ANALYSIS OF MEASURES OF CONSTRUCTION PROJECT SUCCESS IN MALAYSIA

Roshana Takim[1], Akintola Akintoye and John Kelly

[1]*School of Built and Natural Environment, Glasgow Caledonian University, City Campus, Glasgow G4 OBA, UK*

Project efficiency and effectiveness measures are important to judge project performance and project success. This paper provides an empirical analysis of measures of success in terms of efficiency (outputs) and effectiveness (outcomes) in the development of construction projects in Malaysia. The purpose is to distinguish the difference of the two dimensions and to identify the relationship between them. 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 measures of success 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 findings reveal that efficiency measures are related to the *'process'* involved in the development of construction project. These are represented by the four principal factors namely: Quality and Conflicts Resolution, Process Improvement Programme, Resources Management, and Project Objectives. In the meantime, the effectiveness measures are related to the project *'results'*, and represented by the five principal factors namely: Learning and Exploitation, Benefits and Rewards, Corporate objectives, Operational Assurance, and Users' 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), factor analysis, success measures, Malaysia

INTRODUCTION

Since the beginning of the 1980s a widespread movement in many countries has been trying hard to reform client organisations, particularly public clients responding to the mounting pressure to increase the quality of the management of their development projects. The fundamental objective is to eliminate the length of time spent and excessive budgets, and instead increasing the quality of the final product and services provided. This perspective is logical for the reason that after the completion of the project, the occupiers will successfully use and operate the completed buildings and facilities and gain pleasure from them. This movement has been a driving force for clients' organisations, whether public or private, to revise their procedures and business techniques in managing construction projects that comply with the principles of economy, efficiency and effectiveness, as suggested by Arnaboldi et al (2004). A similar trend can be seen in the Malaysian construction industry. In Malaysia, a general concern has been shown for the difficulties of managing projects in the Government sectors. The possible reasons are due to the inappropriate business methodologies adopted, failure to determine the critical success factors across project

[1] R.Takim@gcal.ac.uk

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phases, failure to identify the element of success in the form of efficiency and effectiveness measures, and failure to adopt systematic performance measurement systems conclusively for benchmarking projects. Nevertheless, through the intervention of the Construction Industry Development Board (CIDB, Malaysia), the level of quality consciousness in implementing public projects has been emphasised among industry players especially in large scale projects (Tang and Ogunlana, 2003). Although a quality assessment system called *QLASSICS* (CIDB, 2001b) has been introduced as a measure of assessing the quality of a project, the system is not conclusive enough to embrace the whole project management strategy in managing public projects which appear to be different from project to project.

This empirical study explores and documents the criteria for measuring project success in the form of efficiency and 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 these variables (efficiency and effectiveness measures) to identify the principal factors and to enable a more in-depth understanding of factor grouping techniques to underpin the success measures.

SUCCESS MEASURES

The concept of success in a construction project according to some researchers (Baker *et al*, 1983; Slevin and Pinto, 1986; Morris and Hough, 1987, and Turner 1993) can indeed be evaluated only when the evaluation dimensions are adequately defined. Generally, in any projects the evaluation dimensions correspond to the traditional constraints of time, cost, and quality parameters. This perception, however, is further refined by Pinto and Sleven (1994); Abdel-Razek (1997); Nyhan *et al* (1999) and Cooke-Davies (2002) who noted that the dimensions of project success refer to the *efficiency* and *effectiveness* measures. More specifically, according to them, the efficiency measures correspond to the strong management and internal organisational structures (adhere to schedule and budget, and basic performance expectation) which means getting the project out on time, on budget and meeting a quality threshold. On the other hand, the effectiveness measures refer to the achievement of objectives, users' satisfaction and the use of the project.

Similarly, Maloney (1990) asserts that the efficiency of construction projects involves the utilisation of resources, and it may be represented by the ratio of the resources expected to be consumed divided by the resources actually consumed. The effectiveness of construction project is when the organisation's objectives are fully attained. The above perceptions align with the views of Concerdo (1990) who proposes a model of performance measurements in terms of the final outputs and resources to be measured at different levels. Final outputs are measured to determine whether they help to accomplish objectives (effectiveness), and resources are measured to determine whether a minimum amount of resources are used in the production of the final outputs (efficiency). Given the above, when considering exactly what defines a 'successful' project, it is essential to emphasise both the aspects of project outputs (efficiency) and outcomes (effectiveness).

