AN ASSESSMENT OF CRITICAL SUCCESS FACTORS FOR THE REDUCTION OF THE COST OF POOR QUALITY FROM CONSTRUCTION PROJECTS IN SOUTH AFRICA

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The cost of poor quality (COPQ) in the construction industry are cost associated with the prevention, discovery, and resolving of defects. These are caused due to failure in preventing defects and wastages during construction work. They arise whether the product is at design stages, manufacturing plants, or in the customer's hand. The main purpose of this research is to identify the critical success factors (CSF) which have the potentials to reduce the COPQ during planning and execution stages of construction projects in South Africa. This study is descriptively designed to obtain the views of construction professionals in regard to the CSF for the reduction of the COPQ in construction projects. A structured questionnaire survey was conducted amongst 60 construction professional to identify the CSF for the reduction of the COPQ in construction projects. This study identified 10 CSF for the reduction of COPQ in construction projects from a list of 41 different CSF classified under five themes. The ten most important CSF were: defining quality objectives (standards and specifications); providing effective leadership; defining quality control mechanism; team development and deploying skilled work force; team work; providing effective leadership; fulfilling health and safety requirements; measuring performance of activities on critical path; improving the productivity of resources and initiating accountability process. The study contributes to the body of knowledge on the subject of the CSF for the reduction of COPQ in construction project in South Africa.

Keywords: cost of poor quality, critical success factors, South Africa

INTRODUCTION

The problem of projects poor quality in the construction industry is a global phenomenon and the South Africa construction industry is no exception. Despite the legislated policies assuring quality products from construction firms by the South Africa Council for the Built Environment (CBE) and other associated quality control bodies to prevent this global construction industry problem, this problem is still very much present. The goal of construction stakeholders in either the public or private sector is to successfully complete the project on schedule, within planned budget, in the safest manner and with the highest quality. Construction projects are frequently influenced by either success factors that help project parties reach their goal as planned- such as attainment of the minimum level of quality required, or poor quality problems that stifle or postpone project completion.

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Over time, scholars (see Morris and Hough, 1987; Pinto and Slevin, 1989) have investigated factors which aid successful completion of projects without any effect on the cost, particularly those which affect project quality success more than others. The concept of success in a construction project can, according to some researchers be evaluated only when the evaluation dimensions are adequately defined (Morris and Hough, 1987). Generally, in any project the evaluation dimensions correspond to the traditional constraints of time, cost, and quality parameters. Ashley *et al*. (1987) defined project success as results better than expected or normally observed in terms of cost, schedule, quality, safety, and participant satisfaction. Therefore, when the results obtained during and after completion of construction projects result in significant cost discrepancies due to poor quality for example, then the project is deemed not successful. Thus, this necessitates the studies of CSF for the reduction of construction projects poor quality in order to achieve results better than expected.

Quality is one of the most important competitive strategic tools which many organizations and national states have used as a key to develop products and services in supporting continuing success. Quality management systems in all industries, are designed to set a clear view for organization to follow, enabling understanding and involvement of employees proceeding towards common goal. In the cycle of never ending improvement which is required in the construction industry as client demand value for money spent in line with the construction professionals mandate and training, quality measurement plays an important role in the assessment and assurance of project successes. The assessment of the CSF for the reduction of the cost of poor quality (COPQ) is considered as a trigger for the improvement of construction project quality, and its associated problems such as rework, disputes, time overruns amongst others. Moreover, no improvement in the associated poor quality issues can be achieved when the CSF to mitigate against the COPQ are not studied to assist in identifying opportunities for improvement. There are many success factors, if addressed effectively can reduce COPQ from construction projects. It is these factors that the current study aims to assess in order to enable the South Africa construction industry address effectively one of the many difficulties faced by construction industries worldwide. As there have not been any known study which has addressed this subject in South Africa.

However, the problems facing the construction industry in South Africa are significantly more fundamental, more serious and more complex. In South Africa, these difficulties and challenges sit alongside the general situation of socioeconomic and political issues which are/were underpinned by the previous apartheid regime of segregation; thus polarising the construction section with various problems. Whilst in all countries, the construction industry faces conditions of uncertainty and risk which are totally different from the causes in South Africa. The sources of such problems in South Africa are even more severe because of the dwindling tax base and other areas demanding attention for spending. Therefore, the objective of the current study is to identify the critical success factors (CSF) which have the potentials to reduce the COPQ during planning and execution stages of construction project in South Africa. The identification of CSF for reduction of COPQ would be helpful for the construction industry in South Africa, as it would present an opportunity for the construction industry stakeholders to concentrate on the identified CSF to reduce COPQ from projects. This will enhance profitability, productivity, compatibility and quality which increases the sustainability of national economic growth, strength and performance of the construction industry. The study is descriptively designed to obtain the views of construction professionals in regards to the CSF for the reduction of the COPQ in construction projects.

