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Determinants of contractor satisfaction

ABSTRACT

Construction industry performance is increasingly scrutinised as a result of the delays, cost overruns and poor quality of its products and services. An increasing number of disputes, conflicts and mismatches of objectives among participants are contributory factors. Performance measurement approaches have been developed to overcome these problems. However, these approaches focus primarily on objective measures to the exclusion of subjective measures, particularly those concerning contractor satisfaction (Co-S).

The contractor satisfaction model (CoSMo) developed in the research is intended to rectify the situation. Data derived from a questionnaire survey of 75 large contractors in Malaysia are analysed to identify a key project and participant factors and their strength of relationship with Co-S dimensions. The results are presented in the form of eight regression equations.

The outcome is a tool for use by project participants to provide a better understanding of how they, and the project, affect contractor satisfaction. The developed model sheds some light on a hitherto unknown aspect of construction management in providing an increased awareness

of the importance of major Malaysian construction contractors' needs in the execution of successful projects.

Keywords

Contractor, satisfaction, affecting factors, measurement, model, Malaysia

INTRODUCTION

Concerns over poor project performance and its various causes are not new and have been addressed in several studies by developing models and frameworks (e.g., Almahmoud et al, 2012). In the Malaysian context, Construction Industry Malaysian Planning (CIMP), produced by the Construction Industry Development Board (Plan, 2006), reported that, in terms of overall project performance, an average of 50% of quality failures are attributed to design faults and 40% to construction faults, with only 10% being material faults. Furthermore, the delayed completion of government projects in Malaysia has been due not only to poor performance by contractors, but to a lack of communication between participants, inadequate client finance and late issuance of construction drawings by consultants (Sambasivan & Soon, 2007).

One approach to improving the situation is through *performance measurement*, of which studies in marketing and business have rapidly progressed worldwide in recent years. A notable feature of performance measurement is the broadening of the orthodox paradigm of being purely profit-oriented and project-specific to involve a greater focus on stakeholder issues (Love & Holt, 2000). A common belief emerging from construction performance measurement research is that improvements in the satisfaction levels of project participants will promote a performance-enhancing environment and hence better project outcomes (Kärnä et al., 2009).

The concept of *satisfaction measurement* has been developed recently in the construction industry as a performance measurement tool, particularly in investigating different key stakeholder satisfaction levels, such as home-buyer satisfaction (Ho-S) (Ng et al., 2011) and client satisfaction (Cl-S) (Ling & Cheng, 2005)[1]. However, contractor satisfaction (Co-S) has been a neglected area of study or concern. To date, the sole work is Soetanto and Proverbs' (2002) assessment of contractor satisfaction with the performance of clients. What is needed is a study of contractor satisfaction that includes the whole gamut of contributing factors in addition to client performance. In addition, to improve existing methods, it is necessary to include measurements that consider participant satisfaction in performance measurement in construction. The development of satisfaction measurement in different perspectives is discussed in a later section to clarify the limitations of existing research.

Because of these considerations, a comprehensive Co-S model, CoSMo, is developed to provide a better understanding of contractors' needs, at least in terms of improved relationships with other project participants, in improving project performance. To develop the model, a questionnaire survey was conducted of senior employees of 75 large Malaysian construction companies, in which their satisfaction levels for a specific recent project were matched against 8 Co-S themes and 95 potential influencing factors derived by literature review and initial unstructured interviews. After preliminary screening to ensure sufficient robustness, a set of regression analyses produced the needed importance levels of the

[1] The acronyms Ho-S, Cl-S, Cu-S and Co-S to denote home-buyer satisfaction, client satisfaction, customer satisfaction and contractor satisfaction respectively are from Masrom & Skitmore (2009).

influencing factors. The findings indicate that the satisfaction of large contractors is highly influenced by the effectiveness of the project integration stage.

SATISFACTION MEASUREMENT

Studies of performance measurement have rapidly progressed in recent years, with many performance studies being conducted throughout the world. These are based on a range of different perspectives. For instance, an increasing body of literature is primarily concerned with subjective measures (quality and satisfaction). The early literature of performance measurement is mostly related to marketing or business, with very little concerning the construction industry. Recently, however, there have been studies conducted of several areas and with a common belief that improvements in performance measurement will promote a performance-enhancing environment. In the process, the orthodox paradigm of performance measurement has broadened from being purely profit-oriented and project-specific to a greater focus on stakeholder issues (Love & Holt, 2000). Crucial further improvement in satisfaction measurement is being sought by an increasing consideration of competitive pressures in the current market. This has involved investigating homebuyer satisfaction (Ho-S), client satisfaction (Cl-S) and contractor satisfaction (Co-S). The various dimensions need to be defined clearly as different timeframes, people, locations, and types of project potentially affect project performance (Shenhar et al. 2001).

The concept of satisfaction has been frequently used in determining Ho-S, particularly with respect to quality of life (Amerigo & Aragones, 1997). The same concept has also been applied to improve occupant satisfaction by developing both the Post-Occupant Evaluation

(POE) (Liu, 1999) and Total Quality Method (TQM) (Torbica & Stroh, 1999), with HOMBSAT being used to assess building quality, green building and the indoor environmental quality of a design (Torbica & Stroth, 2001). Measurement from a homebuyer perspective has also further investigated the relationship between homebuilder service quality with homebuyer perceptions (Nahmens & Ikuma, 2009). Studies of Cl-S, on the other hand, began in the late 1990s in terms of service quality.

