Analysis of *Effectiveness Measures* of Construction

Project Success in Malaysia

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Abstract

Project effectiveness measures are normally used by most researchers and practitioners to judge project performance and project success. This paper provides an empirical analysis of measures of success in terms of effectiveness performance in the development of construction projects in Malaysia.   A survey was conducted in Malaysia among the four project stakeholders: the Government, private clients, consultants, and contractors.   In total 93 respondents completed the questionnaire. Lists of effectiveness of success measures were identified for the respondents to identify their level of success criticality to the Malaysian construction projects.

The data were analysed by means of statistical analysis i.e. ranking of variables based on the mean values, Analysis of Variance (ANOVA) and factor analysis techniques. The first finding revealed that the level of success criticality with regards to project efficiency performance in the development of construction projects in Malaysia is according to the specific requirements and priorities of different project stakeholders. The second finding shows that effectiveness measures are related to the project *'results'* achieved in the development of construction project. These are represented by the five principal factors namely: Learning and Exploitation; Client Satisfaction; Stakeholder Objectives; Operational Assurance and User Satisfaction.   It is anticipated that the findings reported in this paper could be important for future strategies and guidelines for the development of projects in Malaysia.

Keywords: Analysis of variance (ANOVA), Effectiveness measures, Factor analysis, Success measures, Malaysia

1. Introduction

A synonym for success, according to Baccarini (1999) is effectiveness, i.e. the degree of achievement of objectives. Projects are formed to accomplish objectives and success is measured in terms of how well these objectives have been met.   Criteria such as meeting project time, budget, technical specification and mission to be performed are the top priorities of project objectives. This corroborates De wit (1988) findings that project success is measured against the overall objectives of the project (i.e. time, cost, quality, and project mission).   More specifically, the concept of success in a construction project according to some researchers is corresponding to the *efficiency* and *effectiveness* measures (Brudney and England, 1982; de Wit, 1988; Pinto and Slevin, 1988: 1989; Smith, 1998; Belout, 1998; Atkinson, 1999; Crawford and Bryce, 2003).   *Efficiency* is broadly understood as the maximisation of output for a given level of input or resources, while *effectiveness* is directed to the achievement of goals or objectives. Pinto and Slevin (1988: 1989) identify project success in terms of efficiency and effectiveness measures.   Efficiency measures refer to strong management and internal organisational structures (adherence to schedule and budget, and basic performance expectations).   In other words, efficiency measures deal with 'time, budget and specifications'. Effectiveness measures refer to the achievement of project objectives, user satisfaction and the use of the project. A project delivered on time, within budget, and meets performance specifications may not be well-received by the client/users for whom it is intended. The efficiency of a project would only be achieved through having a standard system and methodology put in place (George, 1968). This aligns the Smith (1998) and Nyhan and Martin (1999) findings that project efficiency are concerned with the utilisation of equipment and workforce, whereas effectiveness is concerned with the achievement of outcomes. Maloney (1990) also asserts that the efficiency of construction projects involves the utilisation of resources, which may be represented by the ratio of the resources expected to be consumed divided by the resources actually consumed.   The effectiveness of a construction project, on the other hand, is when

the organisation's objectives are fully attained.   Cameron and Whetten, (1993) contribute to the discussion of project efficiency and effectiveness by indicating that a system is effective if it achieves its objectives. Since construction projects are directed towards client's objectives, an effective construction project should meet the client's objectives.

According to Crawford and Bryce (2003), an evaluation of project success is from the efficiency and effectiveness dimensions. Project efficiency ("doing the thing right") is concerned with cost and process management (i.e. the efficient conversion of inputs to outputs within budget and on schedule) and a wise use of human, financial and natural capital. Whilst, project effectiveness ("doing the right thing") is concerned with the development of worthiness or appropriateness of the chosen project goal.   A project may be efficient (i.e. implemented on or ahead of time and cost schedules) but may be ineffective if the internal logic of the project is not grounded in reality (i.e. the development hypothesis is invalid) or if the goal of the project does not address what are in fact the core vulnerabilities of the target community (i.e. the initial development problem analysis was weak). Atkinson (1999) asserts that measuring project success for the process criteria for project management is measuring efficiency, while measuring effectiveness refers to measuring the success of the resultant system or organisation benefits, getting something right and meeting goals.

Given the above arguments, it may be said that project success must consider both the project outputs (efficiency) and project outcomes (effectiveness) (Pinto and Slevin 1988:89; Maloney, 1990; Cameron and Whetten, 1993; Abdel-Razek, 1997; Smith 1998; Atkinson, 1999; Nyhan and Martin 1999; and Mbugua, 2000) which covers a wide scope of area. In this respect, this paper documents and discusses empirical analysis mainly to factors related to project *effectiveness* measures in the development of construction projects in Malaysia by the four groups of project stakeholders, namely: the Government, private clients, consultants and contractors.   The statistical analysis initially deals with the mean values of responses and ranks them based on their level of importance.   Detailed comparisons of ranking order were made between the groups.   The second stage of the analysis deals with hypothesis testing by means of the nonparametric method of Kruskal-Wallis One-Way ANOVA (Analysis of Variance) test for a k independent sample. The purpose is to examine the significant difference in opinions of individual factors among the four groups at the 5% significance level.   However, based on the mean ranking technique, all the variables appeared to be significant which is superfluous and meaningless. Factor analysis technique by means of principal component analysis (PCA) was then employed to effectiveness variables to identify the principal factors and to enable a more in-depth understanding of factor grouping techniques to underpin the success measures.

2. Overview of Project Effectiveness Measures in the Development of Construction Projects

Based on the literature search, the identification of project effectiveness measures are associated with project '*results'* in terms of accomplishing core business and project objectives, users' satisfaction and the use of the project as identified by Pinto and Slevin, (1988; 1989) and Cooke Davies, (2002), ten possible indicators are compiled for effectiveness measures and are reviewed. These are: client satisfaction on service, user satisfaction with product, project effectiveness, project functionality, free from defects, value for money, profitability, absence of any legal claims and proceedings, learning and exploitation and generate positive reputation.

3. Project Effectiveness Measures

3.1 Client and User Satisfactions

Satisfaction describes the level of 'happiness' of people affected by a project (Chan et al, 2002).   According to Bititici (1994) client is satisfied when the project is delivered to quality, reliability, on-time deliveries, high service levels and minimum cost of ownership. Atkinson (1999) cites that two possible criteria which could be used to measure project success from effectiveness dimension are the resultant system (i.e. the product) which meets customers' satisfaction and benefits many stakeholders such as users. End-users will not be happy if the end product does not meet their requirements in terms of functionality and quality of service. Meanwhile, Liu and Walker (1998) consider client satisfaction is an attribute of project success, while Torbica and Stroh (2001), reckon that if end-users are satisfied, the project can be considered successfully completed in the long run.

3.2 Level of Effectiveness (achievement of outcomes)

Effectiveness encompasses the attainment of the organisation's objectives both at the corporate level and project level (Maloney, 1990).   It can be measured against the objectives earlier set by the client organisations (Abdel-Razek, 1997; Cameron and Whetten, 1983). According to Pinto and Slevin (1994), effectiveness measures refer to user satisfaction and the use of the project. Cameron and Whetten (1983) reckon that a system is effective if it achieves its objectives and since construction projects are directed towards client's objectives, an effective construction project is one that meets its objective.