COST OF POOR QUALITY

Quality in the construction industry, according to Goetsch and Devis (2006) is a dynamic state associated with products, services, people, processes and environment that meets or exceeds customer expectations and contract requirements/standards. Whilst Crosby (1979) in his work *"Quality is Free"*, states that quality is the conformance to the standards and fitness for purpose. Likewise, ISO 9000 defined quality as *"the degree to which a set of inherent characteristics fulfils requirements"*. Similarly, FIDIC (2004) defines quality as ...... that quality (excellence), which meets or exceeds the requirements of the employer, as specified in the contract documents, whilst complying with law, codes, standards and regulatory policy, which apply to the contract. Hu (2004) posits that quality is the symbol of human civilization, and with the progress of human civilization, quality control plays an incomparable role in the mandates of businesses. The definition of Hu (2004) bears resemblance to that of Crosby (1979) which informs that quality must conform to standard and fitness for purpose. Also, Duncan, Thorpe and Sunmer (1990) posit that quality refers to standards and the ways and means by which those standards are achieved, maintained and improved upon. Whilst quality is key in construction products, it does not necessarily refer to their prestigious attributes, but to the fitness of purpose of the construction projects to the clients and meeting of customer's requirements (Corsby, 1979; Hu; 2004). Harris and McCaffer (1995) emphasize that quality is meeting the requirements of the customer. The benefits of construction quality improvement have long been emphasised by quality management experts and researchers (Love and Li, 2000). Improving construction quality through reducing poor quality activities brings several advantages such as: increased productivity improved morale and increased adaptability in the process of change. Construction quality improvements increase the chance of significant profits to be gained by providing better production quality, which translates into higher expected utility for the customer.

COQ approach was pioneered by Juran (Venters, 2004) as the *"Cost of Poor Quality"* in his *"Quality Control Hand book"* in 1951. In his work, Juran argues that quality issues need to be conveyed in financial terms for executives to really understand and take notice. Subsequently, Feigenbaum (1951) derived the classification called the Prevention, Appraisal, and Failure (PAF) model of cost. In this model, quality costs were divided into prevention, appraisal and failure costs. Furthermore, Crosby (1979) redefined the cost of quality as the sum of *"Price of Conformance and Price of Non-Conformance"*. A number of articles published on quality related costs in construction refer to these traditional classifications at least at some level (Love and Li, 2000). However, there are categories of costs which need to be considered during the conception of projects. These include: appraisal costs (costs incurred to determine the degree of conformance to quality requirements), prevention costs (costs incurred to keep failure and appraisal costs to a minimum), internal failure costs (costs associated with defects found before the customer receives the product or service), and external failure costs (costs associated with defects found after the customer receives the product or service). COPQ in the construction industry, is the cost faced due to the production of poor quality products and services. The COPQ are easily traced or identified from the existing accounting reports and auditing system as they are obvious whenever they occur. For instance, Schiffauerova and Thomson (2006) informs that 6-15% of construction cost is found to be wasted due to rework of defective components detected late during construction, while a further 5% of construction cost is wasted due to rework of defective components detected during maintenance. Also, Chapalkar (2011) states that the nature of poor works/ errors are quit diverse estimating that 20-40% of all construction project poor quality have their roots in errors arising during the construction phase, and a whopping 54% of all construction poor quality defects can be attributed to human factors like unskilled workers or insufficient supervision of construction work. These observations suggest that a thorough quality management of construction activities is needed and that current construction project quality management approaches need to be improved through the assessment of the CSF's that have the potentials to reduce the COPQ in construction projects.

