Establishing A Performance Efficiency Index for Construction Projects In Kenya

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Abstract

World over, the construction industry continues to receive unparalleled criticism due to deplorable performance with many projects failing to meet clients' expectations. The inefficiency in the projects during execution is a bane, a challenge that is more severe and chronic in developing countries. In Kenya, the problem is congruent and continues to negatively impact on development plans. Additionally, no singular construct exists to objectively measure the various facets constituting the performance of a project. This study, aimed at establishing a Project Performance Efficiency Index (PPEI) that can be used to measure performance efficiency in projects and plan improvement measures. This survey was carried out and data collected from 360 projects in the construction industry of Kenya. Factor Analysis (FA) and Structural Equation Modeling (SEM) were applied on the data to develop the Index, the second order model for the index yielded $\chi 2$ statistics = 234.737, Degrees of freedom = 117, $\chi 2$/degrees of freedom = 2.006, RMSEA Value = 0.079, GFI Value = 0.780, NFI Value = 0.804, IFI Value = 0.949, CFI Value = 0.946, PNFI Value = 0.764 and PCFI = 0.798. The index was validated with typical construction projects and received 94% approval ratings from practitioners via Delphi technique. The study findings contribute to theory and practice. The Efficiency Enablers established add to the existing Built Environment Body of Knowledge in the area of construction project management and forms a basis for future research. In practice, the PPEI developed, enables practitioners to measure and improve performance during execution. The findings point towards the need to rethink Technical Efficiency in projects as well as implementing the PPEI framework as a baseline tool to management of projects in Kenya.

Key Words**: Construction Projects; Performance Efficiency Index; Kenya**

1. Introduction

The construction industry plays cardinal role in providing the physical developments which help in improving social and economic needs of a country. This is amplified and can be inferred from its exponential growth. Turner and Townsend (2018) postulate that the global construction industry grows at a rate of USD 0.3 trillion annually. Therefore, the growth is projected at USD 10.6 trillion in 2021 compared to USD 7.4 Trillion in 2010. Relatedly, according to Global Construction perspectives and Oxford Economics (2015) the GDP growth in the global construction industry was forecasted to grow by 3.5-4.0% annually. It's therefore clear from the foregoing, that the current state of the construction industry generally looks bright but the performance is not optimum.

In Kenya, evidence suggests that the construction industry is growing and is a crucial sector for the growth of the economy. According to the reports of Kenya National Bureau of statistics (KNBS, 2020) and the Kenya Economic Outlook (2020), In 2019, the construction sector registered a growth of 6.4 per cent compared to growth of 6.9 per cent in 2018. The total government expenditure on roads grew by 10.0 per cent to KSh 169.9 billion in 2019/20 from KSh 154.5 billion in 2018/19. Development expenditure rose by 15.5 per cent to KSh 111.7 billion in 2019/20. Additionally, the construction of Phase 2A section 1 of the Standard Gauge Railway (SGR) from Nairobi to Naivasha covering a rail distance of 120 kilometers was completed in September 2019 at a cost of KSh 150.0 billion. Among other notable developments thus far include; the completion of the Single-track Standard Gauge Railway (SGR) from Mombasa to Nairobi, expansion and modernization of Outer Ring Road, Expansion of Ngong Road, Construction of Kenya Western Bypass, Dongo Kundu bypass and Nuno-Modogashe Road (KRB, 2018). Besides this, the Big Four Agenda-that defines the Government`s priorities and development path for the 2018-2022 planning cycle -provides impetus for increased construction activities for the next five years. This paper argues that for Kenya to realize the vision in its development blue-print, the construction industry must operate at optimal performance through enhanced efficiency in the management of construction projects than its presently done

Despite the critical role and the mega projects currently on-going in Kenya, most projects do not achieve their planned cost, time and quality objectives among other performance measures. These problems occur both in the public and private sector projects but more pronounced in the public sector projects and have assumed a chronic trajectory spanning over five decades. Accordingly, authors have dedicated time and resources researching on the concept of project performance, associated problems and how to enhance success in the management of construction projects (Gwaya, 2015; Munano,2012; Muchungu, 2012; Masu, 2006; and Wanyona, 2005). It's however, interesting to note that despite spending considerable time spanning to decades studying this subject, the trend of poor project performance is still persistent. This paper submits that there is need to rethink efficiency management in addressing performance problems in the construction industry of Kenya.

2. Literature Review

2.1 Performance Measurement in the construction industry

It is becoming increasingly difficult to ignore the significance of performance measurement in public and private sector construction organizations given the rapid changes in the construction industry in terms of developments in technology, financial instruments, and complex project execution. The lack of application of performance measurement in the construction sector, despite its importance, is due to several reasons but mainly the lack of information and insufficient training on how to use it (Costa et al. 2004). The construction industry is an important contributor to the economy of a country; however, it has quite an unstable nature (Toor and Ogunlana, 2009). As a result of rapid change and increasing uncertainty in terms of technology, budgets and operational processes, the construction industry has become more complicated and dynamic (Albert, 2001). Consequently, the need for improving the performance of the construction sector is wholly apparent. To achieve performance improvement, measurable objectives must be set and then used to determine critical success factors and performance measures.

The traditional indicators of cost, quality and time (the Iron Triangle) are still being utilized by the construction industry as primary measures of performance despite their deficiency in measuring project successes (Haponava and Al-Jibouri, 2009). Recently, however, measuring success has shifted from these traditional measures to include a wider comprehensive set of metrics of project lifecycle, starting from the initial feasibility phase to the final closedown phase. Performance measurement has not become widely used in construction industry. Therefore, performance measurement is needed to assess how well they have been working, how well they are presently working, and, more significantly, how well they will work in the future so that the aspects in which they are failing can be recognized and corrected (Ankrah and Proverbs, 2005). Jones et al. (2008) also argued that the construction industry should change to be more focused on main drivers such as customer satisfaction, leadership, quality agenda and team, and process integration.

In the construction industry, two aspects of performance can be measured: either the success of the organization's performance, or the success of the project. Ankrah et al. (2005), in an attempt to clarify further, suggested performance measurement has been characterized as the organizational task of designating statistics to entities and the registration of actions in order to offer motivation that provides on-going development. In the construction industry, performance measurement is considered to be an organized technique to evaluate performance by evaluating the inputs, outputs and final project outcomes. In construction projects, the aim of performance measurement is to evaluate and improve quality and efficiency of the project execution process, in addition to identifying potential areas for future improvement.