3.3 Project Functionality and 'Fitness for Purpose'

Chan (2000) and Chan et al, (2002) considers project 'functionality' as one of the success measures in the post-construction phase when the project is finished and delivered. According to them, project functionality correlates

with expectations of project participant and can be best measured by the degree of conformance to all technical specifications. In addition, they further argue that both financial and technical aspects implemented to technical specifications should be considered, achieving the 'fitness for purpose' objective.   Kometa et al, (1995) regard client satisfaction in terms of the functionality of the finish product, meeting safety requirements, flexibility, time, and quality. A study conducted by Chinyio et al, (1998) reckons project functionality as building to be operationally efficient with its intended purpose, durable building and keeping existing buildings operational during construction.   They found that 73% of those who are interested in keeping existing facilities functional are clients whose works were mainly concerned with alterations and renovations.   Hence, taking the points mentioned by those writers, it seems possible that project functionality and fitness for purpose could be associated with project effectiveness measures.

3.4 Free from Defects

Prahl (2002) defines construction defects as work performed that falls below the standard promised or expected by the client or purchaser of the work or services.   According to Mazier (2001) construction defects is a broad term used for a wide range of conditions at a building such as leaky, improperly installed windows or the presence of so-called toxic mould.   Atkinson (1999) divides the cause of building defects into lack of skill, lack of care and lack of knowledge of the site operative and difficult to build, low design and missing project information.   It is a mixture of technical inadequacies, managerial inadequacies and operative's skills. In order to avoid construction defects, one way is to impose quality control during the construction process.

3.5 Value for Money

Value, a fundamental term in project management is a measure expressed in currency, effort, exchange, or on a comparative scale which reflects the desire to obtain or retain an item, services or ideal (Hamilton, 2002; Liu and Leung, 2002). Kloot and Martin (2000) define 'value for money' as the provision of adequate services without wasting limited resources and ensuring services are affordable. Typically, the analysis sees 'value' in which the 'benefits' to each party are perceived as value. Earlier work on 'value for money' equated value for money in terms of cost reduction and higher quality thresholds, which lead to greater client satisfaction (Hamilton, 2002). Value for money is the optimum combination of whole life cost and project quality to meet a client's need and expectation, and value management aims to maximise the functional value of a construction facility to the clients.   Value for money is an effectiveness measure of project success.

3.6 Profitability

Profitability measures the financial success of the project and a project must be properly managed to be profitable (Parfitt and Sanvido, 1993).   Norris (1990) measures profit as the increment by which revenues exceed costs; that is, profitability is measured as the total net revenue (in dollars) over total costs (in dollar).   Profitability is measured in the post-construction phase when the final account is settled and both the paying and the paid parties can be sure of the financial result (Chan et al, 2002), while Maloney (1990) regards profitability as revenues generated by firm exceeding the cost of producing the revenues.

3.7 Absence of any Legal Claims and Proceedings

Claims in construction can be based on the contract itself, a breach of contract, a breach of some other common law duty, a quasi-contractual assertion for reasonable (*quantum merit*) compensation, or extra *ex-gratia* settlement request. Some construction claims are unavoidable or necessary to contractually accommodate unforeseen changes in project conditions or unavoidable changes in client's priorities (Kumaraswamy, 1997). According to Savido et al, (1990), the absence of any claims or proceedings on projects is the major criterion to all parties (client, designer, and contractor) for measuring project success. Whenever a project is completed without using jurisdiction to settle conflict, the construction project can be considered efficient. Claims managers should focus not merely on the significant claims categories but also on the avoidable ones, so as to minimise the damaging effects on a given project.   In certain cases this variable could also be associated with project efficiency measures.

3.8 Learning and Exploitation

Learning addresses specific criteria in terms of organisational learning, changes in knowledge structure, on-going improvements and feedback (Vakola and Rezgui, 2000).   According to Mooraj et al, (1999), the learning and growth perspective focuses on internal skills and capabilities, in order to align them to the strategic goals of the organisation. Learning and exploitation can be defined as the process of improving actions through better knowledge and understanding (Fiol and Lyles, 1985).   In construction project development, the lessons learned in executing a project (whether the project is success or failure) could be applied to future projects.   According to Dalgleish (2003), some developers believe that projects that were cancelled because they were late and over-budget could still be a success if they provided learning something that could be applied to future projects.

3.9 Generate Positive Reputation

In construction project development, project clients are more likely to have a favourable impression of a contractor's company if they have a positive experience in the services offered with a good quality finished product tailored to their initial needs and expectations (Cohen, 1993; Pete, 1987).   In this respect, maintaining a company's positive image and reputation could be an effectiveness measure of project success to contractors and project consultants by creating good results in performance while implementing projects development. A positive reputation may be generated by working closely with construction project management, identifying opportunities for operational improvements, exploiting new technology, product or markets, identifying management information requirements, and resources constraints in offering well defined services and delivering an expected product that fits the client's business objectives.

4. Methodology

A questionnaire survey is one of the most cost effective ways to involve a large number of people in the process in order to achieve better results, as recommended by McQueen and Knussen (2002) and Andi and Minato (2003). The method adopted for this research was based on a structured questionnaire survey of four principal target groups within the Malaysian construction industry, focusing on the states of Selangor and Kuala Lumpur in Malaysia. The data collection exercises were held in Malaysia over a period of three months (3rd March to 25th of May, 2003).   An eleven-page structured questionnaire was distributed to the four targeted groups, representing a mixture of professionals, including those dealing with policy-formulation, design, construction, quantity surveying, and clients of construction projects. The four targeted groups were: Government; private clients (developers); consultants (architects, quantity surveyors, civil & structural engineers, mechanical & electrical engineers) and contractors.   Samples were randomly selected from the listing provided by the respective professional institutions and Construction Industry Development Board (CIDB) Directory.   For project efficiency measures portion, a two-and-a half page questionnaire needed to be answered by those respondents. Moreover, in order to assist respondents in the understanding of the questions, a definition of project effectiveness measures is provided in the questionnaire.

On the government part, the sources from which samples were drawn are: local authorities, irrigation departments, high institutions, universities, public works departments, semi-government bodies, ministries, government departments, statutory bodies, city counsels, construction industry development board (CIDB), and privatised utility bodies within Selangor and Kuala Lumpur areas. The sources were randomly selected from their respective databases. The private clients, however, include all participating developers and the sources were taken from the Real Estate and Housing Developers Association Malaysia and Master Builders Associations of Malaysia data bases. The consultants include architects, civil and structural engineers, mechanical and electrical engineers, and the quantity surveyors. Their sources were randomly selected from the Malaysian Institute of Architect (PAM), the Malaysian Institute of Engineers, and the Malaysian Institution of Surveyors.   The target population for contractors was based on companies that are registered with the CIDB of Malaysia under the Class G7 (projects greater than Ringgit Malaysia 10 Million) categories and were identified from the CIDB directory.

In order to ensure that the data collected is reliable and adequate, it was necessary to have a population sample that is homogeneous and comprehensive (Hoinville et al, 1978 and Odeyinka 2003). It is also important that such a population gives a true representation of the construction organisations.   The two states of Selangor and Kuala Lumpur, Malaysia, were chosen because they were larger groups of consulting firms and Class G7 contractors registered in these regions, which brings the total percentage of the two states to around 61% (CIDB, 2003a).