Following there on, the ideas were adopted and used as guidelines in establishing performance indicators for measuring the efficiency and effectiveness of a project in the Malaysian construction industry. Measuring the efficiency performance of a project means measuring the efficiency of the *'processes'* in terms of strategic planning and management and utilisation of resources which relates to the project outputs. Whereas, the effectiveness performance measures the project *'results'* in terms of accomplishing the core businesses and project objectives, users' satisfaction and the use of the project which relates to the project outcomes.

In order to encourage a meaningful return as suggested by Nachmias and Nachmias (1996), these definitions were incorporated in the questionnaire survey. The purpose is to assist respondents with possible clues while answering the questions, in judging the most critical factors for success measures that could be used in the development of construction projects.

RESEARCH METHOD

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). 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 in 2003. A fourteen-page structured questionnaire was distributed to the four targeted groups (the Government, private clients, consultants, and contractors) representing a mixture of professionals, including those dealing with policy-formulation, design, construction, quantity surveying, and clients of construction projects. Samples were randomly selected from the listing provided by their respective professional institutions. 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. The two states of Selangor and Kuala Lumpur, Malaysia, were chosen because they were larger groups of professionals 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, lists of thirty significant factors of both efficiency and effectiveness measures, respectively, were 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.

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. The respondents had an average construction experience of approximately 16 years. The majority of them were in senior positions in their firms.

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

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 Chan (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 (14-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 representative.

DATA ANALYSIS, RESULTS AND DISCUSSION

As suggested by Tabachnick and Fidell (1996), 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. 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 results were in the range of 0.9590-0.9660, indicating that the data collected from the survey was interrelated and that the scale was consistent with the sample.

In addition, the objective of the data analysis was to test the hypothesis that '*the criteria used to measure project success in terms of efficiency and effectiveness performances do not vary based on the perceptions of the different project stakeholders (Government, private clients, consultants, and contractors) in Malaysia*'

Efficiency Measures

The thirty variables considered for the efficiency measures are shown in Table 2. The overall mean scores were ranked based on their level of importance. Out of these 30 factors, 4 factors were rated as 'very critical' by the groups. These were: meets time (overall mean value=4.32), meets budget (overall mean value=4.27), meets technical specifications (overall mean value=4.11), and fast decision-making process (overall mean value=4.06). The remaining 26 factors were also significant and rated as 'critical' with the mean scores in the range of 3.20 (zero variation) to 3.93 (high quality of workmanship) which is above the mid-point score of 2.5.

When comparisons were made between sectors, consultant (*CONS*) groups agreed to rank 1st 'meets time' (mean value=4.41), whilst the Government (*GOV*), private clients, and contractors (*CONT*) ranked it 2nd with the mean values of 4.05, 4.40 and 4.35, respectively. Meanwhile, private clients and contractors had a similar perception in choosing 'meets budget' as the most crucial (ranked 1st) with the mean values of 4.60 and 4.57, correspondingly. In contrast, the Government sector ranked 'meets technical specification' 1st, whilst ranking 'meets time' (mean value=4.05) 2nd, 'high quality of materials and components used' (mean value= 4.05) 3rd, and 4th 'high quality of workmanship' (mean value=3.90). These results show that the Government sectors in Malaysia are currently putting a great deal of emphasis on 'quality' measures apart from 'time' and 'safety requirements'. The factor 'meets time' become secondary and, amazingly, the factor 'meets budget' goes up to 10th position in the list. The probable reason may be due to the intervention of the CIDB, Malaysia, among industry players to implement quality measures in their projects (CIDB, 2000b). To a certain extent, some project clients in Malaysia require a quality assurance system as a pre-requisite for tender in any construction project.