Studies of satisfaction measurement based on Cl-S have been extensively used to evaluate construction project performance by addressing key contributory factors of satisfaction. Construction clients play an important role in construction project and clients perceive service in their own unique way. They also use a gauge that is based on their cumulative memory of many positive experiences. Cl-S measurement has been identified as a function not only of output but also of client perceptions and expectations and Cl-S models have been widely developed in different countries based on several areas of concern, particularly to measure service quality (Al-Momani, 2000), contractor performance (Egemen & Mohamed, 2006; Soetanto & Proverbs, 2004; Xiao & Proverbs, 2003), and consultant performance (Cheng et al., 2006). The Cl-S model also considers perspectives such as level of profit maximisation (Haransky, 1999), effectiveness of the project brief (Cheong et al., 2004) and efficiency of project dispute resolution (Cheung et al., 2000). Ling and Chong (2005), for example, assert that client expectations of Design and Build projects can be met by the fulfilment of service quality in terms of competencies. On the other hand, Tang et al. (2003) hold Cl-S measurement to be a function of the quality of service and quality of product to customers. Mbachu and Nkado (2006) also note that the building development process can be improved with client satisfaction measurement. However, Cheng et al. (2006) argue that client characteristics including the sector, size and location of the project may have a significant impact on Cl-S levels.

The satisfaction concept is also essential in customer perception measurement of product or outcome. Customer satisfaction (Cu-S) has become a critical issue in recent years (Kärnä, 2004). In the approach used to meet customer needs and requirements, the contractor is required to provide service based on three elements, namely product, environment and delivery (Maloney, 2002). Commonly, completion of a project in accordance with the plans and specifications within budget and on time will meet customer needs and allow contractors to make profits. Kärnä (2004) noted that Cu-S can be used to evaluate quality and ultimately to assess the success of a company's quality improvement programme. This means that a quality improvement effort is important in construction projects as it leads to higher product and service quality. Other factors that have been known to influence Cu-S, include business relationships (Brockmann, 2002), Construction Project Management (CPM) performance (Yang & Peng, 2008), and service provided in facilities management (FM) (Tucker & Pitt, 2009). In developed countries such as Finland and Australia, theories of institution and marketing have been used in developing a model of Cu-S (Forsythe, 2007; Jaakko Kujala & Ahola, 2005). This indicates that concern for the client perspective has received broader attention in several other Cu-S models.

However, to achieve an improved construction project performance, there is a compelling need for a comprehensive satisfaction approach for *all* project stakeholders. That is, architects, engineers, suppliers and the community in general[2], in addition to clients and occupants. As Leung et al. (2004) assert, participant satisfaction measurement may be useful in improving project performance as it assesses the reaction of key participants to such issues as construction conflict and payment. From the foregoing though, it is clear that the Co-S

[2] The burgeoning literature on stakeholder satisfaction during community participation in construction project decisions (e.g., Li *et al*, 2013) is beyond the scope of this paper.

dimension is lacking in this respect and entirely absent in developing countries such as Malaysia where all the existing performance measurement methods that are available are focused on objective measures (time and cost) (Abdul-Rahman et al., 2011; Nima et al., 2001).

CONTRACTOR SATISFACTION DIMENSIONS

A conceptual model is an outcome typically developed in social science research, and is defined as an external and explicit representation of a part of reality (Cavana et al., 2001). This study, therefore, extends the existing Co-S model by using a number of performance and satisfaction measurement models to facilitate the development of CoSMo. That is, the factors of several satisfaction studies, such as Cl-S and Cu-S were adopted. Despite the factors being derived from various perspectives, the dimensions used were considered sufficiently consistent to be included in the model. As a result, three main Co-S components of the model were developed which include eight Co-S dimensions (cost, time, product, design, safety, profitability, business and relationship), 95 Co-S contributory factors (direct factors), and seven contractor and project characteristics (indirect factors). The formulation of 95 factors was formed by carrying out a thorough literature review. The factors were also derived and verified through face-to-face interviews with six different professionals including the owner of a construction firm, selected because of their extensive experience with construction projects. These are detailed in the following sections.

1. Cost performance

A cost budget needs to be established for any project and the difference between this and the actual cost of the project is termed cost performance - one of the most significant factors in project management (Park 2009). Cost performance is not only important to the client, but is also important to contractors as an over budget project influences the contractor's level of satisfaction with the project (Soetanto & Proverbs, 2002). Project costs have to be managed and controlled to the individual satisfaction of client and contractor, which may require different 'definitions' of effective. It is also important to maintain a healthy cash flow (Ling et al., 2008). Additionally, project cost performance that is purely based on contractor perspectives also depends on characteristics of the projects and the construction team (Chan & Park, 2005).

2. Time performance

Adhering to construction time has been acknowledged as the most significant criterion for successful projects (Chan & Chan, 2004), where construction time refers to the duration of a project. Here, 'time' is defined as the project construction period. A fixed construction period is important to the contractor for timely completion. Time performance is measured by comparing the actual and planned duration of a project. This also depends on the early commitment of the project team to the schedule. In contrast, construction delays or time overruns in a project can be caused by excusable delays (Othman et al., 2006), a lack of qualified and experienced personnel and/or a lack of human capital (Brown et al., 2007). Moreover, as Assaf and Al-Hejji (2006) and Odeh and Battaineh (2002) have highlighted, changes in the design, material and scope of work can be one of the main factors contributing to time overruns.

3. Product performance

The quality of the final product also influences contractor satisfaction levels. In addition to time and cost outcomes, construction projects are commonly acknowledged as being successful when the project is completed to an acceptable level of quality. To determine the quality of a product, previous performance measurement studies have provided several criteria, such as functionality, constructability, accuracy and conformity to specification, and fitness for purpose (Minchin et al., 2010). To achieve a good Co-S level, the designer and other participants have to provide sufficient information to the contractor. Therefore, accurate project information, such as bills of quantities, instructions, estimates and specifications, should improve project outcomes overall. This would then enable an effective reduction in rework, which in turn is likely to affect Co-S levels.

4. Design performance

Design performance indicates how design quality influences construction project performance. A complete project design reduces severe project delays, as a defective design can cause serious changes to output prices, project schedule, minimum standard quality, technical development and rework throughout the project. Therefore, a pre-design phase process is important and allows the control and monitoring of the construction phases. Proactive management also helps prevent deficient work. As Thomson et al. (2003)

established, design quality assessment is needed to ensure stakeholders deliver their work effectively during the design stage. This shows that having a thorough process of design evaluation can lead to reduce of design discrepancy.