Based on a comprehensive literature review, a list of thirty significant factors of efficiency measures was produced for the respondents to identify their level of success criticality to the Malaysian construction projects. Respondents were required to rate each question on a five-point Likert scale that required a ranking (1-5), where one represented 'not important' and 5 represented 'extremely important', as the case might be.   The questions were of the 'close-ended' type aimed at simplifying completion, thus enhancing the response rate, as suggested by Dlakwa, (1990). The results were analysed using the Statistical Package for the Social Sciences (SPSS) software.

5. Response Rate

As shown in Table 1, a total of 446 questionnaires were sent to the different target groups in the Malaysian construction organisations.   Ninety-three questionnaires were returned within two months of being sent out, making the total response rate 20.9 percent.   This response rate was finally achieved after several efforts were made in terms of personal contacts and follow-up calls. All the questions were satisfactorily completed.

Twenty-one (29.5%) respondents were from the Government, followed by 15 (18.5%) from private clients, 34 (17.8%) from consultant organisations, and 23 (22.3%) from contractor companies.   The response rate of 20.9 percent is not uncommon and acceptable and is in line with the opinions of Akintoye (2000) and Dulami et al, (2003).   They reported that the norm response rate in the construction industry for postal questionnaires is around 20-30 percent. Ofori and Lean (2001) received a 26 percent response rate, Vidogah and Ndekugri (1998) received a 27 percent response rate and

Shash (1993) received a 28.3 percent rate. Moreover, the current questionnaire survey of Joint Venture projects in Malaysia, conducted by Adnan and Morledge (2003) in August 2002, has also received a 20 percent response rate. Although the volume of the questionnaire (11-pages) is essential to capture the issues involved in project success in Malaysia, it might also have been responsible for the seemingly low response rate. Nevertheless, these questionnaires were completed by the various project stakeholders in Malaysia and, thus, give us some confidence that the responses are reliable.

6. Respondent Experience

Table 2 shows the posts held by respondents with maximum and minimum years of experiences.

The range of personal experience of the respondents in terms of number of years in the construction industry is between 1-36 years with an overall average of approximately 16.46 years; this provides a good spread of personal experience in the sample. A total of 62 respondents (67 percent) are from senior posts (experience≥13 years), and the remaining 31 respondents (33 percent) occupy junior posts. Based on designation, professional background, and work experience of the respondents, it is reasonable to infer that they have reasonable knowledge of the activities associated with construction project performance.

7. Characteristics of the Respondents and Responding Firms

Table 3 elicits information on the organisations' annual turnover, which enables their grouping into small (up to Ringgit Malaysia 25Million), somewhat medium (25-50M), medium (50-100M), large (100-250M) and very large organisations (>250M). The overall percentage of the organisations' turnovers is in the region of somewhat medium (RM 25-50Million) in the last financial years (2002/2003).   In the government sector, equal numbers of respondents (33.3%) are from the somewhat medium size (25-50M) and very large (>250M) size of organisations. Most of the private sector respondents (46.67%) are from the very large organisations (>250M). The consultant respondents are usually from small companies (up to 25M) to somewhat medium class organisations (25-50M) (Government of Malaysia, 2001) with the annual turnover within RM 25 - RM50M. Equal numbers of contractor respondents (26%) are from small and medium organisations.   The reasons for the small number of annual turnovers (within a period of 2002/2003) may be due to the effect of the recent Asian financial crisis which reduced the volume of construction work.

Table 4 shows the distribution of organisations' workload. The major workload of the organisation is building works (55%) followed by civil engineering works (25%). When comparison is made between organisations (government, private clients, consultants, and contractors), the majority of workload is inclined towards building and civil engineering works, suggesting that these two sectors are governing the construction industry in Malaysia.   In building works for example, consultants and government establishments disclose high percentages of 64.12% and 54.025 respectively, compared with contractor (49.35%) and private client (43.33%). This tends to suggest that the data provided cover building and civil engineering works.   Coincidently, these are the construction activities that this study is intended to achieve and thus adds confidence that the information provided by the respondents is very relevant to construction project performance.

8. Data Analysis, Results and Discussion

As suggested by Tabachnick and Fidell (1996) and Pallant (2001), a Kolmogrov-Smirnov test was used to evaluate whether the data on quantitative variables was normally distributed or otherwise.   In this case, the test indicated significant results (Sig.value <0.05), suggesting that a non-parametric technique would be more suitable for the analysis. An important aspect which determines the type of statistical test (parametric or non-parametric) is the type of scale of measurement of data that are generated from a survey. Non-parametric techniques are ideal for data that is measured on nominal and ordinal scales. Since, majority of data are either nominal or ordinal types of scale of measurement, this demands a non-parametric approach of analysis (Siegel & Castellan, 1988; Easterby-Smith et al, 2002).   In addition, to ensure an accurate result was obtained, validity and reliability were important aspects in the construction of scale (Leedy et al, 2001).

The reliability of the 5-point Likert scale measured was determined by using Cronbach's alpha coefficient on the samples. According to Pallant (2001), the value for alpha should be greater than 0.7 for the scale to be reliable, whereas Nunnally (1978) suggests that the modest reliability scale is in the range of 0.50-0.60. Hence, the value for Cronbach's alpha was reported to be 0.9660 (see Table 5) indicating that the data collected from the survey was interrelated and that the scale was consistent with the sample.

9. Measurement of Project Success based on Effectiveness Performances

Table 5 presents the thirty variables considered by survey respondents for the effectiveness measures of project success. The analysis primarily deals with ranking the variables based on their mean score values to determine their level of importance. Out of 30 factors, 6 factors are rated to be 'very critical' by the survey groups. These are: *client satisfaction on service* (overall mean score = 4.27), *users' satisfaction on product* (overall mean score = 4.17), *benefits to client*

(overall mean score = 4.09), *fitness for purpose* (overall mean score =4.07), *benefits to client* (overall mean score = 4.06), and *project functionality* (overall mean score = 4.01). The remaining 24 factors are also significant and classified 'critical' with the mean scores ranging from 3.33 (*lower depreciation cost*) to 3.94 (*value for money*).

The contractor respondents selected 15 variables as 'very critical' compared with private client respondents (9 factors), consultant respondents (8 factors) and government (1 factor). Comparison between the groups revealed that the mean values from private sectors are much higher than the government. This suggests lack of emphasis among government respondents of Malaysia in their rating of effectiveness measures of project success.

The contractor respondents ranked *client satisfaction on service* (mean value = 4.48) 1st, followed by *user satisfaction on product* (mean value = 4.40), *high profit margin* (mean value = 4.38), *meets project stakeholder needs and expectations* (mean value = 4.35), *benefit to client* (mean value = 4.29) and *meeting pre-stated objectives* (mean value= 4.25). Likewise, private clients group ranked *user satisfaction on product* (mean value = 4.36) 1st, followed by *client satisfaction on service* (mean value = 4.27), *fitness for purpose* (mean value = 4.20), *benefit to users* (mean value = 4.14), and *fast rectification of defects* (mean value = 4.14). This shows that these two groups selected important variables that revolve around the issues of client satisfaction on service, user satisfaction on product, high profit margin and meeting pre-stated objectives, all of which are very much associated with project outcomes.