In the meantime the consultant groups believed that the 'efficiency of approval authority' (ranked 5th –mean value 4.00) should also be given a great deal of attention with regard to the success criteria apart from time, budget, and quality parameters. This aligns with Abdul-Rashid and Morledge's (1999) finding that the efficiency of technical approval is the subject matter for most project implementers in Malaysia, especially for consultant architects and Design & Built contractors. On the contrary, the contractors' group was perceived to assess factors on high project productivity (mean value=4.35), efficiency in utilisation of manpower (mean value=4.21), and maximum utilisation of resources (mean value=4.15) as 'very critical'. In the ASEAN region, the availability of cheap foreign workers has been seen to be one of the main reasons for the low level of productivity in the construction industry (Dulami and Hwa, 2001). The low cost mentality and availability of a cheap labour force would discourage the industry from investing in new technology and processes. Thus, to indicate good project productivity, sufficient measures need to be incorporated in factors such as utilisation of manpower, resources and construction site daily programmes as they are inter-related.

Table 2: Efficiency Measures

Criticality	*Overall Mean Sc*	*Rank*	*GOV*	*Private Client*	*CONS*	*CONT*	*Chi-Square value*	*Kruskal Wallis Sig.p*	***Efficiency Measures (Factor Analysis)***	Component: Factor 1	Factor 2	Factor 3	Factor 4
C	3.55	19	3.33	3.67	3.43	3.84	*3.043*	*0.385*	Absence of any legal claims & proceeding	0.74			
C	3.61	18	3.50	3.36	3.60	3.86	*3.403*	*0.334*	Minimum amount of disputes	0.72			
C	3.93	5	3.90	4.00	3.96	3.85	*0.288*	*0.962*	High quality of workmanship	0.67			
C	3.71	14	3.71	3.43	3.71	3.89	*2.309*	*0.511*	Minimum amount of risks	0.67			
C	3.37	26	3.19	3.29	3.50	3.44	*3.102*	*0.376*	Meets social obligations	0.66			
C	3.91	7	4.05	3.79	3.93	3.82	*1.497*	*0.683*	High quality of materials and components	0.63			
C	3.48	23	3.47	3.43	3.33	3.76	*1.722*	*0.632*	Minimum impact from external forces	0.58			
C	3.51	21	3.21	3.50	3.59	3.65	*1.357*	*0.716*	No tremendous hassles and arguments	0.53			
C	3.42	24	3.29	3.29	3.37	3.88	*6.807*	*0.078*	Good quality of work life	0.50			
C	3.66	16	3.38	3.50	3.80	3.86	*4.656*	*0.199*	Minimum scope changes	-			
C	3.20	30	3.44	3.54	3.37	2.50	*9.938*	*0.02**	Zero variation	-			
C	3.53	20	3.25	3.43	3.57	3.53	*3.149*	*0.369*	Comprehensive briefing process		0.74		
C	3.70	15	3.57	3.57	3.82	3.60	*1.568*	*0.667*	Meets facilities requirements		0.63		
C	3.37	27	3.29	3.29	3.41	3.59	*2.365*	*0.500*	Meets adequate training programme to users		0.62		
C	3.38	25	3.31	3.36	3.42	3.40	*0.176*	*0.981*	Meets plant servicing & maintenance prog.		0.61		
C	3.33	28	3.13	3.38	3.40	3.38	*0.599*	*0.897*	Minimum effect to the environment		0.60		
C	3.24	29	3.92	3.69	3.08	3.38	*4.777*	*0.189*	Integration of design and construction		0.54		
C	3.71	13	3.89	3.73	3.64	3.64	*0.872*	*0.832*	Meets safety requirements		0.51		
C	3.49	22	3.00	3.36	3.42	3.59	*7.543*	*0.056*	No Plant standing idle			0.77	
C	3.62	17	3.29	3.36	3.77	3.89	*7.094*	*0.069*	Maximum utilisation of plants & equipment			0.75	
C	3.92	6	3.47	3.80	3.93	4.35	*8.651*	*0.034**	High project productivity			0.65	
C	3.76	11	3.44	3.71	3.70	4.15	*4.901*	*0.179*	Maximum utilisation of resources			0.64	
C	3.78	9	3.64	3.64	3.79	4.21	*6.826*	*0.078*	Efficiency in utilisation of manpower			0.56	
C	3.73	12	3.50	3.50	3.90	3.82	*2.820*	*0.420*	Minimum amount of wastages			0.56	
V.C	4.32	1	4.05	4.40	4.41	4.35	*5.817*	*0.121*	Meets time				0.802
V.C	4.11	3	4.10	4.00	4.15	4.14	*0.327*	*0.955*	Meets technical specification				0.741
V C	4.27	2	3.62	4.60	4.33	4.57	*12.706*	*0.005**	Meets budget				0.700
C	3.83	8	3.79	3.79	4.00	3.63	*2.307*	*0.511*	Efficiency of technical approval authority				0.575
V.C	4.06	4	3.85	3.93	4.19	4.14	*2.223*	*0.527*	Fast decision-making process				0.504
C	3.76	10	3.41	3.64	3.80	4.11	*6.292*	*0.098*	Minimum disturbance to main flow of work	-			
									Eigenvalue	5.57	5.33	4.568	4.015
									Percentage of variance explained	18.5	17.7	15.2	13.385
									Cumulative percentage variance	18.5	36.3	51.6	64.987

