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The Changing Face of Performance Evaluation among Construction Projects in Developing Countries. Development from Literature Review

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Abstract

The present work attempts to develop a theoretical framework of the performance evaluation of construction projects based on six key performance indicators (KPIs) namely time, cost, quality, safety, minimum site disputes and environmental impact. For evaluating the performance on the above KPIs, several characteristic features pertaining to the project, project environment and the stakeholders associated with the project have been identified through an extensive literature review. These characteristic features, termed as critical success factors (CSFs), have been suitably classified under six broad heads based on their commonalities and unique features. The six CSFs are named as project-related, client-related, consultant-related, contractor-related, supply chain-related and external environment-related factors. We have demonstrated the relationship between CSFs and overall project performance with the help of a conceptual diagram. The diagram reveals how the factors influence the performance of a construction project and also how the factors themselves are related to each other. In addition, it also shows how the overall performance leads to community satisfaction. This has been discussed through a set of 20 propositions. We have concluded by highlighting the contributions of the paper to the existing body of project management literature.

Keywords: Construction project, project performance, key performance indicators, critical success factors, propositions.

1.0 Introduction

Construction activity represents a significant share of the economy of most of the countries in terms of its contribution to Gross Domestic Product (GDP) and total employment and it is also an important market for materials and products produced by other sectors of the economy (ILO, 2017). According

to a recent survey by Global Construction 2020, the world construction spending stood at $7.2 trillion in 2010 and is expected to grow to $12 trillion in 2020 (www.globalconstruction2020.com). Further there is a clear relationship between construction activity, economic growth and economic development (Khan, 2020). Ofori (2000) points out that the contribution of this industry includes direct contribution, indirect contribution and accrued contribution due to backward linkages. The construction industry also plays a key role in satisfying a wide range of physical, economic and social needs and contributes significantly to the fulfillment of various major national goals (Long et al., 2004). The industry's size, the nature of its operation and its presence in every developmental activity, therefore, makes it a major source of employment in developing countries (ILO, 2017).

However, the experience of the developing countries pertaining to the implementation of construction projects reveals that the projects are seldom completed without any rework being performed upon them (Love et al., 2010; Ahadzie et al., 2020). In addition, most of the projects are neither completed in time nor meet budgetary constraints (Kamrul and Indra, 2010). Further construction activities are said to be very unsafe (Billy et al., 2006; Haslam et al., 2005; Ortega, 2000) and that they can easily be derailed by disputes (Tabish and Jha, 2011; David, 2005). In the past, constructions have been undertaken without regard to their impact on the environment (Tan et al., 2011; Gangolells et al., 2011; Tsoulfas and Pappis, 2020). For these reasons, the intended benefits hardly reach the real beneficiaries.

In spite of huge fund allocations to construction projects in developing countries, no work has specifically considered the relationships between the performance measures of the projects implemented and the various factors that affect project implementation. Studies on the construction activities have largely concentrated on performance criteria in general (Ahadzie et al., 2020; Chan, et al., 2017; Atkinson, 1999), critical success factors and their classifications (Ameh et al., 2010; Koushki et al. 2005; Chan and Tam 2000), the use of informal labour in construction sector (Mitulla and Wachira, 2003), modeling of construction activity as a system (Mbiti et al., 2011), management of multicultural teams in project construction (Ochieng and Price, 2009) and a review of construction sector statistics as a whole (K'Akumu, 2009). The main shortcoming of these studies has been their inability to aptly come up with an empirical measurement system that cut across different categories of construction projects and link such performance to the various critical success factors. This work therefore differs from previous works in terms of its scope. It focuses mainly on one form of category of projects, the construction projects in developing countries and examines the performance criteria vis-à-vis critical success factors. The present work is also important as it develops a framework for project performance measurement of construction projects in line with similar frameworks for other types of projects developed in different countries.

In order to enable the construction projects provide intended benefits to the people, project management professionals have given emphasis on three dimensions of the project namely, *time, cost and quality* (Ahadzie et al., 2020; Chan, et al., 2017). This traditional focus of project performance has been criticized for being too narrow (Gardiner, 2000). Shenhar et al. (2002) argued that the traditional criteria (i.e. cost, time and quality) are essentially not mutually exclusive. Rather they are related to each other and do not provide an adequate vision of the potential for improvement. The proponents of additional measures of performance have considered safety of the project site as an important aspect of construction project performance (Billy et al., 2006; Haslam et al., 2005; Ortega, 2000). They also contend that construction site should have minimum disputes if the objectives are to be realised (Tabish and Jha, 2011; David, 2005). In addition, construction projects have irreversible impact on the local environment because construction process not only consume huge energy but also create the most waste, use large quantity of non-energy related resources and are responsible for the most pollution (Eriksson and Westerberg, 2011). The foregoing discussion seems to suggest that both the traditional measures (*time, cost and quality*), along with the contemporary ones (*Safety, no-dispute and environmental impact)* need to be considered together for proper evaluation of construction projects. Accordingly, the present work has considered *both traditional and contemporary measures* as key performance indicators (KPIs) of construction projects.