Whilst there is an increasing understanding of the significance of PMSs among construction companies for monitoring and controlling performance, regrettably, this awareness has not been transferred into action in the construction industry (Takim and Akintoye, 2002). Despite this, there are a large number of existing PMSs, whether currently practiced or merely developed and used in academia. These can be categorized across four aspects: construction project performance; construction productivity, project viability, and project quality. Given the project-based nature of the construction industry, the current measurement systems that are driven by the market and, consequently based on measures of profitability, are not appropriate for measuring and improving performance of construction projects (Ankrah and Proverbs, 2005). In the construction industry, any project performance measuring concepts can basically be divided into a macro level (assessed at the end of the project) and a micro level (assessed during project stages). Analysis of performance on the macro level is considered useful for determining future business strategies, whereas analysis of performance on the micro level is useful for determining a project's progress and completion (Cha and Kim, 2011). This study sees performance at micro level being critical and a cardinal input for macro level performance of the project, as such, the study posits that efficiency performance management during the project execution should be given due priority.

2.2 Existing measurement systems and models in the construction industry

a) The Balanced Scorecard, BSC

The BSC model was designed in 1992 by Kaplan & Norton as a new method to measure the performance of the four business "dimensions": - i) Financial; ii) Customers; iii) Business processes; and, iv) Learning and innovation. Learning and innovation are considered to be "leading indicators,"; whereas the focus of the BSC is towards financial measures, which are considered "lagging indicators". This represents one of the weaknesses of BSC models, as well as causing many problems in its performance. Letza (1996) states that this method must be integrated with the participants' goals and general strategies, so that the BSC can translate the strategies into goals to measure them. It measures previous activities, known as lagging indicators, as used in many organizations. The BSC model also has the potential to use leading measures when an organization translates its strategies and visions into a comprehensive framework.

b) European Foundation for Quality Management, EFQM

In 1989, the EFQM Excellence Model was shaped by European Foundation for Quality Management for quality management purposes. Its focus was to improve overall organizational quality, and it is unique in that it distinguishes between results (PMs) and organizations' enablers (Westerveld, 2003). The EFQM model uses nine fundamental concepts of excellence to enhance the continuous improvement of an organization. These are results orientation, people development and involvement, customer focus, continuous learning, innovation and improvement, leadership and constancy of purpose, partnership development, management by process and facts, and public responsibility (Beatham et al. 2004).

The EFQM Excellence Model has been utilized by companies in the construction industry and others such as manufacturing, finance, insurance, and as part of management through Total Quality Management. It is suggested for use as a means of self-assessment in order to benchmark with other organizations, as a guide for improvement, an approach to thinking, and a structure for the organization's management system (EFQM, 2010). Beatham et al. (2004) added that the purpose is to conduct a regular review of an organization's activities. The main aim for implementation of the EFQM model is to identify the performance improvement areas (Beatham et al. 2004).

The key distinction between EFQM Excellence Model and the BSC is that the EFQM model is designed to deal with best practice; whereas, the BSC model is focused on communication and performance measurement. However, the EFQM model is criticized as being less comprehensive and less clear than the BSC model despite the shortcomings mentioned previously.

c) The Contemporary measures of Project Performance

A number of researchers have advocated for a wider focus of construction project performance. Some researchers (Zuo, 2011; Billy et al., 2006; Haslam et al., 2005; Ortega, 2000;) have argued that it is important to incorporate safety aspects of the project in performance evaluation because the construction industry is the most unsafe industry due to its high rate of fatalities. In most developing countries, the construction industry is mainly labor intensive and the majority of the workforce working on construction sites is unskilled. The workers are, therefore, exposed to risk and health hazards inherent in construction projects that require adequate safety provisions (Zuo, 2011). Project safety, being a humane issue, needs to be considered separately from time, cost and quality dimensions. Few other researchers (David, 2009; Tabish and Jha, 2011) have given emphasis on dispute resolution which might otherwise lead to disagreements amongst project participants and derail the project objectives. Dispute resolution is part of stakeholder management and hence should be part of project performance evaluation criteria (David, 2009).

e) Process based models

As Olawale and Sun (2012) pointed out, the basis for many of these studies is the well-known Deming’s Plan-Do-Check- Action (PDCA) wheel (Deming, 2000). Deming’s PDCA wheel describes a management process, originally used for quality control purposes. Some researchers attempted to adopt it for construction project control while acknowledging the need for modifications. For example, Plate and Wadman (1998) cited in Olawale (2012), criticized the PDCA model as having the drawback of no time-dependent element and not fully describing the whole planning and control situation or its development in time. Olawale and Sun (2012) developed, as a follow up on Deeming`s process based control model, a project control and inhibiting-factors management model (PCIM). They argued, those factors inhibiting effective cost and time control should be managed.

2.3 A critic of the Existing measurement systems and models in the construction industry

Admittedly, literature is replete with several models that have been proposed to assess performance in projects under broad headings Critical Success Factors and Key Performance indicators. However, the above studies are faced with several drawbacks. Several authors have found some short comings with them and expressed the doubt whether the true objective of assessment would be achieved. This has to do with the measures in use, the paradigm within which they are being considered, and the nature of the models.

Firstly, those studies have focused neither on the interactions among the key performance efficiency drivers nor on the consequences of performance improvement initiatives being undertaken over time. Importantly, industry players need to be able to measure level of performance efficiency in the execution of projects, identify areas for improvements and evaluate the impacts of various performance improvement initiatives before implementing them. Such actions are essential as the implementation of the initiatives that do not address prioritized areas for improvement, may add little value to industry players’ quest to improve performance efficiency and achieve desired project outcomes in the long-run. Secondly, the studies have not taken into account the dynamism nature of the construction process owing to its complexity. Worse still, the existing models have not considered the dynamic nature of the factors themselves operating in the performance of projects during the execution.

To address the above shortcomings and foster efficiency in the execution of projects, this study propounds the need for a model of project performance for the construction industry of Kenya that investigates the interactions and causal relationships between the key performance efficiency enablers and the consequences of the performance improvement initiatives being undertaken over time during projects execution. This is the gap the current study undertook to fill.

3. Study methods

The study was a survey actualized by way of questionnaire. Authors of research methods (Saunders 2016, Creswell 2014, Bryman 2012, Walliman 2011 and Silverman 2010) believe, Questionnaires are one of the most commonly used data collection techniques within survey research. Furthermore, they suggest that a questionnaire is best suited to a situation where most of the questions are standardized and the researcher is confident that the questions will be interpreted in the same way by all respondents. Even so, the questionnaire is the best tool to be used in descriptive research where the researcher has undertaken some literature review and has understood the subject of research prior to data collection and extending further to draw conclusions from the data collected.