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

Further analysis by means of the Kruskal-Wallis One-Way ANOVA test for a k-independent sample confirmed that 3 out of 30 variables exhibited statistically significant difference in opinions at the 1% and 5 %significance levels. As a result, the null hypothesis related to this segment could not be accepted. To determine the demarcation point between the 30 variables, a Wilcoxon Signed Rank Test of 2 related samples was employed. The overall rating of 3.73 (minimum amount of wastage) was slightly lower than 3.76 (maximum utilisation of resources) at the 0.05 level of significance (p=0.025). Therefore, the two sets of scores were significantly different. However, based on the mean ranking technique, all the variables appeared to be significant, which was superfluous and meaningless. Factor analysis was then employed, as shown in Table 2, to the thirty variables to reduce the large number of variables to a few meaningful factors, based on the cluster of relationships among them by means of a Principal Component Analysis (PCA).

Table 3: Effectiveness Measures

Criticality	Overall Mean Sc	Rank	GOV	Private Client	CONS	CONT	Chi-Square Value	Kruskal Wallis Sig.p	Effectiveness Measures (Factor Analysis)	Components Factor1	Factor 2	Factor 3	Factor 4	Factor 5
C	3.76	13	3.54	3.79	3.75	3.94	1.058	0.787	Develop new knowledge & expertise	0.80				
C	3.80	12	3.43	3.64	3.96	4.00	5.459	0.141	Increase levels of profess. develop.	0.79				
C	3.75	15	3.69	3.79	3.50	4.21	4.633	0.201	Generate positive reputation	0.78				
C	3.38	29	3.00	3.43	3.27	3.79	3.942	0.268	New market penetration	0.69				
C	3.75	14	3.55	3.86	3.58	4.00	2.942	0.401	Develop new business relationship	0.69				
C	3.94	7	3.26	3.93	4.25	4.11	6.489	0.090	Value for money	0.53				
C	3.84	11	3.50	3.93	3.77	4.14	4.171	0.244	Exploitation of technology	0.52				
C	3.62	24	3.29	3.57	3.69	3.87	4.007	0.320	Usable life expectancy	0.51				
C	3.33	30	3.09	3.21	3.26	3.77	3.506	0.261	Lower depreciation cost	-				
V.C	4.06	5	3.80	4.14	4.17	4.13	2.669	0.440	Benefit to users		0.80			
V.C	4.09	3	3.80	4.07	4.17	4.29	5.868	0.118	Benefit to client		0.80			
V.C	4.01	6	3.90	4.00	4.11	4.00	1.588	0.662	Project functionality		0.76			
C	3.67	22	3.50	3.57	3.68	3.94	4.814	0.189	Aesthetic value		0.75			
V.C	4.27	1	3.89	4.27	4.34	4.48	7.252	0.064	Meets client satisfaction on service		0.67			
V.C	4.17	2	3.75	4.36	4.22	4.40	7.711	0.052	Meets client satisfaction on product		0.65			
C	3.63	23	3.64	3.50	3.76	3.50	1.335	0.721	Pleasant environment		0.53			
C	3.90	8	4.11	3.87	3.83	3.82	1.803	0.614	Easy to maintain		0.50			
C	3.74	16	3.47	3.93	3.56	4.19	8.387	0.04*	Accomplish core business needs			0.80		
C	3.71	17	3.38	3.67	3.52	4.35	9.624	0.02*	Meets stakeholders' needs & expect.			0.77		
C	3.68	21	3.24	3.80	3.74	3.89	3.933	0.269	Meets corporate missions			0.71		
C	3.71	18	2.50	4.00	3.59	4.38	24.905	0.00*	High profit margin			0.63		
C	3.89	10	3.58	4.00	3.79	4.25	7.480	0.058	Meets pre-stated objectives			0.62		
C	3.53	26	3.50	3.71	3.61	3.27	1.963	0.580	Supported by warranty programme				0.79	
C	3.69	19	3.57	3.79	3.67	3.73	0.322	0.950	Excellent Commissioning prog.				0.67	
C	3.56	25	3.31	3.57	3.61	3.67	0.817	0.845	Excellent Close-out process				0.62	
V.C	4.07	4	3.84	4.20	4.04	4.24	3.868	0.276	Fitness for purpose				0.59	
C	3.89	9	3.56	4.14	4.00	3.82	4.010	0.260	Fast rectification of defects				0.59	
C	3.68	20	3.63	3.79	3.56	3.87	0.920	0.821	Early occupation					0.820
C	3.53	27	3.20	3.36	3.67	3.79	4.367	0.224	Minimum cost of ownership					0.563
C	3.52	28	3.47	3.64	3.43	3.63	0.690	0.876	Flexible for future expansion					0.551
									Eigenvalue	6.15	6.04	3.85	3.64	2.379
									Percentage of variance explained	20.5	20.1	12.8	12.1	7.929
									Cumulative percentage variance	20.50	40.6	53.50	63.	73.58