Evaluating the performance of construction projects on the above KPIs is, however, not so easy because a construction project is completed as a result of a combination of many events and interactions over its entire life. Thus KPIs of construction projects themselves depend on innumerable number of project-related events and variables. Researchers have suggested the inclusion of vital few factors which will capture the essence of all project related variables for measuring the performance on KPIs. These vital few factors, popularly termed as *critical success factors* (CSFs) have been classified by different researchers from different perspectives. In the present work, we have classified the factors governing the success of a project into six groups based on various characteristic features affecting the KPIs of a construction project. The six CSFs are named as *project related, client related, consultant related, contractor related, supply chain related and external environment related factors.*

The following section provides an account of literature review. Section 3 presents the pilot survey amongst few experts as also few representative respondents based in Kenya. Section 4 deals with the discussion part which is considered to be the heart of this paper. This section presents a theoretical framework of performance evaluation of construction projects depicting conceptually the impact of each factor on the overall performance of a project in terms of *time, cost, quality, safety, no-dispute and environmental impact* which, in turn, results in *community satisfaction*. This is briefly explained with help of a set of propositions. Section 5 describes, in brief, the managerial implications of the

paper. The concluding section summarizes the present work and highlights its contribution to the project management literature. This part also reveals the limitations of the present work and future research directions.

2.0 Literature Review

Literature review was carried out in two phases. Phase I is concerned with the identification of KPIs of construction project performance while phase II of literature review deals with the finalization of critical success factors (CSFs) based on their characteristic features. This was followed by a brief pilot survey to testify the appropriateness of the performance metrics (KPIs) of construction projects and the CSFs affecting the KPIs.

2.1 Literature Review (Phase I)

Performance of construction projects has primarily been evaluated on the basis of cost, time and quality criteria, famously described as 'iron triangle' (Chan, et al., 2017). These traditional criteria have faced criticism due to their inadequate coverage of performance measurement (Gardiner, 2000); the perceived relationship among themselves (Shenhar et al., 2002) and their short term focus (Shenhar, 2017).

In view of these criticisms a number of researchers have advocated for a wider focus of construction project performance to cover aspects of project safety, construction contract management, environmental impact and community satisfaction. The construction industry is said to be one of the most unsafe industry because of its high rate of fatalities (Patrick, 2011). Several researchers, (Billy et al., 2006, Haslam et al., 2005, Ortega, 2000) therefore, consider *safety* of the project site as an important aspect of construction project performance. Few other Researchers (David, 2009; Tabish and Jha, 2011) consider the *absence of disputes* to be a major reason for the smooth progress of a construction project because the progress of the construction project can be severely affected by controversies and disputes. David (2009) explains that public sector construction projects require management of all stakeholders as this will provide an opportunity for dispute resolution.

Similarly, Tsoulfas and Pappis (2020), Chen et al. (2010), Medineckiene et al. (2010), and Tan et al. (2011) have advocated the inclusion of *environmental impact* into the performance metric of construction project performance. Factors such as high energy prices, increased costs of building materials, and regulatory incentives are pushing organizations to adopt environmentally friendly construction methods. Each organization should, therefore, develop the capability of delivering sustainable projects within acceptable cost constraints. Shao and Müller (2011) reported that *community satisfaction* is the ultimate goal of every construction project, hence it must be considered while evaluating construction project performance. The most significant impact is likely to result from the displacement of residents, businesses and community services which has an adverse impact on

community satisfaction for those who remain in the vicinity of the project site (Wang and Huang, 2006).

The above review reveals that the additional dimensions namely *community satisfaction, safety, no-dispute and environmental impact* need to be incorporated into the overall performance evaluation framework of construction projects.

2.2 Literature review (Phase II)

While identifying the KPIs, the researchers came up with an innumerable number of items which have great potential to affect different dimensions of project performance. Evaluating the performance on this huge number of items is neither feasible, nor advisable. Koushki et al. (2005) and more recently Ahsan and Gunawan (2010) found that *project time and cost performance* get influenced by project characteristics, procurement system, project team performance, client characteristics, contractor characteristics, design team characteristics and external conditions. Chan and Kumaraswamy (1997) identified eight causes of delay in a construction project. Mezher and Tawil (1998) studied the causes of delay in the construction industry in Lebanon and categorized these causes into ten main groups. Kaliba et al. (2009) mentioned that poor site management and supervision leads to both time and cost overrun of a construction project. In another study, Love et al. (2005) examined project time-cost performance relationship which revealed that cost is a poor predictor of time performance.

As regards the *quality of construction projects*, research findings have revealed that design changes, lack of quality systems, contractor selection, ineffective use of information technology and inter-organizational interactions significantly influence the quality of construction projects (Alwaer and Clements-Croome, 2010; Love et al., 2010). In addition, inadequate details in drawings and rigidity in project design (Alwaer and Clements-Croome, 2010; Kaliba et al., 2009), lack of technical expertise (Kaliba et al., 2009), and unavailability of right materials or right equipments in the construction site (Kaliba et al., 2009) also affects its quality.

