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Effect of Project Performance on Organization Performance in Sudanese Construction Industry

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ABSTRACT

This paper aims at designing a model to relate construction project performance to Sudanese construction organization performance using financial and non-financial metrics along with objective and subjective measures. The study used an extensive literature review in the field of construction management and professional advice in order to design a questionnaire for data collection. EQS6.2 software was used for data analysis and model fit evaluation. The model showed a strong relationship between construction project performance and Sudanese construction organization performance, as well as strong relationships between construction project performance and its metrics ("project profitability", "external customer satisfaction" and "internal customer satisfaction"). Furthermore, strong relationships were found between Sudanese construction organization performance and its metrics ("financial", "customer", "internal business" and "learning and growth" perspectives).

KEYWORDS: Construction project performance, Construction organization performance, Customer satisfaction, Sudan.

INTRODUCTION

The improvement of performance has become more and more critical to the success of construction projects. It has been the main subject of a considerable number of research studies over the past two decades. Smyth (2010) pointed out that there has been a range of initiatives across many countries over the past 10 to 15 years to introduce reform to the construction process in order to improve performance. Particularly, the Sudanese construction industry is of interest due to the current rapid growth of the Sudanese economy and the significant number of large construction projects being implemented in both public and private sectors.

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Egan (1998) and Latham (1994) highlighted the need to improve the design and construction processes and suggested that improvement could be achieved by reducing the number of variations and resistance to adopt a shared learning program. Egan focused on the issues of product development and project implementation which can be achieved through the adaptation of a generic product to a specific site. As such, innovation and shared learning can be achieved, thereby enabling sustained improvement.

Measuring performance was seen as a way to bypass the current situation. Since then, performance improvement and measurement have become requirements in construction industry, mainly due to their roles as strategic tools in the pursuit of success and sustained improvement. Companies needed to know their status in the industry, what they have to improve and how to influence their sub-ordinate behavior (Neely, 2011). Accordingly, Neely (2011) summarized the reasons for measuring performance. All of these reasons were also pertinent to construction industry (Beatham et al., 2004). After becoming aware of the reasons and the importance of measuring performance, new research areas have arised for the investigation of factors affecting performance. As a result, new concepts related to performance, such as: performance measures, performance drivers, key performance indicators (KPIs), critical success factors, success criteria, project success and failure, project management performance, project performance, organization performance, have been added to the literature. Although the majority of these developments were in manufacturing industry, increased globalization and similarities in different industries have pushed construction industry and construction management researchers to look for new ways to achieve performance improvement.

Traditionally, construction industry research was focused mainly on project performance (Ward et al., 1991; Mohsini and Davidson, 1992). Moreover, the performance of projects was assessed based on the extent to which the client's objectives like cost, time and quality were achieved (Ward et al., 1991; Mohsini and Davidson, 1992; Smallwood and Venter, 2001). Although these three measures provide an indication of the success or failure of a project, they do not, in isolation, provide a balanced view of the project's performance, in addition to that their implementation in construction projects is apparent only at the end of the project. Therefore, as suggested by Kagioglou et al. (2001), these three measures can only be classified as "lagging" rather than "leading" indicators of performance. International research also supports this argument, which indicates that performance relative to cost, quality and schedule is influenced by other factors, like: health and safety, productivity, performance relative to the environment and employee satisfaction (Smallwood and Venter, 2001) (Figure 1).