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

In this study, the value of the Kaiser-Meyer-Olkin (KMO) statistic was 0.784, which according to Kaiser (1974) is satisfactory for factor analysis. Secondly, the value of the Barlett test of Spherecity was 1320.796 and the associated significance level was small (p=0.000), suggesting that the population correlation matrix was not an identity matrix. Moreover, according to Tabachnick and Fidell (1996), the value of the MSAs (Measure of sampling activity) of all the factors was to be greater than 0.3. In this case, the value of the MSA was 0.444-0.887, suggesting that there was no need to eliminate any variable from the analysis. As shown in Table 2, four-factors were extracted with eigenvalues greater than one explaining 64.987% of variances. The four principal factors and associated variables were interpreted as follows: Factor 1 represented quality and conflicts resolution, Factor 2 represented a process improvement programme, Factor 3 represented resources management, and finally Factor 4 represented project objectives. The four principal factors were seemingly associated with the classification of efficiency measures as defined above.

Effectiveness Measures

Table 3 presents the thirty variables considered for the effectiveness measures of project success. The analyses primarily deal with the ranking of variables based on their mean values to determine their level of importance. Out of 30 factors, 6 factors were rated to be 'very critical' by the groups. These were: meets client satisfaction on service (overall mean value = 4.27), meets users' satisfaction on product (overall mean value=4.27), benefit to client (overall mean value=4.09), fitness for purpose (overall mean value=4.07), benefit to users (overall mean value=4.06), and project functionality (overall mean value=4.01). Although the results appeared to include both the users' satisfaction and the use of the project, it failed to include factors on accomplishing core business objectives and corporate missions as vital factors in achieving the successful project outcomes as classified above.

The remaining 24 factors were also significant and classified under 'critical' with mean scores in the range of 3.33 (lower depreciation cost) to 3.94 (value for money). As expected, private clients and contractors selected important variables which revolved around the issues of 'meeting client satisfaction on service', 'meeting users' satisfaction on product', 'high profit margin' and 'meeting pre-stated objectives'. Similarly, consultants' respondents also showed themselves to be inclined to the above perceptions by giving excellent grades to 'meeting client satisfaction on service', followed by 'value for money', 'meeting users' satisfaction on product' and 'benefit to client'. Once again, the Government respondents were seen to be diverse by choosing factors on 'easy to maintain' (mean value=4.11) to be the most critical factors (ranked 1st) out of the list, whilst the factor on 'project functionality' (mean value=3.90) was ranked 2nd, meets client satisfaction on service was ranked 3rd, and fitness for purpose (mean value=3.84) was ranked 4th. The results indicated that the Government sectors in Malaysia are currently switching their priority needs to the level of maintenance and functionality of the finished product. When the Kruskal-Wallis test for a k independent sample was applied; the test confirmed that 3 out of 30 effectiveness variables indicated a statistically significant difference in opinion between the groups at the 1% and 5 % significance levels. This implied that the null hypothesis related to this segment could not be totally accepted.