5. Safety performance

The management of work safety on site, hazard identification and cleanliness, and orderliness of a site is a further criterion for assessing project success. Work safety management on site is important during the construction process to help contractors reduce accidents. An accurate assessment of safety is necessary to make more informed decisions and enable contractors to identify any potential hazards at an early stage (Ng et al., 2005). The comprehensive measurement of health and safety may also minimise the financial losses and extra costs of a project. Having a proper mechanism for developing a safety culture in the organisation may also improve safety and health performance (Ahmad & Gibb, 2003).

6. Profitability

Profitability is defined as the income derived from revenue exceeding cost. Profits, in terms of cost benefits, have been identified as a key performance indicator. Cost benefits can typically be achieved by savings and the early completion of projects. This dimension influences Co-S, as generating sufficient profit is important for a contractor’s continued survival. Profitability is the gain or loss divided by the total contract amount (Han et al, 2007). Also important to contractors is profit optimization, obtained by identifying the amount and timing of the periodical inflow and outflow of resources as projects progress (Liu

& Wang, 2009). However, several factors influence business failure in the construction industry and which, in turn, may influence Co-S levels. Arditi et al. (2000) define failure as the inability of a firm to pay its obligations and is caused by insufficient revenue to cover costs where the average return on investment is below the firm's cost of capital. Generally, it is possible to recognise that failure is a function of two factors: environment-dependent factors and strategic leadership-dependent factors (Arditi et al., 2000). In this case, failure factors potentially contribute to Co-S levels as success in business is a contractor's main objective.

7. Business performance

To improve performance, contractors need to determine standards by gauging their satisfaction level in terms of business performance. High business performance (in terms of profits, value for money, increased opportunity for repeat business and delivery of projects within budget) constitutes a high level of satisfaction. In addition, business competition is essential for contractors to provide high quality performance. Achieving such performance levels should enable contractors to obtain more projects and repeat business. As Lu et al. (2008) comment, competitiveness is a powerful concept in modern economics and management and goes beyond traditional economic indicators such as profitability, productivity or market share. Similarly, Ling et al. (2008) believe a firm's business strategies include the types of products and services it offers.

8. Relationship performance

Relationships can be measured in terms of the effectiveness of communication between project team members (Leung et al., 2004) and efficient project performance is influenced by relationship management in terms of its enhancement of communication, co-operation, trust, commitment and participation among project team members (Davis, 2008; Kadefors, 2004; Karlsen, Graee & Massaoud, 2008; Pinto et al., 2009). The extent to which relationships are successful is likely to influence the level of Co-S in a project. This means that Co-S with respect to relationship performance is not only based on service delivery, but also on the relationships between participants and on communications between project team members.

PERFORMANCE VARIABLES OF CONSTRUCTION PROJECTS

The quality of service delivery depends on the product and/or service performed by participants such as clients, consultants (architect, engineer, etc.), contractors, subcontractors and suppliers. Several studies confirm that an effective performance evaluation of a service or product leads to enhancement of its quality (Al-Kharashi & Skitmore, 2009; Leung et al., 2005). An examination of these studies, in combination with a series of preliminary interviews with senior personnel from several major Malaysian contractors, provided 95 potential contributory hard and soft factors influencing Co-S. These are listed in the Appendix. The influence of these on each of the eight Co-S dimensions may be different as their strength is dependent on contractor and project characteristics. The examination of this and the homogeneity tests involved is described in the following sections.

RESEARCH METHOD

A questionnaire-based survey was used to identify the contributory factors of construction project situations to Co-S and their degree of influence. Two versions of the final questionnaire were developed in Malay and English. Both were piloted before the main survey began. The questionnaire consists of general information concerning the respondents and specific questions in relation to the Co-S dimensions and their contributory factors. The first section of the questionnaire asks respondents to provide information concerning their current position, educational background and experience in the construction industry. The second section contains questions relating to a specific, previously completed construction project, selected by the respondent. Based on the project selected, respondents are requested to indicate their satisfaction level for each of the eight satisfaction dimensions (cost, time, product, design, safety, profitability, business and relationship performance) on a bi-polar five-point Likert scale, where 1 refers to *extremely dissatisfied* and 5 as *extremely satisfied*. The third section concerns the 95 potential Co-S contributory factors. Likert scales are again used to identify the level of influence for each factor, from 1 (“Very Low” influence”) to 5 (“Very High” influence). The questionnaire also provides 0 as a referral for “Don’t Know”. Two types of statistical tests are available to analyse these data - parametric and nonparametric (Bryman and Hardy, 2009). Parametric techniques are often used for this type of study as multiple scales are treated as interval variables, which assumes that the scale is a matter of degree rather than property (Soetanto and Proverbs 2002). The fourth section of the questionnaire encourages respondents to provide further comments or suggestions.

The questionnaire, complete with a covering letter clarifying the purpose of the study and an assurance of anonymity, was sent out via a self-addressed stamped envelope to a sample of large grade (G7) Malaysian contractors selected at random from the list of contractors produced by the Malaysian Construction Industry Development Board (CIDB). A total of 100 questionnaires were dispatched via conventional mail to professionals holding positions in the middle or higher management levels of the companies. Ultimately, 75 respondents (75%) completed and returned the questionnaire. Previous studies have highlighted that a small sample size is acceptable as long as the data is reasonable and interpreted with caution (Abdul Aziz & Wong, 2010; Takim & Adnan, 2008).