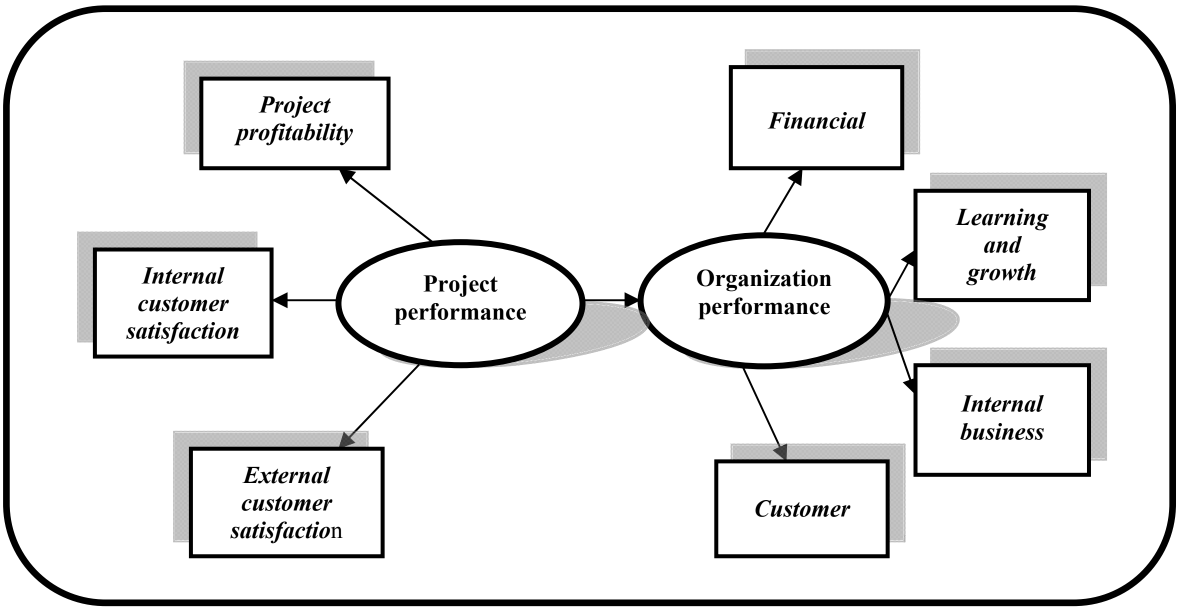

Figure (1): A proposed performance measurement model

Table 1. Performance measures and indicators

Project performance	Organization performance
Project profitability	Financial perspective
Internal customer satisfaction	Internal business perspective
External customer satisfaction	Learning and growth perspective
	Customer perspective

Construction organizations should properly understand how they are currently performing and how they need to perform in the future. However, as in other industries, performance measurement primarily focuses on traditional bottom-line performance measures, such as: efficiency, return on capital employed and profitability which have been defined as retrospective. Hence, they fail to assess the true performance of construction projects and organizations (Kagioglou et al., 2001). The result obtained from such a financial performance measurement system provides limited use for the long-term, strategic construction business planning (Love and Holt, 2000).

BACKGROUND

A comprehensive review of existing literature was carried out in order to identify the performance measures at both organization level and individual project level. Besides, the validity of the determined performance measures and the model was justified by consulting some industry professionals and presenting a theoretical background.

Project Performance

A variety of different projects constitute the structure of construction industry. In spite of the fact that a similar set of processes are performed, each project is unique and considered as a prototype (Wegelius-Lehtonen, 2001). Thus, it can be inferred that measuring performance at the project level is more characteristic than measuring performance at the organization level (Kagioglou et al., 2001). Construction industry is a very dynamic industry which accommodates different uncertainties regarding new technologies, budgets and development processes (Chan et al., 2004). In order to cope with these uncertainties, different interrelated components that influence performance should be considered. In the current study, three indicators were assumed to carry more importance than the other criteria and were therefore selected in order to cover the factors affecting project performance. These indicators are: project profitability, internal customer satisfaction and external customer satisfaction.

Organization Performance

Balanced Scorecards (BSC) perspective was adopted in this study because of its established status and common use in different industries, including construction industry. It is a framework for measuring the strategic, operational and financial characteristics of an organization. It combines four perspectives to assess the performance of an organization (financial, learning and growth, internal business and customer perspectives).

Model Fit Indices

In order to evaluate the model fit, model fit indices are used. There are dozens of model fit indices described in the Structural Equation Modeling (SEM) literature, and new indices are being developed all the time. It is up to the properties of data to decide which particular indices and which values to report (Kenny and McCoach, 2003; Marsh et al., 1996).

Described below is a minimal set of fit indices to be reported and interpreted when reporting the results of SEM analysis of this study.

Model Chi Square *($\chi 2$)*

It is also known as the likelihood ratio Chi Square or the generalized likelihood ratio. If $\chi 2 = 0$, the model perfectly fits the data. As the value of $\boldsymbol{\chi 2}$ increases, the fit of an over-identified model becomes increasingly worse. The only parameter of a central chi-square distribution is its degrees of freedom.

Root Mean Square Error of Approximation (RMSEA)

RMSEA is a parsimony-adjusted index in that its formula includes a built-in correction for model complexity. This means that given two models with similar overall explanatory power for the same data, the simpler model will be favored. A rule of thumb is that RMSEA ≤ 0.05 indicates close approximate fit, values between 0.05 and 0.08 suggest reasonable error of approximation and RMSEA ≥ 0.10 suggests poor fit (Browne and Cudeck, 1993).