Similarly, the consultant respondents follow similar perceptions by *client satisfaction on service* (mean value = 4.34) highest, followed by *value for money* (mean value = 4.25), *user satisfaction on product* (mean value = 4.22), *benefit to client* (mean value = 4.17), *benefit to users* (mean value = 4.17) and *project functionality* (mean value=4.11). This indicates that the status-quo of project objectives, user satisfactions and the use of the project are all considered important measures of project effectiveness by consultants. Once again, the Government respondents seem to have a diverse view by choosing *easy to maintain* (mean value=4.11) to be the most important factor (ranked 1st), followed by *project functionality* (mean value=3.90), *client satisfaction on service* (mean value=3.89), and *fitness for purpose* (mean value=3.84). The results suggest that the Government sectors in Malaysia are currently switching their priority project effectiveness needs to maintenance and functionality of the finished product.

Table 5 also provides the results of the Kruskal-Wallis One-Way ANOVA test for a k independent sample, and shows that 3 out of 30 effectiveness variables have statistically significant difference of opinion between the groups at the 5 per cent significance level. These measures are: *accomplish core business needs* (χ^2=8.387, p=0.039<0.05); *project stakeholder needs and expectations* (χ^2=9.624, p=0.022<0.05); and *high profit margin* (χ^2=24.905, p=0.000<0.05). This implies that the null hypothesis for these three factors cannot be accepted.

The Mann-Whitney U test of two independent samples is applied to the three factors (*accomplish core business needs, meets project stakeholder needs and expectations, and high profit margin*) at the 5 per cent significance level as shown in Table 6. With regards to *accomplish core business needs'* the test showed that it is the contractors respondent group that contributed to the difference between the groups at the 5 per cent significance level (government/ contractors, p= 0.015; consultants/contractors, p =0.030). For *project stakeholders needs and expectations* the test reveals once again that the contractors contributed to the significant differences between the groups (government/ contractors, p = 0.025; private clients/contractors, p=0.018), and consultants/contractors, p =0.004). In terms of *high profit margin,* the initial observation indicates a big gap between the mean values of government and contractor respondents (mean value of 2.50 and 4.38), respectively. Expectedly, the Mann-Whitney U test shows that that both government and contractor respondents contributed to the differences in opinion at the 5 per cent significance level (government/private clients, p = 0.001; government/consultants, p=0.003; government/contractors, p =0.000), and consultants/contractors, p =0.002).

To determine a demarcation point between 30 variables of effectiveness measures, the Wilcoxon Signed Ranked Test of two related samples is employed. The test is only able to detect differences at the 10 percent level of significance. Based on this, the overall rating of 4.01 (*project functionality*) is slightly lower than 4.06 (*benefit to users*) at the 10% level of significance (p=0.088) suggesting that the two variables are significantly different at the 10% level of significance. In this case, although the two variables differed, it is unlikely that the factor *project functionality* can be omitted given that the Government sector ranked it 2nd. Factor reduction technique is then employed to reduce the large number of variables to principal factors based on their relationships by means of *Principal Component Analysis* (PCA). The method of analysis and the results are presented and further discussed in Table 6.

10. Factor Analysis of Effectiveness Measures in Measuring Project Success

Factor analysis is also carried out on the thirty-variables of effectiveness measures. All the parameters are satisfactory for extraction requirements: KMO=0.826, (Approximate Chi-square=1487.852, significant 0.000) and all the MSAs are in the range of 0.638-0.923 (greater than 0.500 as required).

Table 6 summarises the results of the analysis conducted using Principal Component Method. As shown, five *Principal Components* are extracted with eigen values greater than 1. Almost 73.59% of the total variance is attributed to the five Principal Components. The scree plot of the total variance associated with each component suggests that a five-component

model is the most appropriate.   The percentage variations explained by the five Principal Components are 20.50 %, 20.15%, 12.85%, 12.15%, and 7.93% respectively.   Each variable weighs heavily on to only one of the Principal Components and the loading on each Principal Component exceeds 0.50.

Referring to Table 6, eight components/ variables come under Principal Component 1 which appears to be associated to 'Learning and Exploitation'. Principal Component 2 comprises eight components, which may be referred to as 'Client Satisfaction'.   The five components under Principal Component 3 represents 'Stakeholder Objectives'. The four components under Principal Component 4 could be associated to 'Operational Assurance', whilst three components under Principal Component 5 could be associated with 'User Satisfaction'. Hence, each Principal Component is readily interpretable as follows:

Principal Component1 represents Learning and Exploitation;

Principal Component 2 represents Client Satisfaction;

Principal Component 3 represents Stakeholder Objectives;

Principal Component 4 represents Operational   Assurance; and

Principal Component 5 represents User Satisfaction.

11. Discussion of Factor Analysis Results of Effectiveness Measures

11.1 Principal Component 1- Learning and Exploitation

Principal Factor 1 accounts for 20.50% of total percentage of the variance explained. This grouping consists of eight components/variables: *develop new knowledge and expertise* (sig. =0.807), *increase level of professional development* (sig. =0.792), *generate positive reputation* (sig. =0.788), *new market penetration* (sig. =0.698), *develop new business relationships* (sig. =0.693), *value for money* (sig. =0.537), *exploitation of technology* (sig. =0.528), and *usable life expectancy* (sig. =0.518).   All of these variables are categorised as critical based on their mean values (see Table 5) indicating that they are suitable for measuring project success as effectiveness measures.

The highest loading is given to *develop new knowledge and expertise* with a significant value of 0.807.   According to Vokala and Rezgui (2000), learning and growth is measured in terms of organisational learning, changes in knowledge structure, on-going improvement and feedback.   The lesson learned from executed projects will assist the project team members in responding to changes according to the demands of internal and external environment or to establish a new set of norms.   Cooke-Davis (2002) reckons one of the twelve key factors in project-oriented organisations is to be 'an effective means of learning from experience' on projects, that combines explicit knowledge with tacit knowledge in a way that encourages people to learn and to embed that learning into continuous improvement of project management processes and practices.

Moreover, the concept of 'learning' and 'exploitation' provide the opportunity to diversify the construction portfolio by exploring the services to foreign construction market and *develop new business relationship* (sig. =0.693) through partnering or collaborative arrangements as suggested by Pandia (1994) and Tang and Ogunlana (2003).   More specifically, when dealing with complex projects, the *exploitation of technology* (sig. =0.528) provide an exposure to an international business relationships between countries. Successful implementation of project in an international environment can enhance the image of a company and elevate its status from the domestic to a transnational level. Thus, it is not surprising that these variables associated with 'learning and exploitation' are loaded together.

11.2 Principal Component 2- Client Satisfaction

Principal Component 2 (*Client Satisfaction*) accounts for 20.15% of the total percentage of the variance explained. This grouping is made-up of eight components: *benefit to end-user, benefit to client, project functionality, aesthetic value, meets client satisfaction on service, meets end-user satisfaction on product, pleasant environment,* and *easy to maintain*. These variables are   highly ranked based on their overall mean scores and regarded as very critical by all the respondents with the exception of 3 variables: *aesthetic value, pleasant environment*, and *easy to maintain*. Higher loading is given to *benefit to users* with a significant value of 0.807, followed by *benefit to client* (sig. =0.802). The overall results indicate that benefits and satisfactions for clients and end-users as a result of any project development is a critical factor for project success.   This is in line with the opinion of Globerson (1997) who notes that the more closely the product fits the customers' satisfaction, the higher the probability of completing the project successfully.