Typically *safety performance measure* can be evaluated through the number and the rate of fatalities and/or crashes and incidences, emergency response times. According to Tabish and Jha, (2011), among the factors for *no-dispute performance criterion* is thorough understanding and definition of owners, regular monitoring and feedback by top management, adequate communication among all project participants, availability of adequate resources and timely decisions by top management. The main factors that have been identified as *impacting negatively on the environment* include excessive use of energy (Saparauskas and Turskis 2006), emissions into the air (Medineckiene et al., 2010), releases to water, incineration and recycling process and inability to use renewable materials in construction (Medineckiene et al., 2010; Tsoulfas and Pappis, 2020) and poor construction methods (Chen et al., 2010) among others. Sirgy et al. (2010) identified 14 different life domains which were

thought to constitute *community satisfaction.* These were social life, leisure life, health life, safety life, family or home life, political, spiritual life, neighbourhood, environmental, transportation, education, work, financial, and consumer life.

Researchers have attempted to identify the common characteristic features of construction projects and classified these features into CSFs. However, no general agreement can be made regarding one uniform grouping of characteristic features into CSFs (Ameh et al., 2010). The type and nature of a project dictates as to which factor/s is/are most important for its success. The size, value of a project and its uniqueness of activities can be a puzzle for the project manager. Koushki et al. (2005) categorized the CSFs into four groups, viz. (1) industry and environment related, (2) contractor related, (3) material related and (4) client's finance related factors. Chan and Tam (2000) grouped the factors under the headings of client, project, project environment, project team leaders, project procedures and project management procedures. In the present work, we have categorized the factors into six broad heads based on various characteristic features affecting each individual KPI of a construction project. These are:

(1) *Project-related factors* which essentially deal with the type, size and complexity of construction projects and other related aspects.

(2) *Client-related factors* which are primarily concerned with the client's knowledge and experience with different type of projects as well as his project management capabilities.

(3) *Consultant-related factors* which cover aspects pertaining to the preparation of design documents, drawing details, changes in design documents, specifications of the project etc.

(4) *Contractor-related factors* which are responsible for quality management practices adopted by the contractors, their technical expertise, site management and supervision skills etc.

(5) *Supply chain related factors* encompass those factors relating to the selection of suppliers, procurement of right materials and equipment, availability of labour etc.

(6) *External environment related factors* which deal with the economic, social, political, technological and ecological environment affecting the success of a construction project.

These are shown in the following table (table 1):

Table 1: Critical success factors, related variables and their impact on project performance

CSF	Variables	KPI/s affected	References
Project related Factors	Project location and Site conditions.	• Time • Cost	Abdullah et al., (2009); Le-Hoai et al., (2020); Murali, (2013); Ibnu, (2006); Blake, (2006); Omoregie and Radford, (2006); Long et al., (2004);Frimpong et al., (2003); Jackson, (2002).
	Project size and Design Complexity of project (Type, nature and number of floors).	• Cost • Time • Quality	Jha and Iyer, (2006); Chan and Tam, (2000).

	Project managerial actions (planning and control of project activities)	• Cost • Time • Quality	Abdullah et al., (2009); Murali, (2013); Ibnu (2006); Long et al., (2004); Killian, (2003); Alwi, (2002); Yung and Yip, (2000); Chan and Tam, (2000).
	Communication system among project participants	• Cost • No- disputes • Safety.	Abdullah et al., (2009); Aksorn and Hadikusumo, (2020);Murali, (2013); Ibnu, (2006); Abudayyeh et al., (2006); Fang et al., (2004); Long et al., (2004).
	Collaboration **of** project participants	• Quality • Safety • No- disputes.	Al Haadiri and Panuwatwanich, (2011); Tang et al., (2009); Aksorn and Hadikusumo, (2020); Jha and Iyer, (2006); Abudayyeh et al., (2006); Marosszeky et al., (2002).
	Contract modifications.	• No-disputes • Cost • Time	Blake, (2006); Yiu and Cheung, (2004); Al-Moumani, (2000); Syed et al., (2003); Koushki et al., (2005).
	Quality, health and safety program on the site (Necessary variations)	• Time • Quality • Safety	Al Haadiri and Panuwatwanich, (2011); Joaquin et al., (2020); Aksorn and Hadikusumo, (2020); Fang et al., (2004); Chan & Tam, (2000).
	Budget progress monitoring	• Cost	Le-Hoai et al., (2020); Cheung and Yui, (2006); Koushki et al., (2005); Frimpong et al., (2003); Battaineh, (1999).
	Formal organization structure for dispute resolution	• No- dispute • Time.	Yiu and Cheung, (2004).
Client related Factors	Financial capability and payment schedule of the Client.	• Time • Cost	Aksorn and Hadikusumo, (2020); Abudayyeh et al., (2006); Cheung and Yui, (2006); Koushki et al., (2005); Frimpong et al., (2003); Battaineh, (1999).
	The process of project approvals.	• Time	Blake, (2006); Syed et al., (2003); Marosszeky et al., (2002).
	Client's experience on similar projects.	• Cost • Time • Quality	Abdullah et al., (2009); Murali, (2013); Ibnu, (2006); Koushki et al., (2005); Long et al., (2004); Battaineh, (1999).
	Frequent and erratic changes by the client.	• Time • No-disputes.	Ameh et al., (2010);Enshassi et al., (2009); Le-Hoai et al., (2020); Azhar et al., (2020); Ibnu, (2006); Omoregie and Radford, (2006); Creedy, (2005).
	Client's ability to make timely and objective decisions.	• Time • Quality • No-disputes.	Enshassi et al.,, (2009); Abdullah et al., (2009); Ibnu, (2006); Long et al., (2004); Frimpong et al., (2003); Syed et al., (2003) Odeh and Battaineh, (2002).
	Client's emphasis on quick construction instead of quality	• Quality • Safety	Yung and Yip, (2010); Joaquin et al., (2020); Syed et al., (2003); Frimpong et al., (2003); Odeh and Battaineh, (2002).
	Client's emphasis on low construction cost	• Quality • Safety	Enshassi et al., (2009); Abdullah et al., (2009); Azhar et al., (2020); Jha and Iyer, (2006); Frimpong, et al., (2003).
Consultant related factors	Consultant's commitment to ensure compliance of construction work according to specification.	• Quality • No- disputes. • Community satisfaction.	Syed, (2003); Alwi, (2002); Wong and Fung, (1999).
	Adequacy of design, specifications and	• Quality • No- dispute	Al Haadiri and Panuwatwanich, (2011); Aksorn and Hadikusumo, (2020); Blake, (2006); Abudayyeh et al.,

