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. This is the method used to analyse the collected data from the issued questionnaires in this study. Likert scaling is a bipolar scaling method, measuring either positive or negative response to a statement (Sukamolson, nd: 20). After the questionnaire is completed, each item may be analysed separately or item responses may be summed to create a score for a group of items. Hence, Likert scales are often called summative scales.

The computation of the relative mean item score (MIS) was calculated from the total of all weighted responses and then relating it to the total responses on a particular aspect. This was based on the principle that respondents' scores on all the selected criteria, considered together, are the empirically determined indices of relative importance. The index of MIS of a particular factor is the sum of the respondents' actual scores (on the 5-point scale) given by all the respondents' as a proportion of the sum of all maximum possible scores on the 5-point scale that all the respondents could give to that criterion (Pilot & Hungler, 1995:33). Weighting were assigned to each responses ranging from one to five for the responses of 'strongly disagree' to 'strongly agree' and 'Extremely unlikely' to 'Extremely likely'. This is expressed mathematically below. The mean item score (MIS) was calculated for each item as follows:

$$MIS = \frac{1n1 + 2n2 + 3n3 + 4n4 + 5n5}{\Sigma N} \quad \text{.....Equation 1.0}$$

Where;

n1 = Number of respondents for extremely unlikely or strongly disagree;
n2 = Number of respondents for unlikely of disagree;
n3 = Number of respondents for neutral;
n4 = Number of respondents for likely or agree;
n5 = Number of respondents for extremely likely or strongly agree;
N = Total number of respondents

After mathematical computations, the criteria are then ranked in descending order of their mean item score (from the highest to the lowest).

FINDINGS AND DISCUSSIONS

From the 131 usable questionnaires, the following information was gathered; of all the respondents 61% were male and 39% were female. Relating to their qualifications, findings revealed that 1.5% of the respondents had no qualification, 6.1 % had only completed matric (grade 12), 40.5 % had diplomas, while 7.6% of the respondents had B-Degrees, 7.6% had an M-Degree and lastly, only 0.8% of the respondents had a Doctorate qualification. Findings also revealed that 34.6% of the respondents were Quantity surveyors, 21.5% were project managers, 11.5% were civil engineers, 7.7 % were construction project managers, 6.9% were construction managers, 5.4 % were electrical engineers, 1.5% of the respondents were both structural engineers and architects and finally 4.6% were mechanical engineers and the other 4.6% had job a titles that were not identified in the study and therefore their titles fell under the heading "other". When asked about their work experience, findings showed that 54.4% of the respondents had between 2 and 5 years of work experience, 28.3 % had 6-10 years' experience, 7.2 % had 11-15 years' experience, 7.1 % had 16-20 years' experience and 0,8 % of the respondents had 26-30 and 31-35 working experience in the construction industry.

Based on the ranking using the calculated standard devotion and mean score for the listed construction industry's Key Performance Indicators, according to the respondents the most significant performance indicators are as follows; construction time (SD=0.923; $\bar{x}$=4.44; R=1); profitability (SD=0.842; $\bar{x}$=4.42; R=2), Project management (SD=0.782; $\bar{x}$=4.37; R=3), Material ordering, handling and management (SD=0.761; $\bar{x}$=4.36; R=4), Risk management (SD=0.758; $\bar{x}$=4.34; R=5), Quality assurance (SD=0.767; $\bar{x}$=4.30; R=6), Client satisfaction (product) (SD=0.778; $\bar{x}$=4.29; R=7), Safety(SD=0.872; $\bar{x}$=4.26; R=8), Time predictability (project, design, construction) (SD=0.753; $\bar{x}$=4.24; R=9), Productivity (SD=0.793; $\bar{x}$=4.22; R=10), Client satisfaction (service) (SD=0.822; $\bar{x}$=4.22; R=10), Cost predictability (project, design, construction) (SD=0.797; $\bar{x}$=4.20; R=11), Procurement (SD=0.811; $\bar{x}$=4.19; R=12), Construction cos(SD=0.788; $\bar{x}$=4.18; R=13), Defects (SD=0.812; $\bar{x}$=4.05; R=14), Human resource management

(SD=0.813; $\bar{x}$=4.00; R=15).

Table 1. Construction Projects' Key Performance Indicators.

KPIs	$\bar{x}$	σX	R
Construction time	4.44	0.729	1
Profitability	4.42	0.824	2
Project management	4.37	0.782	3
Material ordering, handling and management	4.36	0.761	4
Risk management	4.34	0.758	5
Quality assurance	4.30	0.767	6
Client satisfaction (product)	4.29	0.778	7
Safety	4.26	0.872	8
Time predictability (project, design, construction)	4.24	0.753	9
Productivity	4.22	0.793	10
Client satisfaction (service)	4.22	0.822	10
Cost predictability (project, design, construction)	4.20	0.797	11
Procurement	4.19	0.811	12
Construction cost	4.18	0.788	13
Defects	4.05	0.812	14
Human resource management	4.00	0.813	15

σX = Standard deviation; $\bar{x}$ = Mean item score; R = Rank

The UK working groups on KPIs have identified ten parameters for benchmarking projects, in order to achieve a good performance in response to the Egan's report (1998) (Takim & Akintoye, 2002:345), however for this study, through a thorough review of literature, the researcher identified six additional parameters which were then included in the questionnaire. Findings relating to the KPIs revealed that project management, material ordering, handling and management, risk assurance and quality assurance are considered significant indicators in the South African construction industry. This indicated that the South African construction industry is dynamic in nature as the above mentioned KPIs have never been included in previous studies of this nature. Therefore due to the abovementioned reasons findings to this study were not in agreement with Koelmans (2004:231), who identified Scope and quality of the project as the most influential performance indicator. Furthermore, according to the Marx (2013:2) and Chan and Ada (2004:203-221) cost, time and quality are the three basic and most important performance indicators in construction projects followed by others such as safety, functionality and satisfaction. Enshassie et al is in agreement with the Marx (2013) and also states that time, cost and quality are the three predominant performance indicators for construction projects. Ogunsanmi (2013:29) states that KPIs can also

be referred to as Key success indicators, therefore according to this notion, Al-Tmeemy et al (2010) and Guidiene et al(2012:384) findings are in disagreement with this study's' findings, their findings indicate that cost, time, quality, safety, achieving scope, customer satisfaction are the top four most significant indicators, which is in agreement with Marx (2013) and Ogunsanmi (2013), furthermore according to Al-Tmeemy et al(2010) and Guidiene (2012), revenue and profits, and benefit to stakeholder are the least important indicators.

CONCLUSION

The reviewed literature on the most significant key performance indicators revealed that, scope and quality were the most significant KPIs for construction projects, further review revealed that cost, time and quality are the three basic and most important performance indicators in construction projects followed by safety, functionality and client/ customer satisfaction. From the data collected, using a well-structured questionnaire, it was observed that construction time, profitability, project management, material ordering, handling and management, risk management, quality assurance, client satisfaction (product), safety, time predictability (project, design, construction), productivity, client satisfaction (service), were, according to all respondents the ten most significant key performance indicators for construction projects in Gauteng, South Africa.

However, these findings relating to the KPIs revealed that project management, material ordering, handling and management, risk assurance and quality assurance are considered significant indicators in the South African construction industry. This indicated that the South African construction industry is dynamic in nature as the above mentioned KPIs have never been included in previous studies of this nature.

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