Karlsen (2002) indicates that client and the user are the most important stakeholders to the project.   In relation to this, *client and user satisfaction* issues (sig. = 0.675, and sig. =0.657) largely depend on the absolute level of performance attained based on the pre-determined criteria.   Hence, appreciation of project benefit could be achieved through the client/user acceptance of the project, feel pleasure and satisfied (Walker and Liu, 1998).

Surprisingly, the two components, *pleasant environment* (sig. = 0.537) and *easy to maintain* (sig. =0.508) under this Principal Component have lower loadings, yet *easy to maintain* is regarded as a very critical measure (mean value = 4.11) by government group in measuring project success (effectiveness measures).

11.3 Principal Component 3- Stakeholder Objectives

Principal Component 3 (*stakeholder objectives*) accounts for 12.85% of the total percentage of the variance explained. This grouping is made-up of five components/variables: *accomplish core business needs, meets stakeholder needs and expectations, and meets corporate missions, high profit margin,* and *meeting pre-stated objectives.*

The highest loading is given to *accomplish core business needs* (sig. =0.807), followed by *meeting stakeholder needs and expectations* (sig. = 0.775) and *meets corporate mission* (sig. =0.715). According to Male (1991) and Cox and Townsend (1998), construction needs ought to be aligned with the corporate objectives in terms of meeting core business needs and corporate missions and support the core business process. For instance, in UK, the implementation of this concept could be seen in Rover group of Britain, McDonald's restaurants Ltd, and British Airport Authority construction projects development where every project undertaken reflects the corporate missions of the establishments.

Meanwhile, Morris and Hough (1987) have argued that the achievement of objectives is accomplished when the project is profitably delivered by the contractor (sig. = 0.635). This is in line with the opinion of Sanvido et al, (1992), who agree that the effectiveness of the project outcomes is measured when both designers and contractor meet certain profit and fee goals.

11.4 Principal Component 4- Operational Assurance

Principal Component 4 (*operational assurance*) accounts for 12.15% of the total percentage of the variance explained. This grouping consists of five components/variables: *supported by worthwhile warranty programmes, excellent commissioning programmes, close-out process run smoothly and efficiently, fitness for purpose,* and *fast rectification of defects.*

In the construction industry, *project commissioning* (sig. = 0.676) is a systematic process of verification and documentation, and is vital for all parts of project stages (i.e., from pre-design to staff training and warranty-period monitoring) that all building or facility systems perform interactively in accordance with the design documentation and intent, and in accordance with the client's operational needs (Rothacker, 2003; Wilkinson, 2001; Allen and Trimble, 2003). Once the equipment is installed and modifications are carried out, the installer is expected to make sure that the system is operating. In addition, *warranty programmes* (sig.=0.792) and post contract activities such as in-service training, system and operating staff performance appraisal, periodic inspections, operator training, etc are required to be implemented soon after the handing over of the completed building/facilities to client and users as indicated by Spirer and Hamburger, (1988). The responsible groups must be informed of their specific obligations and all relevant project data (i.e. contracts, drawings, manuals, etc) must be transferred as appropriate.

Moreover, *fast rectification of defects* (sig. = 0.595) within the project is another important aspects in commissioning and warranty programme that should be treated seriously and systematically (Atkinson, 1999). It is the duty of the responsible group to check on the liability insurance programme undertaken by contractors and subcontractors for protection against construction defects claims. In Malaysia, in most construction contracts, the defects liability period is lasts for 12 months from the certificate of practical completion and the contractor is liable to make good any defects that surface during this period in a workmanlike manner.

11.5 Principal Component 5- User Satisfaction

Principal Component 5 (*user satisfaction*) accounts for 7.93% of the total percentage of the variance explained. This grouping consists of three components/variables: *early occupation, minimum cost of ownership,* and *flexibility for future expansion.*

Professional developers normally have a special programme to keep their clients, end-users and purchasers well informed with regard to the construction time table and setbacks (Jackson, 2003). Realising that client and users' satisfaction is the final proof of project success, an *early period to occupy a property* (sig. = 0.820) is one of the fundamental factors that fascinates most customers and home occupiers. Highest loading is given to this factor, indicating the importance of it in measuring the effectiveness of project success.

Moreover, clients, end-users and purchasers are important people that created market demand and they expect that products are affordable and high quality with *minimum cost of ownership* (sig. = 0.563). In Malaysia, most clients, end-users and facility purchasers are delighted to buy affordable properties or homes that provide flexibility for future expansion (Tan, 1996). The main reason could be tight budget when a property is purchased and hence look for the opportunity to expand floor areas at the later stage. This is usually an important part of the Malaysia property acquisition norms.

12. Conclusion

This paper has produced detailed analyses of project success effectiveness measures in the form of a mean ranking of variables and factor reduction techniques in order to unveil empirical findings with regards to the Malaysian construction industry. The evaluation of project success and the level of success criticality in the development of construction projects

in Malaysia are according to the specific requirements and priorities of different project stakeholders and will vary from project to project.

In terms of the effectiveness measures of project success, the first finding revealed that client satisfaction, high profit margin and fitness for purpose are receiving of great importance from both contractor and private client organisations in Malaysia compared to the Government and their consultants. Project profitability, user's satisfactions in terms of service and product, and fitness for purpose are the prime criteria of the private sectors' success measures at the project completion stage which are associated to effectiveness measures of project success. However, the issues related to maintenance and project functionality are of main concerned to most Government organisations in Malaysia at the project completion stage apart from client satisfaction on the good services and excellent product deliverables.

With regards to the above, the Malaysian Government (through CIDB of Malaysia) has begun to make excellent efforts and a drastic initiative in promoting quality consciousness among the construction industry players in order to achieve excellent quality of construction product. Although the commitment in providing good quality assurance to project is tedious and complex, especially in large scale construction projects, the involvement of CIDB, Malaysia to integrate quality assurance programme as reported by Technology Foresight to improve the technical quality and constructability indicating a good process improvement in the development of construction projects (CIDB, 2000). Furthermore, project functionality is also of the priority concerned to the Government organisation in Malaysia given that the effectiveness of a project could be jeopardised if the building fails to meet the functionality criteria or is not operationally efficient for the users intended purpose.

Secondly, project success in terms of *effectiveness* measures revealed five principal component factors and 29 associated variables which are represented by: Learning and Exploitation, Client Satisfaction, Stakeholder Objectives, Operational Assurance and User Satisfaction. Given that effectiveness measures of project success are related to the project *'results'*, factors such as learning from projects, meeting the client and users' satisfaction, meeting pre-stated objectives of project stakeholders (accomplishing core business and project objectives) and supported by a well organised commissioning programmes are the expected project outcomes. Aligning project outcomes with customer needs and expectations is the most ideal situation in measuring project success in terms of effectiveness measures. Although in reality the ideal situation is hard to achieve, the empirical findings has discovered that these are the important variables that need to be measured by the Malaysian construction organisation for project success from the effectiveness point of view. It is hoped that the empirical findings of this study could offer an insight to Government and project-oriented companies in Malaysia for future strategies and guidelines with regards to project effectiveness measures of project success for the development of construction projects.