	documentations.		(2006); Killian, (2003); Alwi, (2002).
	Design team experience and technical skills.	• Quality • Time	Abdullah et al., (2009); Long et al., (2020); Ibnu, (2006); Blake, (2006); Long et al., (2004); Killian, (2003).
	Delay in production of design documents	• Time.	Blake, (2006); Al-momani, (2000).
	Variations to Original design during construction	• Time • Cost • No-disputes.	Koushki et al., (2005); Syed et al., (2003).
Contractor related Factors	Management skill of Site Managers (in controlling workers and sub-contractors)	• Time • Cost • Quality	Ameh et al., (2010); Enshassi et al., (2009); Abdullah et al., (2009); Le-Hoai et al., (2020), Azhar et al., (2020); Leonard, (2020); Murali, (2013); Ibnu (2006); Omoregie and Radford, (2006); Long et al., (2004); Frimpong et al., (2003); Killian, (2003); Wong and Fung, (1999).
	Contractor's technical skills and Experience.	• Cost • Time • Quality.	Ameh et al., (2010); Enshassi et al., (2009); Abdullah et al., (2009); Murali, (2013); Ibnu (2006);Long et al., (2004); Frimpong, et al., (2003); Odeh and Battaineh, (2002).
	Size and skills of the labor force	• Cost • Time	Le-Hoai et al., (2020), Azhar et al., (2020); Abdullah et al., (2009); Murali, (2013); Ibnu, (2006).
	Construction method adopted	• Cost • No- disputes • Safety	Abdullah et al., (2009); Long, et al., (2004);Alwi, (2002).
	Cash flow of the contractor (payments to sub-contractors and workers)	• Time • Cost • No- disputes.	Abdullah et al., (2009); Le-Hoai , et al., (2020); Murali, (2013); Ibnu, (2006); Long et al., (2004); Frimpong, et al., (2003).
Supply chain related Factors	Availability of skilled and experienced workers	• Time • Cost • Quality.	Abdullah et al; (2009); Kaliba et al., (2009);Le-Hoai et al., (2020), Azhar et al., (2020).
	Availability of the right material	• Cost • Time • Quality	Yung and Yip, (2010); Kaliba et al., (2009);Joaquin et al., (2020);Le-Hoai et al., (2020); Azharet al., (2020); Murali, (2013); Ibnu, (2006); Blake, (2006); Omoregie and Radford, (2006); Creedy, (2005) ; Long et al., (2004); Frimpong et al., (2003); Jackson, (2002).
	Adequacy of working capital	• Time	Abdullah et al (2009);Le-Hoai et al., (2020); Azhar et al., (2020); Murali, (2013); Ibnu, (2006); Long et al., (2004).
	Availability of suitable equipment.	• Cost • Time • Quality • Safety	Al Haadiri and Panuwatwanich, (2011); Kaliba et al., (2009).Frimpong et al., (2003); Long et al., (2020); Leonard, (2020); Aksorn and Hadikusumo, (2020);Murali, (2013); Ibnu, (2006);
	Internal procurement challenges	• Time • Cost	Gosling et al., (2010); Enshassi et al., (2009); Abdullah et al., (2009); Murali, (2013); Frimpong et al., (2003).
onme nt relate	Social, Political and Cultural issues of the community.	• Environment.	Ameh et al., (2010); Koushki et al., (2005); Yiu and Cheung, (2004); Long et al., (2004).