The data collected was analysed using the Statistical Packages for Social Science (SPSS) version 18. Data reliability was tested according to the data source and identification of the position held by the respondents as it is critically important that respondents with a detailed knowledge of their projects answer the questionnaire. To realise this aim, only senior personnel within identified organisations received a copy of the questionnaire and the responses received were checked to ensure that only these individuals participated in the study. Having the detailed information from the respondents provided in Section 1 and Section 2 of the questionnaire helps to ensure that no samples are identical to each other (Love et al., 2011). Each of the construct's dimensions and factors have Chronbach's α value greater than 0.9, indicating that they are sufficiently internally consistent (Ling et al., 2008).

DATA ANALYSIS

Sample characteristics

As Table 1 indicates, of the 75 contractor respondents, 61.3% have a bachelor degree and 34.7% have civil engineering background, with 80% having over five years experience with construction projects. The results for project type show that 50.7% are for building work and most clients (61.3%) are public sector clients, with a variety of procurement paths being used.

Relationship between contractor satisfaction Co-S dependent variables and contributory independent variables

Due to the large number (95) of contributory independent variables relative to the number of respondents (75), a preliminary analysis is conducted to identify the candidate variables for the later regression analysis. This is carried out by a correlation analysis to assess the strength of relationship between pairs comprising one Co-S dependent variable (DV) and one contributory independent variable (IV). To ensure robustness, both the Pearson's parametric and Spearman's non-parametric procedures are used – a correlation adjudged being significant if $p<0.05$ for *both* statistics. Table 2 summarises the significant results (marked X) obtained this way for the 8 DVs and 95 IVs. This shows that many of the DV-IV pairs are significantly correlated, as expected, but that the pattern of correlations is different for each DV. PA5, PA7, PA9, PA41, PA59, PA71 and PA91 significantly correlate with all of the eight DVs, while PA26, PA30, PA32, PA34, PA35, PA40, PA44, PA54, PA62, PA68, PA80, PA93, PA94 and PA95 have no significant correlations with any DV. These latter variables are therefore omitted from any further analysis.

These results assume the respondents are homogenous. That is, for example, those more experienced have responded in a similar way to those lesser experienced. The following analyses test this assumption.

Test for homogeneity of mean scores

Multiple one-way Analyses of Variance (ANOVA) tests the homogeneity of mean scores from different respondent groups. As Table 2 indicates, these are performed across the seven respondent characteristics of *academic qualifications*, *professional background*, *experience*, *project type*, *procurement type* and *project client*. For example, for the *academic qualifications* characteristic, the mean scores of respondents with different levels of highest academic qualification such as diploma, bachelor degree, master's degree and doctoral degree (PhD) are compared. The results indicate the mean scores of several factors to be significantly different ($p<0.05$) within each characteristic except for procurement type – a notable result, as procurement type is certainly expected to be a major factor here. In view of the large number of significant results involved and an associated increase in type II errors, a robust test is needed to isolate those differences that are not only statistically significantly different but are also simple and intuitively appealing. This can be done by recategorising each respondent characteristic into just two groups and then performing a t-test on the different mean scores for each group of each IV. The *academic qualification* characteristic, for example, is divided into one group comprising those respondents with a diploma and second group comprising those with a bachelor degree and higher. The t-test is then used to compare the mean score of the first group with the mean score of the second group on the first IV identified as significant for the ANOVA (PA8 in this case). This is then repeated for each of the remaining ANOVA-significant IVs for that characteristic. A further advantage of this is that the t-test, although parametric in nature, is known to be robust for even quite large departures from its implicit assumptions.

For professional background, two characteristics *PB1* and *PB2* are created. *PB1* comprises one group containing respondents with a background in Project Management and another group containing respondents with a background in Civil Engineering or Architecture. *PB2*, on the other hand, comprises one group containing respondents with a background in Civil Engineering and another group containing respondents with a background in Project Management or Architecture.

This analysis identifies 15 significant ($p<0.05$) differences within the *academic qualification*, *professional background*, *experience* and *project client* characteristics. These are PA4, PA17, PA28 and PA70 for *PB1*; PA6 and PA76 for *PB2*; PA14, PA18, PA22, PA36, PA38, PA68 and PA86 for *experience*; and PA25, PA49 and PA61 for *project client*. To accommodate these differences, each of the 15 affected IVs is replaced by two new variables recoded with suffix “a” and “b” accordingly for each grouping. For example, PA14, which was scored significantly differently for the *experience* characteristic is replaced with PA14a (more than ten years experience) and PA14b (less than ten years experience). The following section describes how the revised set of IVs is used as candidates in the multiple regression analysis.

Identification of contractor satisfaction predictors

A series of multiple regression analyses (MRA) are conducted for each of the eight DVs with the revised set of IVs obtained in the preliminary analyses, with only those IVs identified as having a significant relationship with their DV being included in the analysis. The forward stepwise (FWDS) MRA method of IV selection is used. This involves an algorithmic selection process, and is therefore arbitrary to some extent as it proceeds by entering/eliminating one IV at a time. This extracts more significant variables for inclusion in the model (Lowe et al., 2006; Tabish & Jha, 2011; Xiao & Proverbs, 2003). On the other hand, it can be regarded as a form of data dredging (Smith and Ebrahim, 2002), involving the 'torture' of data into a high model fit. To help reduce this prospect and increase robustness, the backward stepwise (BWDS) method is used in addition as advocated by Elliot and Woodward (2006).

The results are summarised in Table 3. Both the FWDS and BWDS analyses are identical, except for CoS3, where **PA56** and **PA57** IVs are interchanged. All the models are highly significant according to the ANOVA *F*-statistics, which are less than 0.01 (p< 0.001). Despite the majority of predictors being positively influenced by the eight Co-S dimensions, three predictors, namely ***PA56***, ***PA57***, and ***PA59***, adversely affect the CoS1 (cost) and CoS6 (profitability) dimensions.