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Table 1. Response Data

Type of organisations	Number of questionnaires		Percentage return
	Sent	Return	(%)
Government	71	21	29.5
Private clients	81	15	18.5
Consultants	191	34	17.8
Contractors	103	23	22.3
Total	446	93	20.9

Table 2. Profile of Survey Respondents and Their Experiences

Sample			Designations		Experience in the construction industry (years)			
Type of Organisations	Frequency		Senior Post	Junior Posts	Max	Average (Mean)	Min	Std. Deviation
			Principal, Director, Managing Director, Senior Surveyor, Senior Manager, Senior Engineer, Senior Quantity Architect, Senior Contract and Chief Project Manager and Head of Organisations	Architect, Engineer, Quantity Surveyor Contract Administration, Planner, Senior Technical Assistant				
Government	21		10	11	27	14.10	3	6.00
Private Client	15		8	7	36	14.40	5	7.36
Consultants	34							
- Architect		9	7	2	28	17.67	1	8.08
- C & S Engineer		10	9	1	27	20.70	11	5.83
- M & E Engineer		4	4	0	23	17.75	13	4.57
- Quantity Surveyor		11	8	3	30	16.54	5	8.62
Contractor (G7)	23		16	7	25	14.13	4	6.05
Total	93		62	31	-	-	-	-

Table 3. Survey Organisations Distribution by Annual Turnover

Annual turnovers (RM Million)	Total Frequency	Overall %	Government (GOV)	(%)	Private Clients	(%)	Consultants (CONS)	(%)	Contractors (CONT)	(%)
Up to 2.5M	29	31.18	0	0	1	6.67	22	64.71	6	26.09
25-50M	24	25.81	7	33.33	3	20.00	9	26.47	5	21.74
50-100M	11	11.83	2	9.52	2	13.33	1	2.94	6	26.09
100-250M	10	10.75	5	23.81	2	13.33	1	2.94	2	8.70
Over 250M	19	20.43	7	33.33	7	46.67	1	2.94	4	17.39
Total	93	100.00	21	100.00	15	100.00	34	100.00	23	100.00

Table 4. Distribution of the Survey Organisations' Workload

Workload	Overall mean (%)	Government (%)	Private Clients (%)	Consultants (%)	Contractors (%)
Building works	54.84	54.05	43.33	64.12	49.35
Civil Engineering works	24.78	20.38	28.00	21.47	31.61
Mechanical & Electrical works	9.16	10.57	7.47	7.79	11.00
Other works	10.73	11.43	21.20	6.32	9.78

Table 5. Criteria for Measuring Project Success in terms of Effectiveness Measures

Criticality	Effectiveness Measures	Overall mean Score	R	GOV (N=21)	R	Private Client (N=15)	R	CONS (N=34)	R	Contractor (N=23)	R	Chi-Square Value	Kruskal Wallis Sig p	Wilcoxon Signed Ran Criticality
V. Critical	Client satisfaction on service	4.27	1	3.89	3	4.27	2	4.34	1	4.48	1	7.252	0.064	
V. Critical	User satisfaction on product	4.17	2	3.75	7	4.36	1	4.22	3	4.40	2	7.711	0.052	
V. Critical	Benefit to client	4.09	3	3.80	5	4.07	6	4.17	4	4.29	5	5.868	0.118	
V. Critical	Fitness for purpose	4.07	4	3.84	4	4.20	3	4.04	7	4.24	7	3.868	0.276	
V. Critical	Benefit to end-user	4.06	5	3.80	6	4.14	4	4.17	5	4.13	11	2.699	0.440	
V. Critical	Project functionality	4.01	6	3.90	2	4.00	7	4.11	6	4.00	13	1.588	0.662	
Critical	Value for money	3.94	7	3.26	25	3.93	10	4.25	2	4.11	12	6.489	0.090	
Critical	Easy to maintain	3.90	8	4.11	1	3.87	13	3.83	10	3.82	21	1.803	0.614	
Critical	Fast rectification of defects	3.89	9	3.56	13	4.14	5	4.00	8	3.82	22	4.010	0.260	
Critical	Meets pre-stated objectives	3.89	10	3.38	11	4.00	8	3.79	11	4.25	6	7.480	0.058	
Critical	Exploitation of technology	3.83	11	3.50	16	3.93	11	3.77	12	4.14	10	4.171	0.244	
Critical	Increase level of professionalism	3.80	12	3.43	21	3.64	22	3.96	9	4.00	14	5.459	0.141	
Critical	Develop new knowledge & expertise	3.76	13	3.54	15	3.79	16	3.75	14	3.94	16	1.058	0.787	
Critical	Develop new business relationship	3.75	14	3.55	14	3.86	14	3.58	23	4.00	15	2.942	0.401	
Critical	Generate positive reputation	3.75	15	3.69	8	3.79	17	3.50	27	4.21	8	4.633	0.201	
Critical	Accomplish core business needs	3.74	16	3.47	19	3.93	12	3.56	24	4.19	9	8.387	0.039*	
Critical	Stakeholder needs & expectations	3.71	17	3.38	22	3.67	21	3.52	26	4.35	4	9.624	0.022*	
Critical	High profit margin	3.71	18	2.50	30	4.00	9	3.59	22	4.38	3	24.905	0.000**	
Critical	Excellent commissioning programmes	3.69	19	3.57	12	3.79	18	3.67	18	3.73	26	0.322	0.956	
Critical	Early occupation	3.68	20	3.63	10	3.79	19	3.56	25	3.87	19	0.920	0.821	
Critical	Corporate missions	3.68	21	3.24	26	3.80	15	3.74	15	3.89	18	3.933	0.269	
Critical	Aesthetic value	3.67	22	3.50	17	3.57	24	3.68	17	3.94	17	4.814	0.189	
Critical	Pleasant environment	3.63	23	3.64	9	3.50	27	3.76	13	3.50	29	1.335	0.721	
Critical	Usable life expectancy	3.62	24	3.29	24	3.57	25	3.69	16	3.87	20	4.007	0.261	
Critical	Excellent close-out process	3.56	25	3.31	23	3.57	26	3.61	20	3.67	27	0.817	0.845	
Critical	Worthwhile warranty programme	3.53	26	3.50	18	3.71	20	3.61	21	3.27	30	1.963	0.580	
Critical	Minimum cost of ownership	3.53	27	3.20	27	3.36	29	3.67	19	3.79	23	4.367	0.224	
Critical	Flexible for future expansion	3.52	28	3.47	20	3.64	23	3.43	28	3.63	28	0.690	0.876	
Critical	New market penetration	3.38	29	3.00	29	3.43	28	3.27	29	3.79	24	3.942	0.268	
Critical	Lower depreciation cost	3.33	30	3.09	28	3.21	30	3.26	30	3.77	25	3.506	0.320	

*The mean difference is significant at the 0.05 level   5=Extremely Critical; 4= Very Critical; 3= Critical; 2=Somewhat Critical; 1= Not Critical