	Weather conditions	• Cost • Time • Quality	Jha and Iyer, (2006); Chan and Tam, (2000); Al-Momani, (2000).
	Economic situation (Boom or Meltdown)	• Cost • Time • Quality	Ameh et al., (2010); Enshassi et al., (2009); Abdullah et al (2009); Le-Hoai et al., (2020), Azhar et al., (2020); Ibnu (2006); Creedy (2005) ;Frimpong et al., (2003).
	Governance policy in the relevant government agencies.	• Cost • No- disputes • Safety.	Tan et al., (2011);Blake, (2006); Syed et al., (2003); Marosszeky et al., (2002).
	Technological advancement of project location	• Quality • Cost	Long et al., (2004);Frimpong et al., (2003); Alwi (2002).
	Industrial relations and physical environment.	• No- disputes • Cost • Time	Tan, (2011); Gangollels, (2011); Medineckiene, (2010); Kamrul and Indra, (2010) Jha and Iyer, (2006).

3.0 Pilot Survey

The list of Key Performance Indicators (KPIs) and Critical Success Factors (CSFs) derived from the literature review were shown to 5 experts comprising 2 academicians, 2 practitioners and 1 consultant in order to secure their viewpoints regarding the suitability of the above KPIs and CSFs in performance measurement of construction projects in developing countries. The two academicians are university professors at the University of Nairobi and Kenyatta University, Kenya in the area of project planning. They were selected because they have had over 10 years of teaching and consulting experience for many government projects. Due to their rich experience, they were thought to be familiar with economic, socio-cultural and political environment surrounding various projects earmarked for this study. They also understood resource and expertise requirements for various projects. The practitioners were chairmen of two regional associations of contractors, Busia and Kakamega counties in Western province, Kenya. The choice of these practicing managers was based on their constant interaction with other contractors in their respective regions. They are also expected to intervene in solving disputes that arise between contractors and any other stakeholder in project construction. The fifth expert, a regional public works officer in charge of the Busia County is responsible for all construction projects funded by the Government in Busia County. This officer was chosen because he has been the regional officer since 2003 when the Government of Kenya started funding projects through Constituency Development Fund (CDF).

Despite community satisfaction having been considered a project performance criterion (Shao and Müller, 2011) in literature, the experts felt that it should be excluded because it was thought to be a consequence of performance and cannot therefore be used to measure performance. They reiterated that the exclusion of community satisfaction from performance metrics could help better explore the remaining key performance indicators. On critical success factors, the practitioner experts explained that project success factors varied widely from project to project and there is no standard classification

of these factors. All experts agreed that by applying these CSFs against the six KPIs, the stakeholders will be able to evaluate the performance of public sector construction projects on its different dimensions.

The literature review along with the feedback received from experts on KPIs and specific variables pertaining to various groups of CSFs enabled us to develop a theoretical framework of construction project performance. This framework (figure 1) demonstrates how *project related (PX_1 PX_2……PX_n), client related (CX_1, CX_2……CX_n), consultant related (SX_1, SX_2,……SX_n), contractor related (RX_1, RX_2……RX_n), supply chain related (LX_1, LX_2,……LX_n)* and *external environment related factors (EX_1,EX_2……EX_n)* influence the overall project performance in terms of six performance indicators, i.e. *time, cost, quality, safety, minimum site disputes and environmental impact* and eventually lead to *community satisfaction*. The diagram further reveals how the above six factors are interrelated.