To determine the demarcation point between the 30 variables of effectiveness measures, a Wilcoxon Signed Rank Test of two related samples was employed. The overall rating of 4.01 (project functionality) was slightly lower than 4.06 (benefit to users) at 0.10 level of significance (p=0.088). Therefore, the two sets of score were significantly different at the 10% level of significant. In this case, although the two sets of scores differed, it was unlikely that the factor on 'project functionality' had been omitted, in view of the fact that the Government sector had ranked it 2nd in the list of 30 as discussed previously. Factor reduction technique was then employed to reduce the large number of variables into a few sensible factors based on their group of relationship, as shown in Table 3. As a result, five factors were extracted with eigenvalues greater than one, explaining 73.588% of variances. The value of Kaiser-Meyer-Olkin (KMO) statistic was 0.826 and the Barlett test of Spherecity was 1487.852 and the associated significant level is small (p=0.000).

The five principal factors and associated variables were interpreted as follows: Factor 1 represented learning and exploitation, Factor 2 represented benefits and rewards, Factor 3 represented corporate objectives, Factor 4 represented operational assurance, and Factor 5 represented users' satisfaction. These principal factors were reckoned to be strongly associated with the classification of effectiveness measures as defined above.

CONCLUSIONS

This paper has produced detailed analyses of project success measures in the form of a mean ranking of variables and factor reduction techniques in order to unveil empirical findings. The first finding revealed that the level of success criticality in the development of construction projects in Malaysia is according to the specific requirements and priorities of different project stakeholders. In the efficiency measures, the Government and consultants sectors are focussing on the high project quality, fast approval and decision-making process, whilst private client and contractors are putting more emphasise on budget and productivity issues.

In the effectiveness measures, however, the Government and consultants groups are stressing on the issues of project functionality and operational programmes, whereas private client and contractors are concentrating on meeting pre-stated objectives and high profit margin. Since there is a slight conflict of interests between these groups of stakeholders, it is suggested that project clients is required to adopt adequate strategies and methodologies and to set firm priorities before the project started, in order to sustain the excellent performance of the construction projects as suggested by Maloney (1990).

Secondly, project success measures in terms of *efficiency* and *effectiveness* measures revealed four and five principal factors, respectively. The four principal factors and associated variables in terms of *efficiency* measures are represented by: Quality and Conflicts Resolution, Process Improvement Programme, Resources Management, and Project Objectives. Given that efficiency measures are related to the *'processes'* involved in the development of construction projects, factors such as excellent quality of workmanship and material used, conflicts resolution skill, absence of legal claims, external factors (political, social etc), the integration of process improvement programmes and policies, efficient resources management, and accomplishing project objectives (time, cost, quality) are the expected project outputs.

Thirdly, project success in terms of *effectiveness* measures revealed five principal factors and associated variables which are represented by: Learning and Exploitation, Benefits and Rewards, Corporate objectives, Operational Assurance, and Users' Satisfaction. The effectiveness measures are observed to be associated to project *'results'*.   In this case, factors such as learning and exploitation are helpful to provide an opportunity to diversify the construction portfolio by exploring the services to foreign construction market and develop new business relationship. In the mean time, client's satisfaction, accomplishing corporate missions, core business needs, meetings stakeholders' needs and expectations, and systematic implementation of the operational assurance programmes are the expected project outcomes.

The research presented in this paper is part of wider ongoing PhD research into a framework for successful construction project performance from the client's perspective. The empirical findings of this study will hopefully offer an insight to project-oriented companies in Malaysia for future strategies and guidelines for the development of construction projects.

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