Comparative Fit Index (CFI)

CFI is one of a class of fit statistics known as incremental or comparative fit indices, which are among the most widely used indices in SEM. All these indices assess the relative improvement in fit of the researcher's model compared with a baseline model.The latter is typically the independence model, also called the null model, which assumes zero population covariance among the observed variables. When means are not analyzed, the only parameters of the independence model are the population variances of these variables. The value of CFI falls within the range $0 \leq \text{CFI} \leq 1.0$.

Non-Normed Fit Index (NNFI)

NNFI is sample-based and parsimony-adjusted. Its value can fall outside of the range (0 – 1.0). NNFI is also called the Bentler-Bonett non-normed fit index or the Tucker-Lewis index (TLI). NNFI is similar to NFI, but penalizes for model complexity. It is one of the fit indices less affected by sample size.

MATERIALS AND METHODS

A questionnaire survey was used to elicit the attitudes of contractors towards the factors affecting the performance of construction projects and organizations in the Sudanese construction industry. The target population of contractors was comprised of those contractors registered at the Sudanese Contractors Association as well as at the Organizing Council of Engineering Works Contractors. 114 questionnaires were distributed to contractors. 93 of them were returned, with a response rate of 82.1%. The questionnaire has been validated by the criterion-related reliability test which measures the correlation coefficient between the factors affecting the performance of construction projects and the structure validity test.

The respondents were experienced construction project managers and organization managers. Seven factors were believed to affect project and organization performance, and these factors were considered in this study. They were listed under two groups based on the literature reviewed. The two groups considered in this paper are: project performance and organization performance. Computer software EQS 6.2 was used for the analysis of the questionnaire data.

RESULTS AND DISCUSSION

Basic Steps of Structural Equation Modeling (SEM)

SEM has been described as a combination of exploratory factor analysis and multiple regression (Ullman, 2001). We like to think of Structural Equation Modeling (SEM) as Confirmatory Factor Analysis (CFA) and multiple regression, because SEM is more a confirmatory technique although it can also be used for exploratory purposes. However, SEM, in comparison with CFA, extends the possibility of relationships among the latent variables and encompasses two components as a measurement model and a structural model. Within the context of structural modeling, exogenous variables represent those constructs that exert an influence on other constructs under study and are not influenced by other factors in the quantitative model. Those constructs, identified as endogenous, are affected by exogenous and other endogenous variables in the model. Basic steps in the structural equation modeling (SEM) technique are;

- □ Specification of the model.
- □ Estimation and identification of the model.
- □ Evaluation of the model fit.

Validity of the Measurement Model

The data obtained from the 93 construction organizations and 325 projects under study were analyzed by using Structural Equation Modeling (SEM) software package EQS 6.2. In this part of the paper, after testing the validity of the measurement model, the analysis results of the structural model will be presented.

Content validity tests rate the extent to which a constituent variable belongs to its corresponding construct. Since content validity cannot be tested by using statistical tools, an in-depth literature survey is necessary to keep the researcher's judgment on the right track (Dunn et al., 1994). An extensive literature survey was conducted to specify the variables that define latent variables.

The scale reliability is the internal consistency of a latent variable and is measured most commonly with a coefficient called Cronbach's alpha. The purpose of testing the reliability of a construct is to understand how each observed indicator represents its correspondent latent variable. According to EQS 6.2 analysis results, Cronbach's alpha values were: 0.716 for "projects performance" and 0.846 for "organization performance". These reliability values are satisfactory, since the Cronbach's alpha coefficients are all above 0.70, the minimum acceptable value (Nunnally, 2010). Convergent validity is the extent to which the latent variable correlates to corresponding items designed to measure the same latent variable. Ideally, convergent validity is tested by determining whether the items in a scale converge or load together on a single construct in the measurement model. It is stated that if the factor loadings are statistically significant, then convergent validity exists (Dunn et al., 1994). Since sample size and statistical power have substantial effects on the significance test, this statement needs expansion. To assess convergent validity, the researcher should also assess the overall fit of the measurement model, as well as the magnitude, direction and statistical significance of the estimated parameters between latent variables and their indicators. The model parameters were assessed and all factor loadings were found to be significant at $\alpha = 0.05$.

The discriminant validity is the extent to which the items representing a latent variable discriminate that construct from other items representing other latent variables. Low correlations between variables indicate the presence of discriminant validity. The correlation metrics calculated for all constructs shows that all intercorrelations are below 0.90, suggesting that there is no multi-collinearity (Hair et al., 2010), but indicating that the constructs have discriminant validity and these correlations provide evidence that they are complementary.