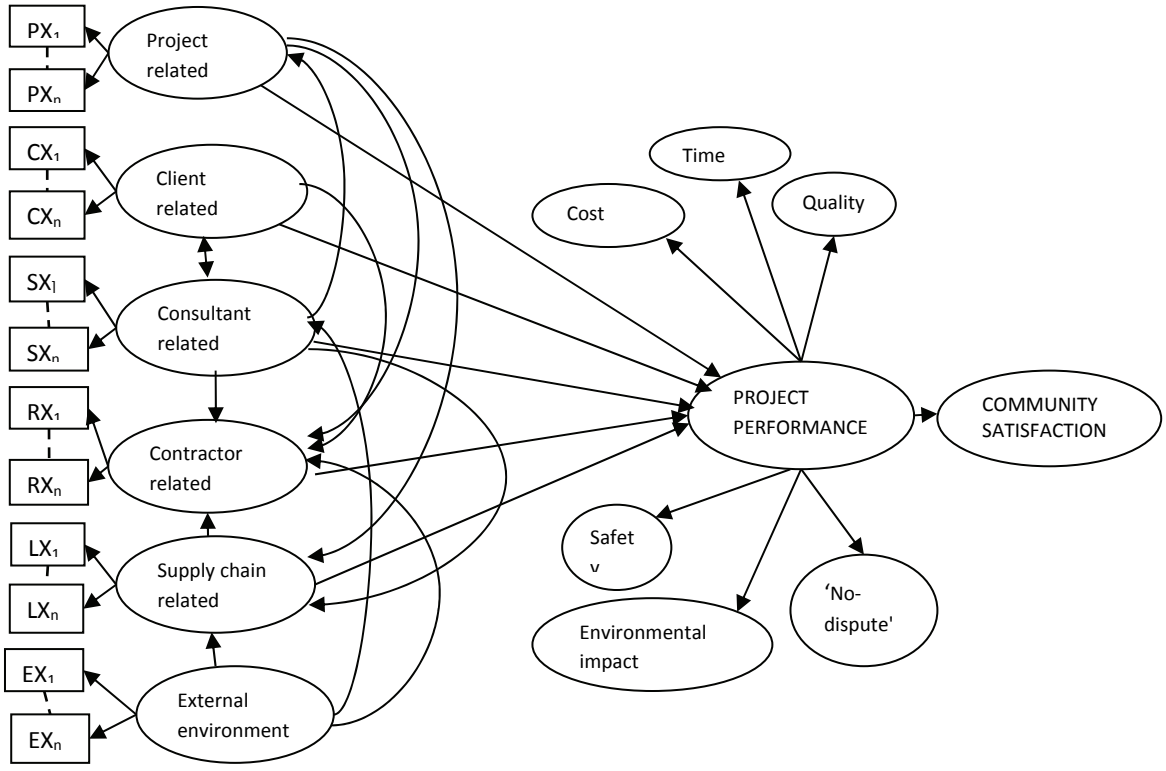

Figure 1: Theoretical framework of performance evaluation of construction projects

The theoretical framework enabled us to design a preliminary questionnaire on the relationship between KPIs and CSFs. The questionnaire was presented to the same experts once again with a view to seeking their expert opinion on the adequate and appropriate coverage of all the items affecting the performance of construction projects and also the framing of each question. The comments received helped us in refining the questionnaire further.

This preliminary questionnaire was then administered to a few representative respondents based in Busia County in order to judge its workability in reality. The aim was to examine whether the respondents understood the language of the questionnaire and whether the items on which responses are being sought are appropriate. The questionnaire survey was carried out through personal interview among 5 contractors (including 2 sub-contractors), 3 consultants and 4 clients, who were working on 10 ongoing construction projects. The list of the stakeholders used in this survey was drawn primarily from a database of contractors/builders, consultants and CDF committees in Western province maintained by the CDF regional office in Western Province**.** These respondents were found to have over 7 years experience in the construction industry and had been involved in the construction of CDF projects for at least 3 years. Further, they handled over 4 CDF projects per year in various constituencies. They are, therefore, expected to have varied experience by playing different roles in different projects with different capacity. Some of the projects identified were educational, health and agricultural markets. This implies that these respondents are capable of providing the information requested in the questionnaire.

The respondents indicated that the KPIs and the CSFs are very much relevant to the construction industry in developing countries. They, however, stated that some of the questions need to be rephrased for ease of understanding given the varying level of education of the prospective respondents. They also indicated that the classification of items into various factor groupings was not mutually exclusive. They explained that there were items that could fall under more than one classification group. They also mentioned that information pertaining to cost and time overruns, deficiencies in project quality, occurrence of accidents and emergence of project disputes could be obtained from project records maintained by the stakeholders. These viewpoints have aided in the design of final questionnaire whose validity and reliability would further be sought before actual administration.

4.0 Discussion

The relationship between the set of factors and overall project performance and also between the factors themselves as depicted in figure 1 through arrows has been captured with the help of 20 propositions. An arrow emanating from a particular group of factors to the overall project performance indicates that the factor group influences the performance of the project. Further an arrow originating from one group of factors to another group indicates that the factor group with the tail end of the arrow influences the factor group with the head end of the arrow. Two factor groups having an arrow between them with head at both the ends imply that the factor groups influence each other. Further the arrows coming out from one factor group towards the individual variables point out that the factor group is composed of those variables. The arrows emerging out of overall project performance towards time, cost, quality, safety, minimum site disputes and environmental impact

indicate that the project performance is evaluated on these performance metrics. Finally the arrow coming out of overall project performance towards community satisfaction indicates that project performance influences community satisfaction. Based on the theoretical framework of the performance evaluation of construction projects shown in figure 1, we have developed a set of 20 propositions. These are described below in a concise form.