METHOD

The data used in this paper were derived from both primary and secondary sources. The primary data was obtained through the survey method, while the secondary data was derived from the review of literature and archival records. The primary data was obtained through the use of a structured questionnaire aimed at 60 construction professional in Johannesburg to meet the research objectives. The professionals were randomly selected amongst their peers. Survey participants included architects, quantity surveyors, civil engineers, construction and project managers; excluding construction clients and contractors. A list of construction professional who works within the greater Johannesburg Metropolitan Municipality was obtained from the respective professional council and the Council for the Built Environment- the watchdog of professionals in the country via the various professional councils. This approach concurs with the work of Swan and Khalfan (2007) who advise that the inclusion of all construction professionals, is essential for successful project delivery- which applies to the current study. Random sampling was used to select the professionals. According to Kombo and Tromp (2006) random sampling is the probability whereby people, place or things are randomly selected. From the list of construction professionals, 60 were randomly selected. This yardstick was considered vital for the survey in order to have a true assessment of the critical success factors which have the potentials to reduce the COPQ during planning and execution stages of construction project in South Africa. Because all professionals as contained on the list had an equal chance to be drawn and participate in the survey. Out of the 60 questionnaires sent out, 58 were received back representing a 96.7% response rate. This was considered satisfactory for the analysis based on the assertion by Moser and Kalton (1971) that the result of a survey could be considered as biased and of little value if the return rate was lower than 30% to 40%. Because the sample size for this study was relatively small, all groups of respondents were lumped together in the analysis in order to obtain significant results. The data were analysed by calculating frequencies and the mean item score (MIS) of the rated CSF. Although the empirical study is based on a relatively small sample of 60 construction professionals, the findings provide an insight into the general perception of the COPQ in Johannesburg construction projects. The calculation of the MIS is explained in the next section. The research was conducted between the months of July to October, 2013. The questionnaire was designed based on the information gathered during the literature review and does not form part of an existing survey instrument.

Mean Item Score (MIS)

A five point Likert scale was used to determine the CSF which have the potentials to reduce the COPQ during planning and execution stages of construction project in South Africa with regards to the identified factors from the extant review of literature. The adopted scale was as follows: (1) = Strongly disagree; (2) = Disagree; (3) = Neutral; (4) = Agree; and (5) = Strongly agree. The five-point Likert scale scores were transformed to an MIS for each of the CSF as scored by the respondents. The indices were then used to determine the rank of each item. These rankings made it possible to cross compare the relative importance of the items as perceived by the respondents. The computation of the 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. Weighting were assigned to each responses ranging from one to five for the responses of 'strongly disagree' to 'strongly agree'. This is expressed mathematically below in Equation 1.0. The relative index for each item was calculated for each item as follows, after Lim and Alum (1995):

$$MIS = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\sum N} \qquad \text{Equation 1.0}$$

Where; n_1 = Number of respondents for strongly disagree; n_2 = Number of respondents for disagree; n_3 = Number of respondents for neutral; n_4 = Number of respondents for agree; n_5 = Number of respondents for strongly agree; N = Total number of respondents. Following the mathematical computations, the criteria were then ranked in descending order of their relative importance index (from the highest to the lowest). The next section of the article presents the findings of the survey and some discussion.

RESULTS AND DISCUSSION

Demographical specifics

From the structure questionnaire survey, it was found that the surveyed professionals' composition were: 10.0% architects, 25.0% quantity surveyors, 20.0% civil structural engineers, and 25.0% construction managers and 20.0% project managers. It was also found that the respondents' are currently handling construction projects ranging from residential, road construction, and civil engineering related projects.

Further findings revealed that 59.0% of the respondents were male while 41.0% were female. This finding thus shows that the orientation of a male dominated construction industry is gradually being revolutionised in South Africa, into an industry where a significant numbers of females are now participating. Howbeit, 80.0% of the reported 25.0% quantity surveyors in the study were females. Also, findings relating to the respondents' ethnic background reveals that Black Africans were 80.0%, while 15.0% were Whites, 2.0% where Indians / Asians and 3.0% were Coloured people of South Africa. The respondents' educational qualification reveals that 53.0% have post-diploma degrees, 27.0% have an equivalent of B-degree and 20.0% with a post graduate degree as their highest qualification. A survey of the respondents' professional registration revealed that 35.0% of the respondents where professionally registered with different built environment professions, while 65.0% where registered as under the candidate category of their professional route to formal registration as professionals. Also, it was found that 87.0% of the respondents have been working in Johannesburg for more than 10 years, while 13.0% have worked in Johannesburg for a period of less than 5 years. Findings also shows that 45.0% of the respondents work for construction consultant firms while 20.0% of the respondents' works for public sector client (government), while a further 35.% works for contractors. These finding thus reveals that the respondents have a working knowledge of the construction industry/ projects and activities in Johannesburg; hence their opinions on the study objective will be deemed credible. The following sections present the result of the survey findings on the CSF which have the potentials to reduce the COPQ during planning and execution stages of construction project in South Africa with regards to the identified factors from the extant review of literature.