To achieve the objective of the study, the researchers obtained a research permit from the National Commission for Science and Technology and Innovation (NACOSTI) to collect field data. The approval referenced as NACOSTI/P/19/2035 was obtained in time before commencement of fieldwork. Furthermore, in carrying out the questionnaire survey, names of the respondents were omitted to enhance their privacy. The questionnaire tool was piloted and final questionnaire refined in line with the pilot study findings. A total of 380 questionnaires were distributed to the public sector projects sampled from the fourteen (14) NCA regional centers. A total of 320 questionnaires were reasonably and adequately completed representing 84.21 percent response rate while 60 questionnaires were not returned. The questionnaires were responded to by the individual project team leaders. The majority of the respondents were project contractors constituting 23.1% this was followed by Project Managers comprising of 20.3%. 16.6%, 12.4% 10.6% and 10.3% of the respondents were Architects, Quantity Surveyors, Civil/Structural and Mechanical engineers respectively. 2.3% of the respondents comprised of "other" consultant not initially captured in the questionnaire, this was filled by physical planners, Site foremen, and clerk of works.

Additionally, 29.1% and 23.1% were residential and road projects respectively. The response for educational, commercial and health projects were equally high at 20.3%, 10.6% and 10.3% respectively. Water and Sewerage projects followed at 6.6%. High demand for residential units in Kenya can account for this condition especially given the crusade by the government on affordable housing under the Big Four Agenda development blue-plinth The Project Performance Efficiency Index (PPEI) was developed through modeling of key performance efficiency drivers. The statistical techniques of Exploratory Factor Analysis and Structural Equation Modeling were performed.

4. Results and discussions

4.1 Assessing the factorability of Performance Efficiency Measurement variables

In assessing the factorability of the performance efficiency measurement variables, the study found out the correlation for each pair of the variables which is demonstrated with the help of a correlation matrix. The correlation matrix suggested that the sample is characterized by high degree of related variables which could be grouped together. Additionally, before carrying out EFA, the overall significance of the correlation matrix and its factorability needed to be tested with the help of Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy respectively. Although both tests met the minimum criteria for carrying out factor analysis in the dataset, observation of the correlations along the diagonal of the anti-image correlation matrix revealed that 7 variables had their KMO values less than 0.5, which indicates that the dataset, in its current form, is still not suitable for factor analysis (Hair et al., 2006). These variables were iteratively removed one after another starting with the one whose correlation along the diagonal of the anti-image matrix was the lowest (Jahmane et al., 2011). After the removal of seven variables, it was found that all variables had individual KMO values greater than 0.5. This resulted in the improvement of overall KMO measure of sampling adequacy to 0.687. Further Bartlett's test statistics was found significant at 0.000 levels. These measures indicate that the reduced set of variables is appropriate for factor analysis.

4.2 Theoretical framework of PPE Index

Having established that factor analysis could be applied on the Performance efficiency enablers, Principal Component Analysis (PCA) was employed with Varimax rotation in order to identify the underlying structure of relationships. Due to the lack of a priori basis on the number of factors to be extracted, initially, all the variables were allowed to load freely on various factors so long as they had eigenvalue greater than one. Further a scree plot for different components was obtained (as shown in figure 1) in order to have an idea about the amount of variance explained by each factor.

Consequently, while identifying the final factors underlying the Project Performance Efficiency Enablers (PPEE), the process was subjected to four conditions: (i) the number of factors fixed at five, (ii) deletion of items with loadings of less than 0.5 or cross loadings of greater than 0.5, (iii) retention of only those factors with at least two items and (iv) the number of factors extracted should account for at least 60% of the variance (Field, 2005; Hair et al. 2006; Malhotra and Dash, 2011). Based on these conditions, Factor analysis was iteratively repeated and items deleted sequentially resulting in a final instrument of 25 items. The 25- item 5-factor instrument accounted for 73.023% of the variance in the dataset.

From the analysis and findings (Table 1), it was evident that five variables loaded under factor 1 seem to be associated with Technical Efficiency Enablers Factors (TEE). The second factor comprises five variables which reflect the Project Management Efficiency Enablers (PMEE) of project performance. The five variables under factor 3 represent factors relating to Contractor Efficiency Enablers (CEE) whereas the five variables under factor 4 attempt to capture Client Efficiency Enablers dimension of project performance. The five variables under factor 5 are associated with External Environment Efficiency Enablers (EEEE). The findings (Table 1) reveals that ‘Technical Efficiency Enabler’ is the most important measure of construction project performance efficiency, having the highest eigenvalue of 4.128 and accounting for 19.05% of the variance in the dataset. This is followed by the measure ‘Project Management Efficiency Enabler’ with an eigenvalue of 2.865 which explains 11.46% of the total variance. The third most important performance efficiency measure was found to be ‘The Contractor`s Efficiency’ with an eigenvalue of 2.415 and explaining 8.58% of the variance while the fourth important measure turns out to be ‘Client Efficiency with an eigenvalue of 1.747 and contributing to 6.98% of the total variance. The last performance efficiency measure in order of importance was ‘External Environment influence’ with an eigenvalue of 1.446 hence explaining 5.78% variance on the data set. These five constructs of performance efficiency constitute the Project Performance Efficiency Enablers (PPEE).

In sum, the following constructs were inferred and constituted the PPEI theoretical framework (Figure 2).

Factor 1 represents Technical Efficiency Measure

Technical Efficiency measure, as shown in Table 1, is considered to be the most important factor amongst all five constructs. In this construct, the highest loading is observed in “clarity of Designs and Details, CoD” (0.995) while the lowest one is found in “Clarity of Construction Method statement, CoCMM (0.978). Theoretically, the variable “Design Changes” should have been loaded the highest given the impact it has on project schedules and cost but results of factor analysis reveal that it emerged second after Clarity of Designs and Details. A closer look at the survey instrument indicates that the respondents perceived Clarity of Designs and Details in project to be critical attribute that require attention in order to avoid time lags in projects. This might be the possible reason why the above variable loaded under Technical efficiency. Similarly, the item “Clarity of Construction Method Statement” is widely thought to be associated with Contractor Operations. In the current study, this item loaded on Technical Matters. The respondents perceive Construction Method statement a technical matter which may give rise to incorrect work flows that eventually lead to delay in certain activities of the project.