Validity of the Structural Model

The effect of project performance on organization performance was investigated through their constituent variables. Projects performance was indicated by three factors (project profitability, internal customer satisfaction and external customer satisfaction) in the model which summarize the critical success factors of a project. The indicators of organization performance were taken from the perspectives of the Balanced Scorecard of Kaplan and Norton; namely, "financial", "learning and growth", "internal business" and "customer" perspectives as shown in Figure (2).

The structural model was analyzed and the model fit indices were found to be very close to perfect values of recommended ranges. Non-normed index has a value of 0.961, comparative fit index has a value of 0.965, Root Mean Square of Error Approximation (RMSEA) has a value of 0.077 and chi square over degree of freedom has a value of 1.340 as shown in Table (2) which can be considered as an evidence of the strength of relationship between two constructs.

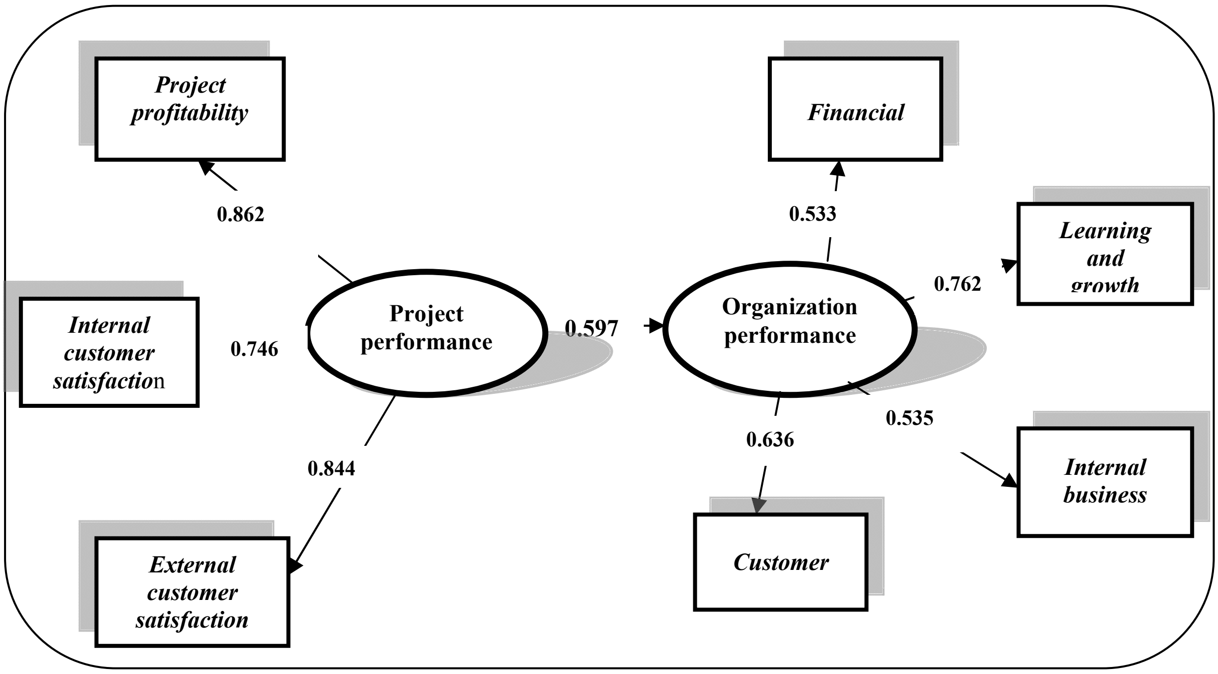

Figure (2): The effect of "project performance" on "organization performance"

Table 2. Model fit indices for "projects performance to organization performance"

Fit indices	Allowable range	Overall
NNI	0 (no fit)-1 (perfect fit)	0.961
CFI	0 (no fit)-1 (perfect fit)	0.965
RMSEA	< 0.1	0.077
$\chi2$/ dof	< 3	1.340

Then, within the structural model illustrated in Figure (2), the relations can be calculated as shown below.

Project profitability × 0.862 × 0.59 = 0.533 × Financial perspective,

0.966 × Project profitability=Financial perspective. (1)

The remaining equations which have the ability to evaluate the effect of "project performance" on "organization performance" indicators are shown below:

0.836×Internal customer satisfaction = Financial perspective (2)

0.990×External customer satisfaction = Financial perspective (3)

0.675×Project profitability = Learning and growth perspective (4)

0.585×Internal customer satisfaction = Learning and growth perspective (5)

0.693×External customer satisfaction = Learning and growth perspective (6)

0.962×Project profitability = Internal business perspective (7)

0.932×Internal customer satisfaction = Learning and growth perspective (8)