Summarising the results therefore

CoS1= 0.289 + (.378) ***PA21*** + (.378) ***PA9*** + ***PA76b*** (.330) + (.286) ***PA41*** **-** (.418) ***PA59***

CoS2 = -0.336 + (.560) ***PA71*** + (.476) ***PA9***

CoS3 = 0.916 + (.494) ***PA9*** + (.272) ***PA56*** **(or *PA57*)**

CoS4= 0.510 + (.550) ***PA9*** + (.335) ***PA25a***

CoS5= 1.392 + (.358) ***PA84*** + (.266) ***PA5***

CoS6= 0.129 + (.595) ***PA5*** + (.557) ***PA85*** + (.347) ***PA41*** **–** (.276) ***PA57*-** (.291) ***PA59***

CoS7= -1.066 + (.563) ***PA5*** + (.442) ***PA22b*** + (.257) ***PA84***

CoS8= 0.116 + (.454) ***PA22b*** + (.335) ***PA73*** + (.204) ***PA3***

Evaluating these with a series of standard procedures to examine the extent to which the models and data satisfy the regression assumptions confirms the validity and robustness of all the eight models (lack of publication space prevents a detailed account of these).

DISCUSSION

In contrast with previous research, which focussed solely on contractor satisfaction with the client/owner, this study investigates the whole gamut of influences on contractor satisfaction, including both tangible (relating to project performance) and intangible factors (relating to participant performance in terms of service delivery, relationship and communication). The models obtained for the sizeable sample of larger Malaysian contractors involved can be considered as reasonably reliable in view of the highly significant *F*-values and R^2 explaining 22.6% to 58.0% of the variation involved, while the magnitude of the regression coefficients provides an indication of the importance of the IVs and can be interpreted in terms of:

- *Satisfaction with cost*: corresponds with fairly processed claims by the client; conciseness of project scope; participants' satisfaction in the project; and, according to those respondents with a project management and architecture background, motivational support by participants. This suggests that large contractors have significant concerns over the quality of information provided by the project consultants. Having a clear project definition and unambiguous needs from the project team enables the contractor to deliver the project with less rework. In addition, satisfaction with cost is negatively associated with the appropriateness of the communication system used in the project, which reflects Malaysian contractors' lack of concern with technology such as internet, wifi, camera and teleconferencing. This is most likely due to the need to invest extra money that potentially affects their overall budget and project profitability. As a result, the traditional paper-based and face-to-face communication methods are preferred at present.

- *Satisfaction with time*: corresponds with increased levels of negotiation between project participants and conciseness of the project scope. The amount of understanding and toleratation between project team is significant in forging good relatioonaships during project delivery. This also implies that project completion can more easily be achieved within the stipulated time when each party is willing to communicate openly, compromise and avoid confrontation.
- *Satisfaction with the construction product*: corresponds with the conciseness of project scope and manpower productivity/subcontractor efficiency. Clear instructions of the work needed are key informational requirements for a contractor to produce a project with better quality.
- *Satisfaction with the design*: corresponds again with the conciseness of project scope and, according to respondents with a Project Client-Government background, the quality of design prepared by the project designer.
- *Satisfaction with construction safety*: corresponds with the extent of the health and safety measures taken in the project, and quality of the project brief. This indicates the extent to which attention to providing clear guidelines for health and safety and an awareness of safety culture among the project team is needed.
- *Satisfaction with profitability:* corresponds with the quality of the project brief, appropriateness of procurement system used, and the other participants' satisfaction with the project. In addition, satisfaction with profitability is negatively associated with subcontractor efficiency and again the appropriateness of communication system used. The latter has already been discussed above. That subcontractor efficiency

should have a negative effect on satisfaction with profitability is rather more difficult to explain except that this is possibly a reflection on the presence of subcontractors necessarily reducing the main contractor's opportunity to make more profit by undertaking the work directly.

- *Satisfaction with business performance*: corresponds again with the quality of the project brief, the extent of the health and safety measures in the project and, according to the younger respondents (with less than 10 years experience in the industry), the project transaction cost throughout the construction period.
- *Satisfaction with relationships*: corresponds with an increased level of understanding between participants and the project team, the extent of the client's control of the project work and, again, according to the younger respondents (with less than 10 years experience in the industry), the project transaction cost throughout the construction period.

Worthy of note is that the developed models indicate the satisfaction of contractors to be affected by the two most frequently recurring predictors, namely the *conciseness of project scope* as influential in satisfaction with cost, time, product and design, while *quality of project brief* influences satisfaction with safety, profitability and business performance – suggesting that project satisfaction of large contractors is highly influenced by the effectiveness of the project integration stage. However, as has been highlighted in previous section, continuous improvement is also required in terms of quality of information.

Interestingly, there is a lack of any (significant) influence of the procurement method used. Clearly, a reasonable expectation is that nonconventional methods such as management contracting would have improved communications among team members (PA59-PA61) or the Design and Build would influence many of the earlier factors (e.g., PA1-PA10). This finding is clearly in need of further study to establish the underlying causes involved. A further option for future research is be to further analyse "conciseness of project scope", as it corresponds with so many performance measures and so more value may be derived from dividing this into a number of more precise definitions.

CONCLUSIONS

The findings have several implications. For example, participants should be encouraged to be more proactive in measuring Co-S and to improve their understanding of the value of open communication, cooperation and teamwork between project team members. It would also be beneficial for participants such as the client to consider indicators for re-assessing their own performance in terms of their consultants, nominated subcontractors and suppliers in addressing document quality, openness of negotiations and project team relationships. To achieve this benefit, the key parties may need to prepare an assessment of Co-S at an early stage. The transparency of the tool in highlighting Co-S directly should improve project value by reducing “double-handling”, improving the construction product and reducing risks. Although improved project performance will not be achieved purely by increased satisfaction levels, a closer match of participants in terms of understanding and objectives would help mitigate conflict and disputes in projects, particularly within a separated design and construct procurement system. A systematic approach to performance measurement based on contractor satisfaction is expected to significantly increase overall project performance (Kärnä et al., 2009).