Factor 2 represents Project Management Efficiency Measure

Project Management Efficiency measure, as shown in Table 1, is considered to be the second most important factor amongst all five constructs. In this construct, the highest loading is observed in two variables "Time Management Factors, TMF" and "Cost & Financial Management Factors, TMF" (0.985) while "Quality Management, QMF" (0.985) was loaded second in the cluster. the lowest items were found in the variables of "Health, Safety & Security Management factors as well as Project Leadership Factors (0.795). It's clear from the analysis that time management is a critical limb of project management. Lim and Mohamed (2000) considered project completion time to be the first criterion for project success. Other researchers (Kamrul and Indra, 2010; Khosravi and Afshari, 2011) have termed time to be the most important factor in the performance measurement of construction projects. Public sector projects, given the benefits they accrue to the public and the multiplier effect, utmost importance is given to time dimension because the funding of these projects is always done annually based on its progressive performance.

Factor 3 represents Contractor Efficiency Measure

Contractor Efficiency measure, as shown in Table 1, is considered to be the third most important factor amongst all five constructs. In this construct, the highest loading is observed in “Technical and Managerial capacity” (0.898) while the lowest one is found in “Procurement Efficiency (0.410). A closer look at the survey instrument indicates that the respondents perceived Financial Condition and stability of contractors (FS) as paramount to their efficiency in Projects (0.879). Another important aspect is the Labour Mobilization ability, LMA (0.881). In the current study, this item loaded on time. Sub-contractors’ coordination (SC) remains a key efficiency enabler for contractors and this was perceived as such by the respondents (0.873)

Factor 4 represents Client Efficiency Measure

Client Efficiency measure, as shown in Table 1, is considered to be the fourth most important factor amongst all five constructs. In this construct, the highest loading is observed in "Top Management Support, TMS" (0.792). Decision making process, DMP as well as Dispute Resolution ability DRA, were loaded equally under this construct (0.741). From the upshot, it's interesting to note that, Client`s Project Financing Ability & Cash flow behavior, PFA was loaded as the 2nd item under this construct (0.756). Naturally, the variable "Project Financing and cash flow behavior" was expected to be loaded highly under this section but results of factor analysis reveal that it loaded below the Top Management Support Variable. This can be attributed to the fact that the respondents could be perceiving financial support and resource mobilization from the top management as central to successful execution of projects. However, top management support should go beyond the provision of funds and making resources available. Johnson (2006) argues that top management support ought to include aspects such as providing clarity on the project objectives and reassuring project team members that they will be valuable after the project. Changes that would come about due to the project can cause team members to be highly skeptical of their future in the organization. This will directly affect their level of performance towards the project.

Factor 5 represents External Environment Efficiency Measure

External Environment Efficiency measure, as shown in Table 1, is considered to be the fifth most important factor amongst all five constructs. In this construct, the highest loading is observed in "Stakeholders influence" (0.943). Riots and strikes were loaded seconded in this construct (0.887). Legal Environment influence LEI, (0.779) and Pandemics /Outbreaks was loaded third and fourth respectively. Coincidently, the impact of Covid-19 pandemic disrupted majority projects and the ripple effect has a continuing effect in the construction sector. Stakeholders influence in projects remain a key aspect in execution of government project. This result reflects the impact of neighbors and adjacent lands on the project. Perhaps the respondents are taking into consideration the view that resistance from the neighbors to the project as a result of poor relationship will affect the progress of the project. The use of project location by others also may affect the project activities, so many times the activities of project may be stopped in such like cases.

4.3 Project Performance Efficiency measurement model

The Structural Equation Modelling (SEM) was conducted to test the relationships between the first order constructs (Figure 3) and the second order construct (Figure 4) namely overall project performance efficiency. The test of the second order model implied that project performance efficiency, a higher order latent factor governs the correlations amongst first order constructs: Technical, Project Management, Contractor, Client efficiency and external environmental influence. The second order model yielded the following results of test statistics: $\chi2$ statistics = 234.737, Degrees of freedom = 117, $\chi2$/degrees of freedom = 2.006, RMSEA Value = 0.079, GFI Value = 0.780, NFI Value = 0.804, IFI Value = 0.949, CFI Value = 0.946, PNFI Value = 0.764 and PCFI = 0.798. These estimated model fit indexes were adequate. The second order loadings on overall project performance efficiency are 0.32 for Technical Efficiency, 0.25 for Project Management Efficiency, 0.18 for Contractor Efficiency, 0.14 for client efficiency, - and 0.11 for external environment efficiency. From the Structural Equation Modelling, it was deduced that;

PPEI=0.32TEE+0.25PME+0.18COE+0.14CLE+ 0.11EEE…………. Eqn 1

Where;

PPEI= Project Performance Efficiency Index

TEE= Technical Efficiency

PME=Project Management Efficiency

COE=Contractor Efficiency

CLE=Client Efficiency

EEE=External Environment Efficiency

4.4 Validation and application of PPE Index

The practical applicability of the PPE Index was applied to typical construction projects. The practitioners, selected with due consideration to their backgrounds, field of involvement, exposure to the key subject matters of the research objectives, were requested to identify a project which they have been involved in that is on-going which can be used to demonstrate application of the index. Seven projects were suggested and three were selected randomly. The rationale was to evaluate how the PPE Index can be used to depict the performance behavior of a construction project. All the three projects were being public sector projects being implemented various government agencies. The project particulars have been given in Table 2.

The participating project team members were required to assess the adoption of the Efficiency Enablers implemented on the project. The scale given was in percentages from 0% for non-implementation to 100% as a fully implemented on the project. The average of their overall ratings was used as the value for a particular Enabler Score within the Model equation for the eventual summations. The ratings for the PPE Enabler variables were established within a range of 0% to 100% as this could easily be understood in the adoption or implementation of a particular variable for the PPEE.

From the application findings (figure 5), two issues can be discerned; Firstly, performance efficiency is not optimum, pointing to the challenges of delivering projects with set performance targets albeit with majority projects failing to live up to the expectations of the clients and the general public. Secondly, performance efficiency fluctuates hence not static, pointing to the underlying dynamism behavior of operating variables within the project environment. At the end of the validation exercise, the practitioners considered the PPE Index appropriate for use in measuring efficiency in construction projects and was rated 95% suitable for use by the participating practitioners.