While describing the problems faced by the construction projects, previous researchers have cited quality (Ogano, 2010; Love et al, 2010; Jha and Iyer, 2006), time (Kamrul and Indra, 2010; Williams, 2003) and cost (Kaming et al, 1997) as the main measures of project performance. The implication is that every project should be completed on time, within the budget and should also adhere to the performance specifications. The contemporary findings suggest that the project should also consider safety (Billy et al., 2006, Haslam et al., 2005, Ortega, 2000), remain free from disputes (David, 2009; Tabish and Jha, 2011) and should have minimum environmental impact (Ding 2005; Shen et al, 2005).
Proposition 1: *Performance of construction projects is measured using six performance dimensions, i.e. time, cost, quality, safety, 'no-dispute' and environmental impact.*

Project scope, nature of the project and the complexity of the project referred to as the project characteristics collectively determine the construction process (Walker, 1994) which eventually determines overall performance of a project.
Proposition 2: *Project related factors have a direct effect on the overall performance of public sector construction projects.*

Project related characteristics will determine the kind of technical skills and expertise required by the contractors in undertaking the execution of a project.
Proposition 3: *Project related factors have a direct effect on contractor related factors.*

The project characteristics define the kind of materials, equipment and labour to be used for construction. This, in essence, determines the type of construction supply chain to be employed for successful completion of the project.
Proposition 4: *Project related factors have a direct effect on supply chain related factors.*

The client conceptualizes a project idea and eventually translates his idea into design/construction intent by employing expert vendors. Client takes care of outsourcing the technical aspects of a project and manages quality assurance through constant monitoring during project execution.
Proposition 5: *Client related factors have a direct effect on overall project performance.*

The client develops a conceptual sketch of the intended project which essentially reflects his expectation from the project. He engages a consultant who is given the responsibility of designing the

blue-print of the project based on his conceptual sketch. Subsequently the consultant attempts to give a physical shape to the blue-print with the help of contractors.

Proposition 6: *Client related factors have a direct effect on consultant related factors.*

The client is central to project implementation because he involves himself in selecting a suitable contractor/s and constantly supervises the progress of the construction work. The nature and type of the client (whether belonging to public or private sector), the clarity of the project mission, the competency of the client in terms of the ability to brief, make decisions, and define roles etc. have been found to significantly affect the performance of the contractor/s (Naoum,1991).

Proposition 7: *Client related factors have a direct effect on contractor related factors.*

In many occasions, the consultant (architect or engineer) acts as the project coordinator. His or her role is to design the works, prepare the specifications, produce construction drawings, administer the contract, tender the works, and manage the works from inception to completion (Ratnasabapathy, 2020). The detailed drawings also include the specifications of construction materials on the basis of which materials are procured from vendors. This significantly affects the performance of a construction project.

Proposition 8: *Consultant related factors have a direct effect on the overall performance of public sector construction projects.*

The project consultant designs the project giving it an identity that later defines project characteristics. In project performance literature, issues such as complexity of designs and the accompanying documents have been cited to affect the project related issues (Alwaer and Clements-Croome, 2010, Othman, et al, 2006, Kaming, et al., 1997).

Proposition 9: *Consultant related factors have a direct effect on project related factors.*

The consultant is responsible for advising the client at various stages of the construction project especially on necessary changes and variations. Accordingly, the client takes a pragmatic decision on incorporating necessary modifications into a project (Al-Tmeemy et al., 2010; Ahadzie et al., 2020; Chan and Kumaraswamy, 1997).

Proposition 10: *Consultant related factors have a direct effect on client related factors.*

The consultant provides drawings which produce detailed specifications to be used by the contractor/s. In addition, the consultant also prepares detailed documents of project design and provides the same to the contractor/s which serve as guidelines in construction work (Alwaer and Clements-Croome, 2010; Kaliba et al, 2009; Saqib et al, 2020).

Proposition 11: *Consultant related factors have a direct effect on contractor related factors.*

Through the development of project design, the consultant specifies the kind of material, labour and equipment to be used in a construction project, generally referred to as project bill of quantities. Issues concerning the availability of labour, equipment and materials are important in supply chain management.

Proposition 12: *Consultant related factors have a direct effect on supply chain related factors.*

In many developing countries, contractors are usually private firms or individuals who undertake construction of a project under certain terms and conditions as suggested by the client while agreeing to complying with the design and specifications provided by the consultant. Construction contractors undertake the construction work in accordance with the prescribed technical, managerial and contract specifications (Wang, 2006), which essentially influence the performance of public sector construction projects.

Proposition 13: *Contractor related factors have a direct effect on the overall performance of public sector construction projects.*

Unless project resources arrive in right time and right place, achieving success in construction project is very difficult. Actual practice in construction does not seem to address the issues of supply chain management (SCM). Rather it follows practices that make supply chain performance worse. SCM can play major roles in construction. Some application areas of SCM include the reduction in logistics costs, decrease in lead-time and inventory across the supply chain (Vrijhoef and Koskela, 2000).

Proposition 14: *Supply chain related factors have a direct effect on the overall performance of public sector construction projects.*

Effective construction SCM must coordinate all different pieces of supply chain in a timely manner without losing any aspect of quality, while still keeping costs down. The flow of materials, labour and equipment on site has a significant bearing on the pace and quality of the construction work.

Proposition 15: *Supply chain related factors have a direct effect on contractor related factors.*

The construction industry is considered to be the backbone of many economies. Its uniqueness throughout the world is determined by the external environment in which it operates. Litsikakis (2009) argues that external environment can be said to be the combination of ecological, political, economic, socio-cultural and technological (EPEST) context in which the project is executed. Thus the operating environment of projects is characterized by high degree of uncertainty and complexity, when compared to the operating environment of general business operations. Because different projects within the same environment are likely to differ in their performance, the environmental effects are said to be indirect since they have to combine with some other characteristics in the project environment.