Previous satisfaction studies also indicate that using contactor perspectives improves the identification of critical areas that need to be improved. It is relevant to note that using this model extensively in project development can benefit contractors in terms practically identifying and informing the best practices needed of other participants. The outcome therefore is a tool for use by project participants to provide a better understanding of how they, and the project, affect contractor satisfaction. This offers the potential for the improvement of contractor satisfaction by better management and organisation of projects.

The work to date also offers an alternative to help steer the industry away from objective measures to those of more subjective in nature. In doing this, these results provide a useful means of identifying a method to help re-focus efforts away from performance measures that solely relate to costs and profits. Ultimately, with the development of similar models for the satisfaction of the other project participants, it should be possible to seek a solution that optimises the predicted satisfaction of all involved.

A next step in doing this is to go beyond offering a level of guidance towards the determinants of satisfaction. This will involve improving the definition of the performance measures that can be used in the completed model, and providing an indication of the level of significance or impact that each of the proposed performance measures has upon satisfaction. Meanwhile, the developed model sheds some light on a hitherto unknown aspect of construction management in providing an increased awareness of the importance of major Malaysian construction contractors' needs in the execution of successful projects. The limitation of the research is that it used only contractor perceptions and did not consider the perspectives of other participants in a project such as clients, architects, engineers, subcontractors, suppliers and labourers. Further study of these perspectives and their interrelationships will provide a more complete picture of the contributory factors that influence contractor satisfaction with project performance in Malaysia and possibly South East Asia in general.

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APPENDIX. *Variables Codes*

Code	***Contractor satisfaction dimensions (DVs)***
Co-S1	*Cost performance*
Co-S2	*Time performance*
Co-S3	*Product performance*
Co-S4	*Design performance*
Co-S5	*Safety of worksite*
Co-S6	*Project profitability*
Co-S7	*Business performance*
Co-S8	*Relationship between participants*
Code	***Contributory factors (IVs)***
PA1	*Completeness of project development plan by client*
PA2	*Completeness of project execution plan by client*
PA3	*Client's control of project work*
PA4	*Clarity of client's explanation on the project objective*
PA5	*Quality of project brief (e.g. needs and requirements)*
PA6	*Completeness of project brief*
PA7	*Certainty of project brief*
PA8	*Clarity of project scope*
PA9	*Conciseness of project scope*
PA10	*Efficiency of monitoring project and product scope according to*
PA11	*Timeliness of design completion by designer*
PA12	*Participants' speed in responding to problems encountered by contractor (e.g. queries and discrepancies)*
PA13	*Speed in processing variation claims*
PA14	*Duration of honouring payment for progress payment*
PA15	*Ease of final account settlement*
PA16	*Speed of final account settlement*
PA17	*Timeliness of project completion*
PA18	*Project cash flow throughout construction process*
PA19	*Project financial turnover*
PA20	*Promptness of progress payment made by the client*
PA21	*Fairly processed claims by the client*
PA22	*Project transaction cost throughout construction*
PA23	*Project cost savings to your company*
PA24	*Project incentives provided by the client*
PA25	*Level of design quality prepared by the project designer (e.g. accuracy, details, technical, conformance to standard)*
PA26	*Quality of project specification (e.g. clear, complete and consistent with reference to drawings)*
PA27	*Design constructability*

Variables Codes (continued)

Code	**Contributory factors (IVs)**
PA28	*Comprehensiveness of design*
PA29	*Flexibility of design to accommodate changes*
PA30	*Safety level of design prepared by the designer*
PA31	*Economical level of design (compliance with budget)*
PA32	*Compliance of design with legislative requirements*
PA33	*Compliance of design with customer needs/requirements*
PA34	*Frequency of changing requirements and specification by participants*
PA35	*Frequency of rework throughout project*
PA36	*Quality of documents (e.g. contract)*
PA37	*Compliance level to environmental measures*
PA38	*Quality assurance (e.g. minimize product defects)*
PA39	*Level of innovation in design*
PA40	*Level of innovation in method*
PA41	*Participants' satisfaction in the project*
PA42	*Material quality supplied by supplier*
PA43	*Completeness of material specification provided by supplier*
PA44	*Participants' competencies level (technical)*
PA45	*Participants' ability to define their role*
PA46	*Participants' ability to contribute their idea to project*
PA47	*Participants' ability to make authoritative decisions*
PA48	*Participants' ability in dealing with problems/issues*
PA49	*Leadership of the client*
PA50	*Leadership of the design team leader*
PA51	*Appropriateness of participants' working experience*
PA52	*Appropriateness of participants' academic qualification*
PA53	*Appropriateness of participants' skills*
PA54	*Project team consistencies from initial stage to completion stage*
PA55	*Level of participants' skills*
PA56	*Productivity of project manpower*
PA57	*Efficiency of subcontractor to undertake their works (e.g. skilful and specialise)*
PA58	*Supplier effectiveness in material supply*
PA59	*Appropriateness of communication system used in the project*
PA60	*Two- way communication between participants and your project team*
PA61	*Effectiveness of open communication among project team*
PA62	*Application of IT usage by participants in the project*
PA63	*Willingness to share knowledge between participants and your project team*
PA64	*Willingness to share experience between participants and your project team*
PA65	*Participant support in providing information*
PA66	*Effectiveness of verbal instructions made by participants*
PA67	*Effectiveness of written instructions made by participants*
PA68	*Efficiency of knowledge management in the project made by participants*
PA69	*Teamwork between participants and your project team*

Variables Codes (continued)