**The mean difference is significant at the 0.01 level   Reliability coefficient (Cronbach's alpha) =0.9660

Table 6.   Factor Matrix grouping after Varimax Rotation (Effectiveness Measures)

Components	Principal Components (PC)				
	Principal Component 1	*Principal Component 2*	*Principal Component 3*	*Principal Component 4*	*Principal Component 5*
Develop new knowledge and expertise	0.807				
Increase level of professional development	0.792				
Generate positive reputation	0.788				
New market penetration	0.698				
Develop new business relationship	0.693				
Value for money	0.537				
Exploitation of technology	0.528				
Usable life expectancy	0.518				
Benefit to end-user		0.807			
Benefit to client		0.802			
Project functionality		0.765			
Aesthetic value		0.755			
Meets client satisfaction on service		0.675			
Meets end-user satisfaction on product		0.657			
Pleasant environment		0.537			
Easy to maintain		0.508			
Accomplish core business needs			0.807		
Meets stakeholders' needs & expectations			0.775		
Meets corporate missions			0.715		
High profit margin			0.635		
Meeting pre-stated objectives			0.624		
Supported by warranty programme				0.792	
Excellent testing and commissioning programmes				0.676	
Close-out process run smoothly & efficiently				0.629	
Fitness for purpose				0.597	
Fast rectification of defects				0.595	
Early occupation					0.820
Minimum cost of ownership					0.563
Flexibility for future expansion					0.551
Eigenvalue	6.151	6.045	3.856	3.645	2.379
Percentage of variance explained	20.503	20.151	12.854	12.151	7.929
Cumulative percentage variance	20.503	40.654	53.508	63.659	73.588

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.826;

Barlett's Test of Sphericity =1487.852, significance p=0.000

Appendix 1-Correlation Matrix of 30 variables of Effectiveness Measures

	1	2	3	4	5	6	7	8	9	10	11	12
1 Meets corporate missions	1.000											
2 Meets pre-stated objectives	0.613	1.000										
3 Accomplish core business needs	0.611	0.645	1.000									
4 Meets client satisfaction on service	0.458	0.507	0.566	1.000								
5 Meets end-user satisfaction on product	0.327	0.509	0.405	0.812	1.000							
6 Meets project stakeholders' needs & expectations	0.549	0.533	0.78	0.538	0.450	1.000						
7 Aesthetic value	0.256	0.513	0.492	0.647	0.668	0.456	1.000					
8 Benefit to client	0.425	0.566	0.637	0.720	0.625	0.583	0.719	1.000				
9 Benefit to end-user	0.446	0.574	0.536	0.729	0.758	0.526	0.755	0.896	1.000			
10 Project functionality	0.333	0.636	0.417	0.592	0.676	0.337	0.739	0.703	0.768	1.000		
11 Fitness for purpose	0.314	0.575	0.421	0.286	0.354	0.322	0.453	0.540	0.485	0.606	1.000	
12 Value for money	0.476	0.452	0.383	0.696	0.632	0.426	0.510	0.541	0.634	0.547	0.355	1.000
13 Free from defects	0.414	0.366	0.269	0.424	0.521	0.358	0.349	0.233	0.351	0.318	0.230	0.563
14 Flexible for future expansion	0.230	0.299	0.352	0.460	0.494	0.256	0.486	0.507	0.529	0.581	0.356	0.412
15 Usable life expectancy	0.435	0.515	0.49	0.569	0.626	0.477	0.600	0.554	0.658	0.590	0.396	0.681
16 Easy to maintain	0.340	0.434	0.329	0.494	0.527	0.432	0.543	0.550	0.531	0.564	0.349	0.548
17 Early occupation	0.237	0.212	0.29	0.367	0.330	0.236	0.416	0.339	0.407	0.441	0.202	0.312
18 Minimum cost of ownership	0.434	0.367	0.537	0.491	0.450	0.569	0.569	0.493	0.547	0.395	0.266	0.465
19 Lower depreciation cost	0.407	0.458	0.473	0.572	0.554	0.543	0.544	0.509	0.558	0.552	0.429	0.587
20 New market penetration	0.342	0.331	0.297	0.621	0.619	0.384	0.389	0.386	0.480	0.483	0.281	0.613
21 Generate positive reputation	0.370	0.292	0.449	0.585	0.600	0.531	0.418	0.382	0.464	0.324	0.162	0.512
22 Develop new business relationship	0.287	0.300	0.358	0.418	0.467	0.464	0.285	0.327	0.392	0.287	0.171	0.483
23 Develop new knowledge and expertise	0.287	0.273	0.408	0.513	0.534	0.526	0.331	0.351	0.415	0.309	0.171	0.460
24 Increase level of professional development	0.314	0.274	0.283	0.607	0.655	0.399	0.492	0.397	0.521	0.395	0.223	0.641
25 Pleasant environment	0.283	0.495	0.467	0.562	0.460	0.433	0.690	0.602	0.597	0.579	0.408	0.437
26 Close-out process run smoothly & efficiently	0.450	0.514	0.419	0.523	0.632	0.333	0.560	0.524	0.603	0.665	0.506	0.565
27 Excellent commissioning programme	0.396	0.419	0.46	0.502	0.529	0.410	0.474	0.470	0.489	0.537	0.471	0.545
28 Fast rectification of defects	0.410	0.479	0.435	0.614	0.670	0.413	0.640	0.539	0.566	0.533	0.497	0.631
29 Supported by worthwhile guarantees	0.373	0.387	0.323	0.378	0.463	0.227	0.448	0.319	0.402	0.503	0.445	0.529
30 High profit margin	0.544	0.573	0.593	0.480	0.546	0.625	0.430	0.448	0.444	0.333	0.372	0.427

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy 0.826

Barlett's Test of Sphericity

Approx. Chi-square	1487.852
df	435.000
Sig	0.000

	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
13	1.000																	
14	0.349	1.000																
15	0.494	0.647	1.000															
16	0.453	0.640	0.705	1.000														
17	0.401	0.570	0.533	0.427	1.000													
18	0.482	0.396	0.532	0.300	0.558	1.000												
19	0.521	0.727	0.624	0.578	0.382	0.587	1.000											
20	0.521	0.541	0.678	0.454	0.473	0.492	0.716	1.000										
21	0.588	0.517	0.596	0.441	0.552	0.658	0.614	0.651	1.000									
22	0.505	0.405	0.520	0.355	0.405	0.457	0.474	0.638	0.723	1.000								
23	0.439	0.479	0.620	0.492	0.255	0.433	0.573	0.638	0.782	0.679	1.000							
24	0.413	0.445	0.711	0.579	0.303	0.446	0.560	0.679	0.736	0.540	0.731	1.000						
25	0.318	0.421	0.541	0.492	0.463	0.533	0.459	0.465	0.417	0.401	0.401	0.438	1.000					
26	0.501	0.551	0.660	0.480	0.383	0.505	0.617	0.639	0.651	0.500	0.548	0.600	0.521	1.000				
27	0.440	0.432	0.651	0.534	0.323	0.417	0.504	0.565	0.562	0.511	0.556	0.589	0.524	0.788	1.000			
28	0.632	0.468	0.706	0.671	0.393	0.460	0.584	0.539	0.569	0.384	0.487	0.588	0.500	0.687	0.718	1.000		
29	0.521	0.411	0.609	0.494	0.448	0.411	0.429	0.560	0.565	0.517	0.450	0.565	0.479	0.769	0.827	0.736	1.000	
30	0.489	0.325	0.469	0.394	0.338	0.422	0.444	0.427	0.565	0.549	0.488	0.493	0.304	0.502	0.536	0.557	0.485	1.000