Critical Success Factors for the Reduction of the COPQ

Based on the ranking (R) of the weighted averages, the mean item scores (MIS) for the listed CSF which have the potentials to reduce the COPQ in South Africa construction projects were identified (Table 1-5). The survey findings revealed the ten (10) most CSF from a list of 41 CSF classified under five themes that have the potentials to reduce the COPQ on construction projects in Johannesburg. The most important CSF identified under the planning stage CSF were: defining quality objectives- standards and specifications (MIS = 4.39); providing effective leadership (MIS = 4.20); and team development and deploying of skilled workforce (MIS = 4.13) as shown in Table 1.

Table 1: Planning Stage CSF for the reduction of the COPQ

	Planning stage CSF	MIS	RANK (R)
Planning stage	Defining quality objectives (standards and specifications)	4.39	1.00
	Providing effective leadership	4.20	2.00
	Team development and deploying skilled work force	4.13	3.00
	Clearly defining the project objectives (scope, time and cost)	4.12	4.00
	Identification of processes and skills for activities	4.08	5.00
	Identifying technology requirement for processes	4.03	6.00
	Cash flow planning	3.85	7.00
	Defining measurement and testing procedures	3.34	8.00

The CSF scores of the COPQ reduction for the organising stage of project construction were: defining quality control mechanism (MIS = 4.12); team development and deploying skilled work force (MIS = 4.12) and providing effective project management process (MIS = 4.02). Other CSF's include: defining the decision making process and empowerment, use of appropriate technology amongst others as shown in Table 2.

Table 2: Organizing Stage CSF for the reduction of the COPQ

	Organizing stage CSF	MIS	RANK (R)
Organizing stage	Defining quality control mechanism	4.12	1.00
	Team development and deploying skilled work force	4.10	2.00
	Providing effective project management process	4.02	3.00
	Defining the decision making process and empowerment	3.76	4.00
	Usage of appropriate technology	3.88	4.00
	Defining organizational structure	3.78	5.00
	Use of integrated procurement systems	3.71	6.00
	Training, development and quality awareness of HR	3.68	7.00

Furthermore, the findings relating to the execution stage as classified include: team work (MIS = 4.32); providing effective leadership (MIS = 4.20) and the optimum use of resources (MIS = 4.05). Others findings include- fulfilling contractual obligations, fulfilling health and safety requirements, employee's involvement amongst others as shown in Table 3.

Table 3: Executing Stage CSF for the reduction of the COPQ

	Executing stage CSF	MIS	RANK (R)
Executing stage	Team work	4.32	1.00
	Providing effective leadership	4.20	2.00
	Optimum use of resources	4.05	3.00
	Fulfilling contractual obligations	3.93	4.00
	Fulfilling health and safety requirements	3.87	5.00
	Employee involvement	3.71	6.00
	Fulfilling environmental protection requirements	3.66	7.00
	Exercising transparency in procurement process and transactions	3.63	8.00
	Protecting stakeholder rights	3.51	9.00

The most CSF finding for COPQ reduction relating to the monitoring stages were found to include: fulfilling health and safety requirements (MIS = 4.10); measuring performance of activities on critical path (MIS = 3.93); and measurement of executed works (3.85) as shown in Table 4.

Table 4: Monitoring Stage CSF for the reduction of the COPQ

	Monitoring stage CSF	MIS	RANK (R)
Monitoring stage	Fulfilling health and safety requirements	4.10	1.00
	Measuring performance of activities on critical path	3.93	2.00
	Measurement of executed works	3.85	3.00
	Measurement of wastage and reworks (COPQ)	3.80	4.00
	Audit of expenditure and procurement process	3.70	5.00
	Fulfilling environmental protection requirements	3.68	6.00
	Testing of executed works	3.68	6.00
	Measurement of productivity of resources	3.68	6.00
	Measure Variation in planned and actual resource utilization	3.61	7.00

Lastly, the most CSF for the reduction of COPQ at the controlling stage of construction include: improving the productivity of resources (MIS = 4.05); initiating accountability process (MIS = 4.05) and improving the quality of input materials and resources (MIS = 3.98).