Proposition 16: *External environment related factors have an indirect effect on the overall performance of public sector construction projects.*

While designing a construction project for a particular location, the consultant has to keep in mind the ecological environment of that location and accordingly has to comply with the statutory guidelines for designing the project. He should design such projects which will minimize environmental degradation, avoid depletion of raw materials and encourage the use of environmentally friendly methods (Gangolells, et al., 2011; Tan et al, 2011; Ortiz et al, 2009; Tsoulfas and Pappis, 2020).

Proposition 17: *External environment related factors have a direct effect on consultant related factors.*

In many cases, the construction process is guided by certain environmental guidelines in order to minimize the impact of construction work on the environment. In every country, government provides environmental codes to guide construction of new projects (Tan et al, 2011; Ortiz et al., 2009; Tsoulfas and Pappis, 2020) which the contractors are expected to comply with.

Proposition 18: *External environment related factors have a direct effect on contractor related factors.*

The materials, labour and equipment used in construction come from the external environment. Because of this, the environment plays an important role in the construction process in terms of uninterrupted supply of inputs.

Proposition 19: *External environment related factors have a direct effect on supply chain related factors.*

Realization of the key performance indicators of time, cost, quality, health and safety, no-dispute and minimum environmental impact means that the project is capable of providing satisfactory services to the community.

Proposition 20: *Construction project performance leads to community satisfaction.*

5.0 Managerial Implications

Project environment is highly uncertain and a construction project undergoes a lot of amendments at different stages of its life cycle due to changes in the economic, political, societal and ecological environment. As such, assuming the task of executing a construction project is a gigantic exercise in itself. The conceptual framework shown in figure 1 provides valuable insight to the managers involved in a construction project with regard to the interplay of different factors on overall project performance. This also gives them an idea about how a particular factor influences other factors and

also gets affected by other factors. This will enable the project managers to understand the antecedents and consequents of each factor and their combined impact on overall project performance. Of course, the exact nature of relationship between the antecedents and a factor as also between the factor and the consequents could only be ascertained after collecting relevant data from the respondents and carrying out appropriate statistical tests. The relative impact of each factor on the overall performance could also be assessed after conducting suitable statistical tests. Nevertheless, this would definitely enhance the understanding and sensitivity of the project manager about different dimensions of construction project environment. Project manager will no longer merely be motivated by the economic factors for the success of a project. Rather he will incorporate additional dimensions of construction project performance, i.e. environmental and community related factors for evaluating its success.

6.0 Conclusion

In this paper, we have demonstrated the rationale behind considering six performance dimensions (KPIs) of a construction project namely *time, cost, quality, safety, minimum site disputes and environmental impact* as opposed to the traditional three dimensions i.e. time, cost and quality for evaluating its performance. The traditional framework evaluates a construction project merely from economic perspective. The new framework incorporates both societal and environmental dimensions into the traditional one and thus adds holistic flavour to the performance evaluation framework.

This has been followed by the identification of CSFs through an extensive review of literature. Review of literature pertaining to CSFs has given us an insight on identifying the broad constructs influencing the performance of construction projects on any of its performance dimension/s. The review has further enabled us to categorize the above constructs under six heads based on their common and unique features and also give them suitable nomenclature to the same. The identified six constructs are *project-related factors, client-related factors, consultant-related factors, contractor-related factors, supply chain related factors and external environment-related factors.*

We have carried out a pilot survey amongst few experts in order to find out the appropriateness of the KPIs and CSFs and have developed a theoretical framework of the performance evaluation of construction projects with the help of the above six CSFs and six KPIs in terms of *time, cost, quality, safety, minimum site disputes and environmental impact*. We have conceptually demonstrated how various factors affect the performance of construction projects and subsequently how overall project performance leads to *community satisfaction*. The conceptual diagram also indicates how the factors are related among themselves. This gives us an extremely valuable insight on positing the relationship between the set of factors and the overall project performance, between overall project performance and community satisfaction and also between the factors themselves which has been described

through a set of 20 propositions. The theoretical framework, in fact, enabled us to design a preliminary questionnaire and administer the same to a few respondents to find out its efficacy in bringing out responses from them. The performance evaluation framework developed in this paper is expected to contribute to the existing body of project management literature in terms of exploring the variegated nature of relationship as described above. The framework will not merely help evaluate construction projects, the same could also assist in evaluating other kinds of projects with suitable modifications.

However, the paper is not without limitations. The CSFs have been identified and subsequently classified based on literature review, preliminary pilot survey and our own subjective judgment. Secondly, the propositions put forth in this paper are merely based on our own observation, understanding and the concepts developed through literature review and pilot survey. The empirical testing of the propositions has not been shown in the paper which would have evaluated the validity and theoretical soundness of the conceptual framework from practical standpoint. The same would be considered as the foundation of our future research directions.

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