5. Practical relevance of the study findings

The study findings have a practical, societal relevance and use. To begin with, the results of this study are of practical use in the construction industry. The Project Performance Efficiency Index (PPEI) developed, provides an opportunity to industry practitioners to objectively measure the performance efficiency of their projects during implementation and plan improvement measures. Specifically, the results of this research study, inform the project managers on the performance efficiency enablers at play during the execution of construction projects.

Ultimately, the study findings have societal relevance. Essentially, Public sector construction projects are intended to yield built facilities to benefit the general public. Even so, the effects of delayed delivery of construction projects have far reaching impact on the economy and society including but not limited to retarding the process of development, cost overruns and delayed use of the projects which may result in projects not meeting the set objectives. Furthermore, when projects are not delivered as planned, there are lost opportunities as the finished facilities are put to use later than anticipated. It was earlier noted that the construction industry contributes immensely to national GDP and contributes to creation of employment opportunities nationally with a multiplier effect, this is still below the global industry performance and there is need for growth. And as Kenya is geared towards pursuing its development blue- print envisaged in vision 2030, it's important that the implementation of projects is done efficiently and effectively so as to deliver successful building projects within time, budget and specifications. The current study and its findings play a pivotal role in this endeavor.

6. Conclusion and Recommendations

This study aimed at establishing a Project Performance Efficiency Index (PPEI) that can objectively be used to measure the performance efficiency in projects and plan improvement measures. This comes against a background of myriad problems facing execution of construction projects compounded by the fact that no singular construct exists to objectively measure the various facets that constitute the 'health' of a project. The study established five constructs that impact on the performance efficiency in projects, the constructs were named Performance Efficiency Enablers (PEEs) and they comprise of; Technical Efficiency Enablers (TEE). The second factor comprises five variables which reflect the Project Management Efficiency Enablers (PMEE) of project performance. The five variables under factor 3 represent factors relating to Contractor Efficiency Enablers (COEE) whereas the five variables under factor 4 attempt to capture Client Efficiency Enablers(CEE) dimension of project performance. The five variables under factor 5 are associated with External Environment Efficiency Enablers (EEEE). These five constructs of performance efficiency constitute the Project Performance Efficiency Enablers (PPEE). The structural equation modelling conducted yielded a project performance efficiency index (PPEI) which industry practitioners can use to objectively measure the performance of projects.

In conclusion, the study contributes to theory and practice. The Efficiency Enablers established adds to the existing Built Environment Body of Knowledge in the area of construction project management, particularly in the subject of project performance and forms a basis for future research. In practice, the PPEI developed, provides an opportunity to industry practitioners to objectively measure and improve the performance efficiency of their projects during implementation. Most importantly, in order to enhance efficiency in the performance of construction projects, industry Practitioners should rethink their Technical Efficiency as well as implement the Project Performance Efficiency Index (PPEI) framework developed as a baseline tool to management of projects in Kenya.

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References

Ankrah Nii & David Proverbs (2005). A framework for Measuring Construction Project Performance: Overcoming Key Challenges of Performance measurement

Beatham Simon et al (2004). KPIs Acritical appraisal of their use in construction

Bryman. (2012). Social Research methods

4th edition. New York: Oxford University

Press Inc.

Cha H.S.,& Kim, C.K.(2011), "Quantitative Approach For Project Performance Measurement on Building Construction in South Korea"

Creswell, J.W (2014). Research Design:

Qualitative,quantittative,and mixed methods

approaches.4th Edition. Thousands Oak,CA:

SAGE Publications.

David. R.Fred(2009) Strategic Management:Concepts and cases

Deming W. Edwards(2000). The new economics:For Industry, government, education

Field,AP (2005), Discovering Statistics Using SSPS.2nd Edition,Sage Publications,London

GlobalConstructionperspectivesandOxford Economics,(2015). A global forecast for the construction industry to 2030

Gwaya, A. (2014). Development of appropriate project management factors for the construction industry in Kenya. International Journal of Soft Computing and Engineering (IJSCE), ISSN:2231-2307,Vol 4,Issue 1.

Hair et al (2006) Multivariate Data Analysis. Sixth Edition. Prentice Hall, Upper Saddle River, New Jersey

Haponava Tatsiana & Saad Al-Jibouri Establishing influence of design process performance on end-project goals in construction using process-based model

Haslam Roger et al(2005). Contributing factors in construction accidents

Jones Peter et al(2006) Corporate Social Responsibility and the UK Construction Industry

Kamrul Ahsan & Indra Gunawan (2010) Analysis of cost and schedule performance of international development projects

Kenya Economic Outlook (2020)

Kenya National Bureau of Statistics (KNBS) 2020: Economic Survey, 2020: Government Printers, Nairobi

Khosravi Shahzard & H. Afshari (2011) A success Measurement Model for Construction Projects

Lim. C.S. &MOHAMED Zain (2000) Criteria of project success. An exploratory re-examination

Letza, S. R. (1996). The Design and Implementation of the balanced business scorecard. Business Process Re-engineering & Management Journal 2(3), 54-76

Malhotra, N.K., & Dash, S. (2011). Marketing Research an Applied Orientation. London: Pearson Publishing

Muchungu, P. (2012). The contribution of

human factors in the performance of

construction projects in kenya. Nairobi:

Unpublished Phd.Thesis.University of Nairobi.

Munano, A. (2012). Pre-constrcution

Planning: Exploring the factors that

influence timelines of project completion for

public sectors buildings in Kenya.

Unpublished Master of Construction

Management Thesis.Jomo Kenyatta

University

Olawale,Yakubu and Ming Sun (2010)"Cost and timecontrol

of construction projects: Inhibitng factors and

mitigating measures in practice".

Construction Management and Economics,

28 (5),509-526.

Ortega Mariana(2006) Being lovingly,knowingly ignorant:white feminism and women of color

Saunders, M., Lewis, P. and Thornhil, A.(2016) Research Methods for BusinesStudies.7th Edition,Pearson,Harlow

Silverman, D. (2010). Doing Qualitative

Research.3rd Edition. London: SAGE

Publications Ltd.

Kenya Roads Board (2018) Strategic plan 2018-2022

Tabish S.Z.S & Jha Kumar Neeraj (2011) Important factors for sucess of public construction projects

Takim, R., &Akintoye, A. (2002). Performance Indicators for sucesful construction project performance.In U. of Northumbria (Ed), Vol. 2,545-5(Vol. 2, pp. 2-4). 18th Annual ARCOM Conference

Turner and Townsend (2018): International Construction Market Survey 2018 Report: www.turnerandtownsend.com.