Table 5: Controlling Stage CSF for the reduction of the COPQ

	Controlling stage COPQ	MIS	RANK (R)
Controlling stage	Improving the productivity of resources	4.05	1.00
	Initiating accountability process	4.05	1.00
	Improving the quality of input materials and resources	3.98	2.00
	Reducing the gap in planned and actual schedule	3.85	3.00
	Reducing the gap in planned and actual cost	3.83	4.00
	Reducing the gap in planned and actual scope	3.73	5.00
	Reducing the gap in planned and actual resource utilization	3.49	6.00

The research findings are not significantly different from findings of other cultural contexts. However, they are peculiar the South Africa construction industry because of the extent of regulation via policies and the various government legislated professional bodies and councils. The ten most important CSF as identified from the above five classification (1) defining quality objectives (standards and specifications); (2) providing effective leadership; (3) defining quality control mechanism; (4) team development and deploying skilled work force; (5) team work; (6) providing effective leadership; (7) fulfilling health and safety requirements; (8) measuring performance of activities on critical path; (9) improving the productivity of resources and (10) initiating accountability process are the topical issues the various regulatory professional councils/ bodies such as the South Africa Construction Industry Development Board (cidb) have been mandated to address since inception. For instance, on the CSF for the provision of effective leadership- the various professional bodies such as the South Africa Council of Quantity surveying Profession (SACQSP) and the Construction Project Management Council have organiser series of leadership training which contribute to the registered professional Continuous Professional Development (CPD) training. Besides, in order to create health and safety leadership, the Construction Project Management Council through the order of the Minister of Public Works have create a separate registration route for professional health and safety managers who will be responsible for leadership in this aspect.

Furthermore, the survey results concurs with the findings of the study of Jha and Iyer (2006), where it was found that defining quality objectives (standards and specifications); providing effective leadership; and team development and deploying skilled work force as factors which could mitigate against the COPQ in construction projects. Also, the findings from the current work concurs with the study of Mahmood, Shahrukh and Sajid (2012) when they found that team work; providing effective leadership; fulfilling health and safety requirements; measuring performance of activities on critical path; improving the productivity of resources and initiating accountability process are CSF for the reduction of the COPQ in construction projects in the Pakistani construction industry. Moreover, Newton (2005) states that resource plan has to be adequately developed and distributed to every section involved in any project in order to ensure the successful delivery of the project, thus avoiding the incidences of cost overruns. In addition, Johnson, Scholes and Whittington (2006) stresses the importance of adequate funding throughout the project which is also highlighted in the current finding. This they informed will ensure that no activity is hampered, due to funding shortages. The importance of contract documentation was highlighted by Kerzner (2006), who suggests that, if no contract is signed, it would be difficult to ensure performance of the necessary activities. This seldom happens, but where there is no adequate leadership to ensure the coordination of construction activities, this can occur. Likewise, the ground breaking work of Ashley *et al*. (1987) on CSF construction project also concurs partially with the current findings. Ashley *et al*. (1987) found that management, organisation and communication; scope and planning; controls; environmental, economic, political and social; and construction technical are typical CSF's for the reduction of the COPQ in construction projects. Based on the results of studies conducted in other geographical regions such as Pakistan and Brunei, the current results seem to be more or less the same; howbeit, it the first of its kind in South Africa. These results are important for future research studies in order to observe trends and shifts with regard to the CSF which have the potentials to reduce the COPQ on construction projects in South Africa, using the Johannesburg construction industry as a case study. This study provides a baseline for further studies in South Africa to enable researchers to monitor the CSF which will reduce the COPQ in construction projects.

CONCLUSIONS

The study investigated the CSF which have the potentials to reduce the COPQ in construction projects in the South Africa construction industry, a case Johannesburg. This study identified 10 CSF for the reduction of COPQ in construction projects from a list of 41 different CSF classified under five themes. The ten most important CSF as identified in from the study were: defining quality objectives (standards and specifications); providing effective leadership; defining quality control mechanism; team development and deploying skilled work force; team work; providing effective leadership; fulfilling health and safety requirements; measuring performance of activities on critical path; improving the productivity of resources and initiating accountability process.

The study concludes that there are a number of factors which have the potentials to reduce the COPQ in construction projects in South Africa of which when properly implemented will give the industry an advantage to meaningful enhance profitability, productivity, compatibility and quality delivery of construction jobs which will boost the sustainability of the South Africa national economic growth and strength and performance of the construction industry. Hence, it is therefore recommended that adequate and effective monitoring of construction projects and provision of feedback by the project team, adequately planning and coordination of construction activities, timely issuing of information, and sound project management skills and periodic quality audit of construction projects should be the main focus of the parties in project construction process. It is believed that the results of this study can be of immense assistance to the construction stakeholders (clients, contractors and consultants) and construction industry academics. The stakeholders can better understand the changing aspects of construction project management and they will be able to make concerted efforts to reduce the incidents of construction poor quality thus avoiding cost discrepancies which can result to dispute and other problems. In addition, the construction industry academics can conduct similar studies in other parts of South Africa and identify the CSF for the reduction of COPQ and the cost of reworks amongst others.

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