Code	***Contributory factors (IVs)***
PA70	*Participants' attitude during the project (e.g. respect, politeness and friendliness)*
PA71	*Negotiation level between participants and your project team*
PA72	*Level of trust between participants and your project team*
PA73	*Level of understanding between participants and your project team*
PA74	*Collaborative work between participants and your project team*
PA75	*Coordination of the project by participants*
PA76	*Motivation support by participants (e.g. recognition and rewards system)*
PA77	*Level of participants' ethics*
PA78	*Quality of relationship between subcontractor and your project team*
PA79	*Quality of relationship between supplier and your project team*
PA80	*Efficiency of risk control (e.g. identification, plan, evaluation)*
PA81	*Effectiveness of conflict management*
PA82	*Appropriateness of sharing risks*
PA83	*Level of project uncertainties*
PA84	*Health and safety measures in the project*
PA85	*Appropriateness of procurements system used*
PA86	*Appropriateness of client contract conditions*
PA87	*Effectiveness of dispute resolution mechanism*
PA88	*Effectiveness of your supply chain management (e.g. Domestic sub-*
PA89	*Effectiveness of client supply chain management (e.g. Nominated sub-contractor, Nominated supplier)*
PA90	*Effectiveness approach in settling claims issues*
PA91	*Appropriateness of subcontracting made by participants (conformance to contract)*
PA92	*Working environment quality*
PA93	*Level of fluctuation (e.g. material price)*
PA94	*Political influence (e.g. policy changes)*
PA95	*Appropriateness of technology*

Table 1: Respondent characteristics

Characteristic	Details	n	%
i) Personal			
Academic Background	*Diploma*	*24*	*32.0*
	Bachelor degree	*46*	*61.3*
	Master degree	*3*	*4.0*
	Other	*2*	*2.7*
Professional Background	*Architecture*	*3*	*4.0*
	Project Management	*15*	*20.0*
	Quantity Surveying	*24*	*32.0*
	Civil Engineering	*26*	*34.7*
	Other	*7*	*9.3*
Working Experience	*1 to 5 years*	*15*	*20.0*
	6 to 10 years	*30*	*40.0*
	11 to 15 years	*14*	*18.7*
	More than 16 years	*16*	*21.3*
ii) Project			
Project type	*Building Work*	*38*	*50.7*
	Civil/ infrastructure works	*17*	*22.7*
	Mechanical works	*1*	*1.3*
	Other	*2*	*2.7*
	More than 1	*17*	*22.7*
Project Client	*Federal Government*	*27*	*36.0*
	Local Authority	*5*	*6.7*
	State Government	*6*	*8.0*
	Private Sector	*29*	*38.7*
	Other	*8*	*10.7*
Procurement Route	*Traditional method*	*43*	*57.3*
	Management contractor	*10*	*13.3*
	Design and Build	*19*	*25.3*
	Partnering	*1*	*1.3*
	Other	*2*	*2.7*

Table 2: Correlation analysis between Co-S dimensions and contributory factors and Analysis of Variance (ANOVA) of characteristics

Contributory factors	***Correlation of Co-S dimensions***								***ANOVA of characteristics***					
	CoS1	***CoS2***	***CoS3***	***CoS4***	***CoS5***	***CoS6***	***CoS7***	***CoS8***	**Academic qualification**	**Professional Background**	**Experience**	**Project Type**	**Procurement Type**	**Project Client**
PA1		*X*	*X*	*X*	*X*	*X*	*X*							*x*
PA2					*X*									
PA3		*X*	*X*	*X*	*X*	*X*	*X*	*X*		*x*				
PA4					*X*		*X*			*x*				
PA5	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*		*x*				
PA6	*X*	*X*			*X*	*X*	*X*	*X*		*x*				
PA7	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*		*x*				
PA8	*X*	*X*	*X*	*X*	*X*		*X*		*x*	*x*				
PA9	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*						
PA10	*X*	*X*				*X*	*X*	*X*	*xx*					
PA11	*X*	*X*	*X*	*X*		*X*	*X*	*X*						
PA12	*X*						*X*		*x*					*xx*
PA13						*X*						*x*		
PA14	*X*	*X*									*xx*			
PA15	*X*					*X*	*X*							
PA14	*X*	*X*												
PA15	*X*					*X*	*X*							
PA16	*X*					*X*	*X*							
PA17	*X*	*X*	*X*	*X*		*X*	*X*	*X*		*x*				
PA18	*X*	*X*				*X*	*X*				*x*			
PA19	*X*	*X*	*X*			*X*	*X*	*X*						
PA20	*X*	*X*				*X*	*X*							
PA21	*X*	*X*				*X*	*X*	*X*						*x*
PA22	*X*	*X*				*X*	*X*	*X*	*x*		*x*			
PA23	*X*	*X*				*X*	*X*	*X*						
PA24						*X*			*x*					
PA25	*X*	*X*	*X*	*X*	*X*		*X*	*X*						*x*
PA26														
PA27	*X*	*X*	*X*	*X*		*X*	*X*	*X*						
PA28	*X*			*X*			*X*	*X*		*xx*				
PA29	*X*	*X*		*X*	*X*	*X*	*X*							*x*
PA30									*x*					
PA31		*X*												
PA32														
PA33	*X*		*X*	*X*		*X*		*X*						
PA34														
PA35														
PA36	*X*							*X*	*x*		*x*			
PA37	*X*		*X*					*X*						
PA38								*X*			*x*			
PA39				*X*								*x*		