Tor Shamas-ur-Rehman & Stephen O. Ogunlana (2009) Construction professionals' perception of critical success factors for large scale construction projects

Westerveld.E. (2003) The projects excellence model linking success criteria and critical success factors

Walliman, N. (2011). Research Project: 3rd

Edition. London: SAGE Publications Ltd.

Wanyona, G. (2005). Risk Managment in the

cost planning and control of building

projects.The case of quantity Surveying

profession in Kenya. Unpublished PhD

Thesis.University of Cape Town.

Figure 1: Scree Plot of Project Performance Efficiency Enablers (PPEEs)[1]

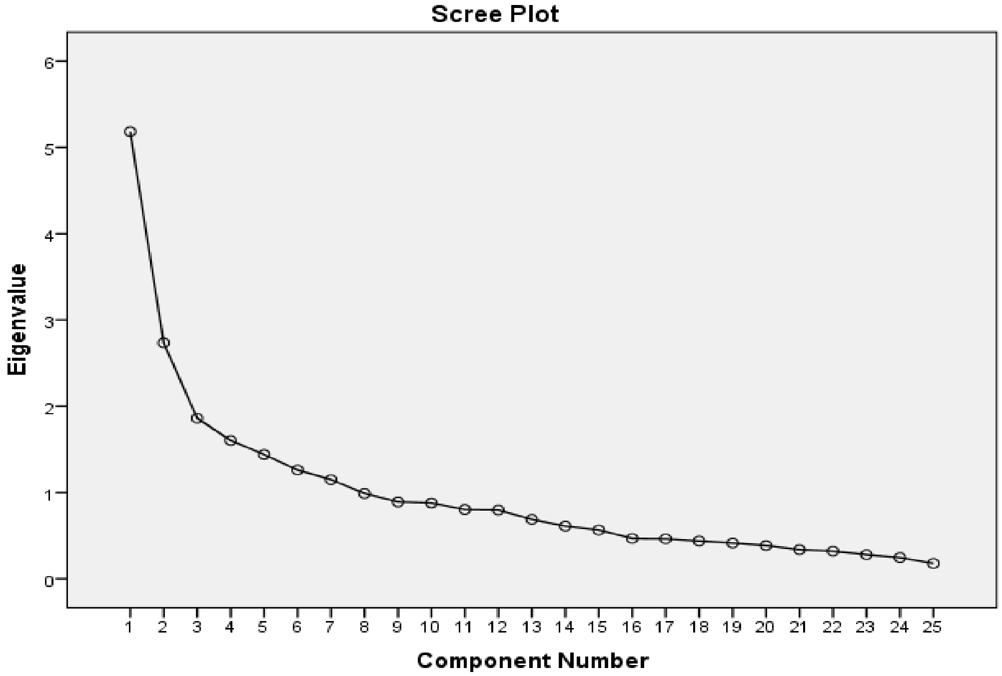
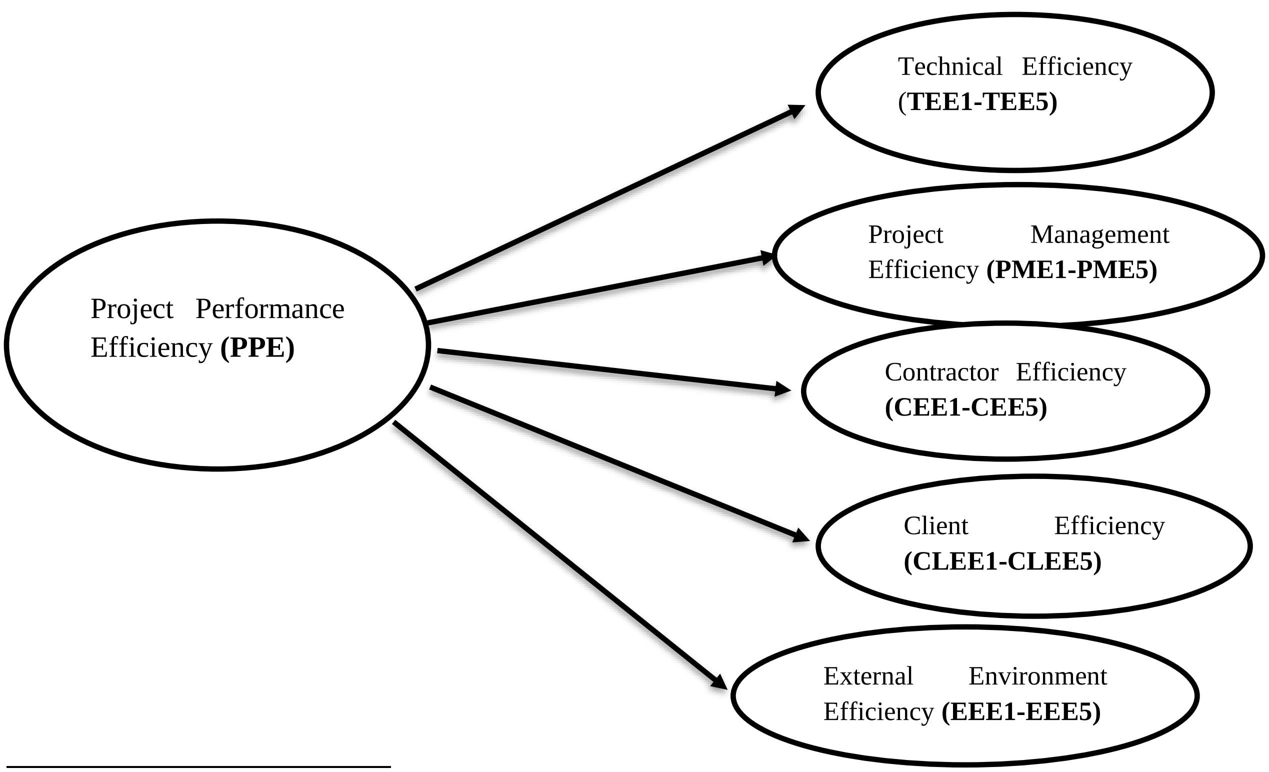
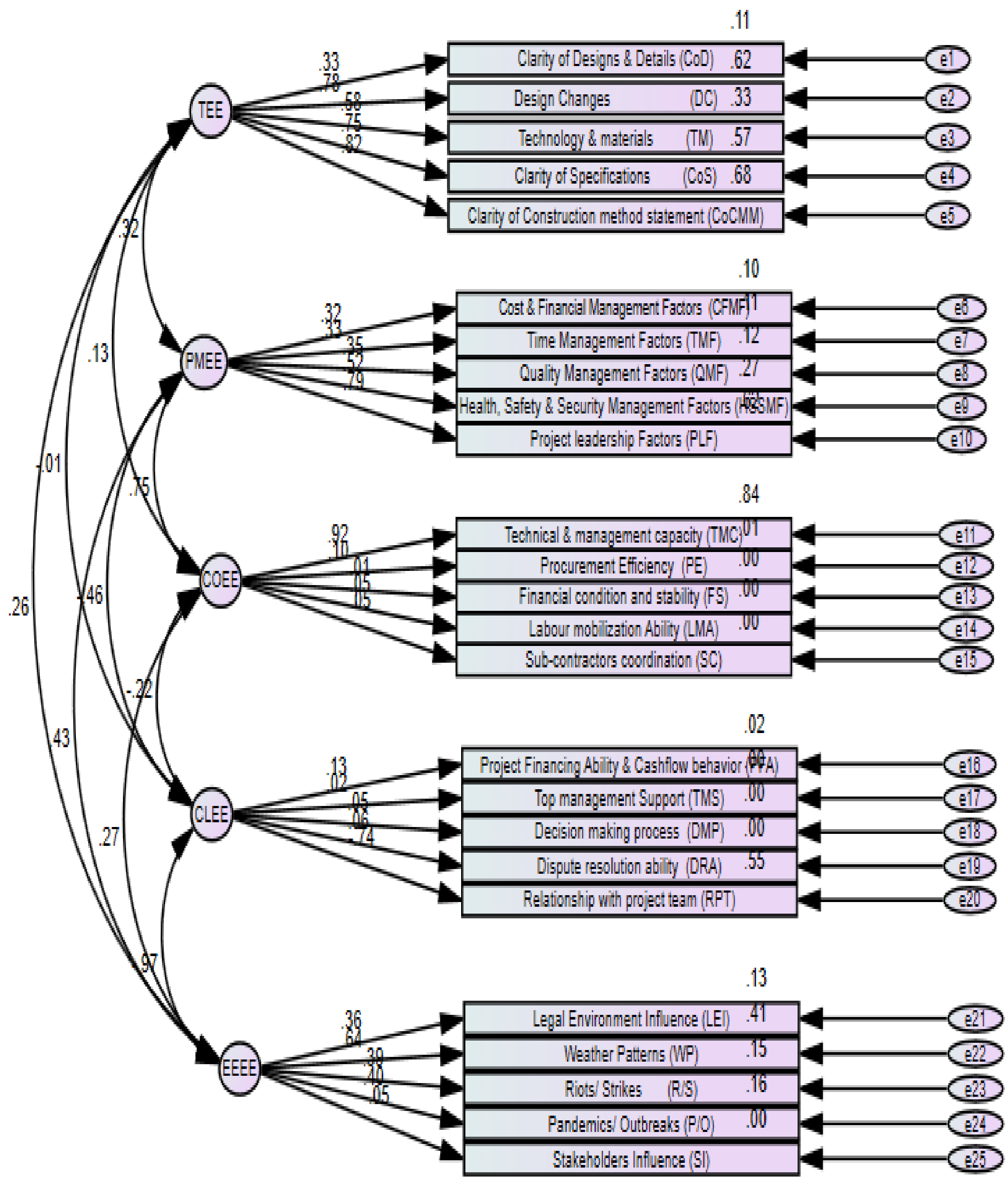