0.987×External customer satisfaction = Learning and growth perspective (9)

0.809×Project profitability = Customer perspective (10)

0.700×Internal customer satisfaction = Customer perspective (11)

0.830×External customer satisfaction = Customer perspective (12)

CONCLUSIONS

Construction is an industry which assembles separate organizations in a temporary multi-disciplinary organization to produce utilities, like: buildings, roads, bridges,… etc. In this regard, construction organizations are project-based organizations and it is not far-fetched to argue that "project performance" has a direct effect on "organization performance". Therefore, it was decided to evaluate the effects of "project performance" measures, such as: project profitability, internal customer satisfaction and external customer satisfaction on "organization performance" perspectives, such as: financial, learning and growth, internal business and customer perspectives in a separate model. Highly satisfactory and reliable findings of the analysis verified this approach.

The prominent highlights of the model were the effects of internal/external satisfaction on the performance regarding the customer perspective and the effect of project profitability corresponding to financial perspective. In internal business perspective, emphasis is placed on identifying and measuring the processes that organizations must excel at to meet organizational and client/user expectations in order to achieve their profitability and satisfaction goals.

The major findings of the study indicated that construction industry is conceived to the new challenges of business environment in the pursuit of success and that there is a considerable change in the perceptions of the construction organizations. Traditional criteria of success, such as finance and profitability, which are short-term factors, yielded long-term strategic factors of success, such as: research and development activities, organizational learning and customer satisfaction, thereby leading to long-term contributions of individual projects to enhance the performance perspectives which have the ability to provide sustainability to the organizations.

REFERENCES

Beatham, S., Anumba, C. J., Thorpe, T., and Hedges, I. (2004). "KPIs – a critical appraisal of their use in construction." Benchmarking, 11 (1), 93-117.

Browne, M.W., and Cudeck, R. (1993). "Alternative ways of assessing model fit." In K. A.Bollen and J. S. Long (Eds.). Testing Structural Equation Models. Newbury Park, CA: Sage.

Chan, A.P.C., and Chan, A.P.L. (2004). "Key performance indicators for measuring construction success." Benchmarking, 11 (2), 203-221.

Dunn, S.C., Seaker, R.F., and Waller, M. A. (1994). "Latent variables in business logistics research: scale development and validation". Journal of Business Logistics, 15 (2), 145-172.

Egan Sir, J. (1998). "Rethinking construction". Department of Environment, Transport and Regions, London, UK.

Hair, Jr., J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (2010)."Multivariate data analysis". Prentice-Hall, Englewood Cliffs, N.J.

Kagioglou, M., Cooper, R., and Aouad, G. (2001). “Performance management in construction: a conceptual framework." Construction Management and Economics, 19 (12), 85-95.

Kenny, D.A., and McCoach, D.B. (2003). “Effects of number of variables on measures of fit in structural equation modeling”. Structural Equation Modeling, 10 (3), 333-351.

Kline, R.B. (2011). "Principles and practice of structural equation modeling". Guilford Press, New York, NY.

Latham Sir, M. (1994). "Constructing the team". HMSO, London.

Love, P.E.D., and Holt, G.D. (2000). “Construction business performance measurement: the stakeholder perspective measurement alternative.” Process Management Journal, 6 (5), 408-416.

Marsh, H.W., Balla, J.R., and Hau, K.T. (1996). “An evaluation of incremental fit indices: a clarification of mathematical and empirical properties”.

Mohsini, R.A., and Davidson, C. H. (1992). “Determinants of performance in the traditional building process". Construction Management and Economics, 10 (4), 343-359.

Neely, A. (2011). "Business performance measurement: unifying theories and integrating practice". Cambridge University Press, Cambridge, UK.

Nunnally, J. (2010). "Psychometric theory". McGraw-Hill, New York, NY.

Smallwood, J., and Venter, D. (2001). “The performance of contractors: client’s perceptions”. Performance in Product and Service, CIB World Building Congress, Wellington, New Zealand.

Smyth, H. (2010). "Construction industry performance improvement programmes: the UK case of demonstration projects in the ‘continuous improvement’ programme". Construction Management and Economics, 28 (3), 255-270.

Ullman, J. B. (2001). "Structural equation modeling: using multivariate statistics". Allyn and Bacon, Needham Heights, MA.

Ward, S. C., Curtis, B., and Chapman, C. B. (1991). "Objectives and performance in construction projects." Construction Management and Economics, 9 (4), 343-353.

Wegelius-Lehtonen, T. (2001). “Performance measurement in construction logistics.” International Journal of Production Economics, 69 (1), 107-116.