Contributory factors	*Correlation of Co-S dimensions*								*ANOVA of characteristics*					
	CoS1	***CoS2***	***CoS3***	***CoS4***	***CoS5***	***CoS6***	***CoS7***	***CoS8***	**Academic qualification**	**Professional Background**	**Experience**	**Project Type**	**Procurement Type**	**Project Client**
PA40														
PA41	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*						
PA42					*X*				*x*					
PA43	*X*	*X*	*X*		*X*	*X*								
PA44														
PA45	*X*	*X*	*X*	*X*		*X*	*X*	*X*						
PA46	*X*						*X*	*X*						
PA47	*X*	*X*	*X*				*X*	*X*						
PA48	*X*	*X*					*X*	*X*			*x*			
PA49	*X*					*X*								*x*
PA50	*X*					*X*	*X*	*X*	*xx*					*x*
PA51	*X*	*X*												
PA52	*X*	*X*				*X*			*x*					
PA53	*X*	*X*				*X*	*X*	*X*						
PA54									*xx*			*x*		
PA55	*X*	*X*	*X*	*X*	*X*	*X*		*X*						
PA56		*X*	*X*	*X*	*X*			*X*						
PA57	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*						
PA58			*X*	*X*				*X*				*x*		
PA59	*X*	*X*	*X*		*X*	*X*	*X*	*X*						*xx*
PA60	*X*	*X*	*X*		*X*		*X*	*X*	*xx*	*xx*				*xx*
PA61	*X*	*X*	*X*	*X*			*X*	*X*						*x*
PA62									*x*					
PA63		*X*		*X*	*X*		*X*	*X*				*x*		
PA64	*X*	*X*		*X*	*X*		*X*	*X*	*x*		*x*			
PA65		*X*		*X*			*X*					*xx*		
PA66		*X*					*X*		*xx*					
PA67	*X*	*X*		*X*										
PA68											*x*			
PA69		*X*	*X*					*X*						
PA70	*X*	*X*						*X*		*x*				
PA71	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*		*x*				
PA72	*X*	*X*				*X*	*X*	*X*	*x*					
PA73	*X*	*X*	*X*	*X*		*X*	*X*	*X*						
PA74	*X*	*X*	*X*	*X*			*X*	*X*						
PA75	*X*	*X*						*X*		*x*				
PA76	*X*	*X*		*X*		*X*	*X*	*X*	*xx*	*x*				
PA77	*X*	*X*		*X*		*X*	*X*	*X*						
PA78	*X*	*X*			*X*		*X*	*X*	*xx*					*x*
PA79	*X*	*X*	*X*	*X*	*X*		*X*	*X*		*x*		*x*		
PA80												*x*		

Contributory factors	*Correlation of Co-S dimensions*								*ANOVA of characteristics*					
	CoS1	***CoS2***	***CoS3***	***CoS4***	***CoS5***	***CoS6***	***CoS7***	***CoS8***	**Academic qualification**	**Professional Background**	**Experience**	**Project Type**	**Procurement Type**	**Project Client**
PA81	*X*	*X*	*X*	*X*	*X*		*X*	*X*						
PA82	*X*		*X*	*X*	*X*		*X*	*X*	*x*					
PA83	*X*													
PA84	*X*		*X*		*X*		*X*		*x*					
PA85	*X*	*X*	*X*			*X*	*X*	*X*						
PA86	*X*	*X*				*X*	*X*		*xx*		*x*			
PA87			*X*			*X*								
PA88	*X*	*X*			*X*	*X*	*X*	*X*						
PA89	*X*	*X*	*X*		*X*	*X*	*X*							
PA90	*X*	*X*				*X*	*X*		*x*					
PA91	*X*	*X*	*X*	*X*	*X*	*X*	*X*	*X*						
PA92		*X*						*X*	*xx*			*x*		
PA93														
PA94														
PA95														
Number of variables	***65***	***59***	***36***	***35***	***30***	***44***	***56***	***52***						

*p< .05, **p< .01

Table 3: Results of forward and backward stepwise MRA

	Mode	Constant	B	B	B	B	B	B	R^2 (%)	Adj.R^2 (%)	F- stat (ANOVA)
CoS1 (Cost)	Fwd	.289	***PA21*** *(.378)***	***PA9*** *(.378)***	***PA76b*** *(.330)***	***PA41*** *(.286)***	***PA59*** *(-.418)***		58.0	54.9	.000
	Bwd	.289	***PA21*** *(.378)***	***PA9*** *(.378)***	***PA76b*** *(.330)***	***PA41*** *(.286)***	***PA59*** *(-.418)***		58.0	54.9	.000
CoS2 (Time)	Fwd	-.336	***PA71*** *(.560)***	***PA9*** *(.476)***					44.5	43.0	.000
	Bwd	-.336	***PA71*** *(.560)***	***PA9*** *(.476)***					44.5	43.0	.000
CoS3 (Product)	Fwd	.916	***PA9*** *(.494)***	***PA56*** *(.272)**					31.8	29.9	.000
	Bwd	.916	***PA9*** *(.494)***	***PA57*** *(.194)**					31.8	29.9	.000
CoS4 (Design)	Fwd	.510	***PA9*** *(.550)***	***PA25a*** *(.335)**					33.5	31.6	.000
	Bwd	.510	***PA9*** *(.550)***	***PA25a*** *(.335)**					33.5	31.6	.000
CoS5 (Safety)	Fwd	1.392	***PA84*** *(.358)***	***PA5*** *(.266)**					22.6	20.5	.000
	Bwd	1.392	***PA84*** *(.358)***	***PA5*** *(.266)**					22.6	20.5	.000
CoS6 (Profitability)	Fwd	.129	***PA5*** *(.595)***	***PA85*** *(.557)***	***PA41*** *(.347)***	***PA57*** *(-.276)**	***PA59*** *(-.291)**		56.5	53.3	.000
	Bwd	.129	***PA5*** *(.595)***	***PA85*** *(.557)***	***PA41*** *(.347)***	***PA57*** *(-.276)**	***PA59*** *(-.291)**		56.5	53.3	.000
CoS7 (Business)	Fwd	-1.066	***PA5*** *(.563)***	***PA22b*** *(.442)***	***PA84*** *(.257)***				46.9	44.6	.000
	Bwd	-1.066	***PA5*** *(.563)***	***PA22b*** *(.442)***	***PA84*** *(.257)***				46.9	44.6	.000
CoS8 (Relationship)	Fwd	.116	***PA22b*** *(.454)***	***PA73*** *(.335)***	***PA3*** *(.204)**				34.9	32.1	.000
	Bwd	.116	***PA22b*** *(.454)***	***PA73*** *(.335)***	***PA3*** *(.204)**				34.9	32.1	.000

*p< .05, ** p<.01