Figure 2: Project Performance Efficiency theoretical framework, PPE[2]



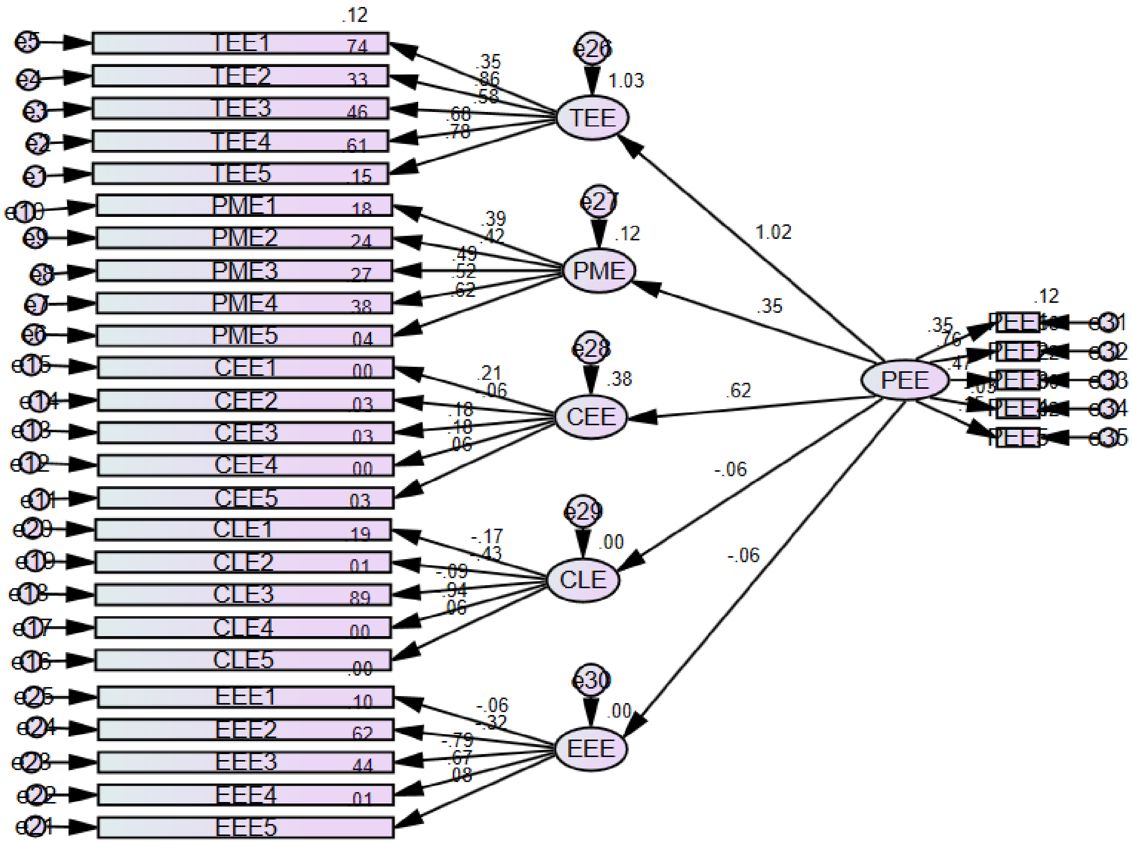
[1] Figure 1: Scree Plot of Project Performance Efficiency Enablers (PPEEs), Author`s findings, 2021
[2] Figure 2: Project Performance Efficiency theoretical framework, PPE, Author`s construct, 2021