Appendix 2. Anti-image Correlation Matrix of 30 variables of Effectiveness Measures

	1	2	3	4	5	6	7	8	9	10	11
1 Meets corporate missions	**0.849**										
2 Meets pre-stated objectives	-0.135	**0.721**									
3 Accomplish core business needs	-0.200	-0.205	**0.881**								
4 Meets client satisfaction on service	-0.295	-0.303	-0.187	**0.803**							
5 Meets end-user satisfaction on product	0.367	0.05003	0.01255	-0.537	**0.835**						
6 Meets project stakeholders' needs & expectations	-0.117	0.252	-0.472	0.04652	-0.08566	**0.824**					
7 Aesthetic value	0.305	0.279	-0.05811	-0.253	0.08522	0.01868	**0.850**				
8 Benefit to client	0.233	0.180	-0.271	-0.399	0.465	-0.01214	0.031	**0.787**			
9 Benefit to end-user	-0.305	-0.06790	0.25900	0.244	-0.520	-0.05938	-0.07841	-0.800	**0.835**		
10 Project functionality	-0.03303	-0.450	0.06192	0.173	-0.328	-0.07607	-0.486	-0.08312	-0.05137	**0.838**	
11 Fitness for purpose	0.03136	-0.289	0.01009	0.336	-0.06693	-0.131	0.09965	-0.336	0.190	0.167	**0.837**
12 Value for money	0.020	0.231	0.06636	-0.492	0.241	0.04256	0.245	0.08642	-0.123	-0.250	-0.103
13 Free from defects	-0.151	0.03053	0.05456	0.07218	-0.162	0.080623	0.002657	0.201	-0.07501	0.05396	-0.04610
14 Flexible for future expansion	-0.02257	0.427	-0.158	-0.128	-0.170	0.508	0.151	-0.141	0.101	-0.148	-0.135
15 Usable life expectancy	0.07588	-0.524	-0.213	0.410	-0.01269	-0.192	-0.276	0.113	-0.192	0.303	0.165
16 Easy to maintain	-0.176	-0.299	0.365	0.262	-0.157	-0.387	-0.01772	-0.475	0.409	-0.05220	0.354
17 Early occupation	0.113	0.421	-0.05652	-0.326	0.386	0.170	0.204	0.340	-0.285	-0.429	-0.158
18 Minimum cost of ownership	-0.213	-0.06820	0.01336	0.242	-0.164	-0.08135	-0.262	-0.231	0.116	0.140	0.0839
19 Lower depreciation cost	0.100	-0.259	-0.06035	0.05642	0.327	-0.317	-0.205	0.328	-0.270	0.03388	-0.08471
20 New market penetration	-0.03672	0.182	0.259	-0.301	-0.192	-0.03436	0.328	-0.215	0.308	-0.119	0.0228
21 Generate positive reputation	0.084	-0.236	0.006884	-0.04465	-0.106	-0.306	0.02906	-0.09676	0.129	0.248	0.196
22 Develop new business relationship	0.06292	-0.02977	0.07669	0.183	-0.09911	0.002270	-0.04292	-0.128	0.02830	0.09114	0.0349
23 Develop new knowledge and expertise	0.148	0.227	-0.124	-0.169	0.221	0.002699	0.238	0.223	-0.167	-0.263	-0.04732
24 Increase level of professional development	-0.05666	0.384	0.099	-0.204	-0.04359	0.280	-0.07896	0.195	-0.153	0.07005	-0.263
25 Pleasant environment	0.094	-0.409	0.013	-0.04940	0.128	-0.161	-0.419	-0.03360	-0.03179	0.263	-0.01997
26 Close-out process run smoothly & efficiently	-0.271	-0.06419	0.05980	0.284	-0.157	0.241	-0.07607	-0.188	0.07296	-0.190	0.035
27 Excellent commissioning programme	0.147	0.388	-0.04182	-0.323	0.118	-0.05450	0.328	0.04290	0.02103	-0.243	-0.08291
28 Fast rectification of defects	-0.02514	0.209	0.07081	-0.189	-0.255	0.210	-0.184	-0.168	0.157	0.237	-0.291
29 Supported by worthwhile guarantees	-0.05013	-0.127	-0.215	0.217	0.174	0.128	-0.09722	0.025	-0.163	-0.6988	-0.02875
30 High profit margin	-0.204	-0.558	-0.008045	0.350	-0.297	-0.329	-0.333	-0.228	0.201	0.405	0.103

Note: Measure of Sampling Adequacy (MSA) are printed on the diagonal

	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	0.880																		
	-0.259	**0.923**																	
	0.197	0.09780	**0.759**																
	-0.361	0.01560	-0.490	**0.787**															
	-0.09712	-0.202	-0.329	0.02166	**0.787**														
	0.246	0.01680	0.06287	-0.379	-0.343	**0.638**													
	-0.125	-0.107	0.160	0.07378	0.295	-0.311	**0.898**												
	-0.179	-0.0694	-0.683	0.434	-0.086	0.208	-0.286	**0.808**											
	0.169	-0.0676	0.280	-0.399	0.247	-0.221	0.0588	-0.587	**0.840**										
	0.04950	-0.201	-0.216	0.330	0.247	-0.504	-0.216	0.0245	0.229	**0.821**									
	-0.241	-0.0683	0.01110	0.06837	0.0188	0.04817	0.143	0.02265	-0.248	-0.351	**0.894**								
	0.239	-0.0145	-0.03208	-0.228	-0.184	0.453	0.02055	0.06495	-0.110	-0.398	-0.196	**0.870**							
	-0.08950	0.332	0.343	-0.453	-0.421	0.394	0.019	-0.142	-0.109	-0.542	0.262	-0.0495	**0.796**						
	0.01658	-0.0919	-0.160	0.307	0.07028	-0.300	-0.125	0.205	-0.147	0.285	-0.160	-0.201	-0.223	**0.848**					
	-0.0322	0.01420	-0.02112	0.06448	0.188	0.161	0.078	0.09605	-0.147	-0.397	0.200	0.07340	0.09780	-0.104	**0.923**				
	0.177	0.07484	0.189	-0.334	-0.136	0.267	0.07109	-0.123	0.184	0.02928	-0.0556	0.02900	0.135	-0.231	-0.334	**0.852**			
	0.03966	-0.185	0.380	-0.407	-0.273	0.049	0.127	-0.340	0.174	-0.179	0.303	-0.05645	0.355	-0.0256	0.017	0.01820	**0.961**		
	-0.150	0.08970	-0.158	0.314	0.05933	-0.102	0.05364	0.335	-0.270	-0.02619	-0.226	0.136	-0.215	0.0273	-0.147	-0.482	-0.460	**0.859**	
	-0.134	-0.115	-0.296	0.478	0.295	-0.503	0.123	0.164	-0.04884	0.323	-0.211	-0.203	-0.443	0.414	-0.01323	-0.323	-0.198	0.09364	**0.726**