***Figure 3: 1st Order Measurement Model for Project Performance Efficiency*[3]**



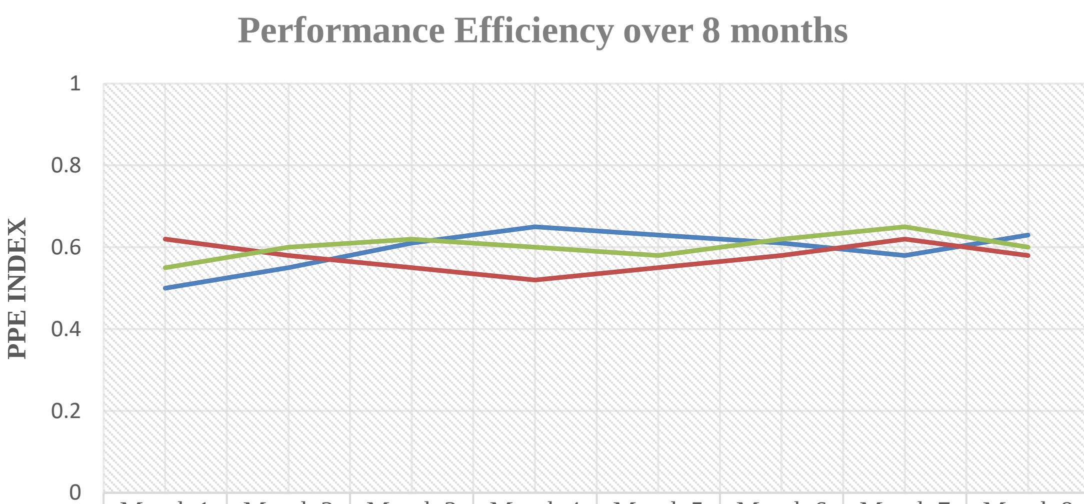
[3] Figure 3: 1st Order Measurement Model for Project Performance Efficiency, Author`s finding, 2021

Figure 4: 2nd Order Measurement Model for Project Performance Efficiency[4]



[4] Figure 4: 2nd Order Measurement Model for Project Performance Efficiency, Author`s finding, 2021

Figure 5: PPE Index validation findings[5]



	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8
A	0.5	0.55	0.61	0.65	0.63	0.61	0.58	0.63
B	0.62	0.58	0.55	0.52	0.55	0.58	0.62	0.58
C	0.55	0.6	0.62	0.6	0.58	0.62	0.65	0.6

[5] Figure 5: PPE Index validation findings, Author`s finding, 2021

Table 1. Results for Factor Analysis Performance Efficiency Measurement Variable[6]

Components					
	1	2	3	4	5
Cronbach`s alpha (α)	0.984	0.873	0.654	0.814	0.808
TEE1: Clarity of Designs & Details (CoD)	.995				
TEE2: Design Changes (DC)	.993				
TEE3: Technology & materials (TM)	.985				
TEE4: Clarity of Specifications (CoS)	.981				
TEE5: Clarity of Construction method statement (CoCMM)	.978				
PMEE1: Cost & Financial Management Factors (CFMF)		.985			
PMEE2: Time Management Factors (TMF)		.985			
PMEE3: Quality Management Factors (QMF)		.806			
PMEE4: Health, Safety & Security Management Factors(HSSMF)		.795			
PMEE5: Project leadership Factors (PLF)		.795			
CEE1: Technical & management capacity (TMC)			.898		
CEE2: Procurement Efficiency (PE)			.410		
CEE3: Financial condition and stability (FS)			.879		
CEE4: Labour mobilization Ability (LMA)			.881		
CEE5: Sub-contractors coordination (SC)			.873		
CLEE1: Project Financing Ability & Cashflow behavior (PFA)				.756	
CLEE2: Top management Support (TMS)				.792	
CLEE3: Decision making process (DMP)				.741	
CLEE4: Dispute resolution ability (DRA)				.741	
CLEE5: Relationship with project team (RPT)				.739	
EEE1: Legal Environment Influence (LEI)					.779
EEE2: Weather Patterns (WP)					.657
EEE3: Riots/ Strikes (R/S)					.887
EEE4: Pandemics/ Outbreaks (P/O)					.775
EEE5: Stakeholders Influence (SI)					.943
Eigenvalue	4.762	2.865	2.145	1.747	1.446
Percentage of variance explained	19.049	11.460	8.578	6.988	5.785
Cumulative percentage	69.049	70.509	69.088	76.075	71.860

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.
Kaiser-Meyer-Olkin Measure of Sampling Adequacy=0.69, Bartlett's Test of Sphericity=4137.533, Significance =0.000

[6] Table 1: Results for Factor Analysis Performance Efficiency Measurement Variable, Author`s finding, 2021

Table 2: Project particulars for PPE Index validation[7]

Name of project	Project A	Project B	Project C
Nature of Project	Hostel	Hospital	Administration Block
Project location	Nairobi	Kisumu	Kiambu
Contract Period	76 Calendar weeks	81 Weeks	104 Weeks
Contract Start Date	13th May 2020	4th March 2020	15th Jan 2020
Initial anticipated Practical Completion Date	13th Oct 2021	4th Sept 2021	15th Jan 2022
Time Elapsed	50 Weeks	58 Weeks	66 Weeks
Approved Extensions	8 Weeks	12 Weeks	16 Weeks
Percentage of Time Elapsed	65.79%	71.60%	63.46%
Percentage of work done	58.1%	63.1%	51.8%
Initial Defects liability Period (DLP)	13th April 2022	4th Mar 2022	15th July 2022
Revised Defects Liability Period (DLP)	13th June 2022	13th May 2022	13th Nov 2022
Initial Contract Sum	Ksh.246, 094,184	Ksh.358, 054,400	Ksh.464, 594,320
Net Additions (Appraisal No.01)	Ksh.21, 641,964.95.	Ksh.3,041,180.95.	Ksh.8,005,211.45
Net Additions (Appraisal No.02)	Ksh. 2, 722,240.63.	-	-

[7] Table 2: Project particulars for PPE Index validation, Author`s finding, 2021