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RESEARCH ARTICLE

Relationship between contractor satisfaction and project management performance

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Abstract

Despite the fast growth of project-based companies and industries, studies of the satisfaction-performance (S-P) nexus of project participants are lacking. This study aims to explore the role of contractor satisfaction in affecting contractor project management performance along with considering external effects from other key participants. Two broad dimensions of satisfaction toward noneconomic factors and economic factors were used to develop hypothesized models. Structural equation modelling techniques were applied with data collected from 117 projects, showing that it is insufficient to simply conclude that contractor satisfaction influences project managerial performance and *vice versa*, and that satisfaction disaggregation is necessary. Additionally, it was found that noneconomic satisfaction contributes to performance, which in turn contributes to economic satisfaction. The theoretical and practical implications are further discussed.

Keywords:

Contractor satisfaction, performance, project management, structural equation modelling.

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Introduction

Research into the possible connection between job satisfaction and job performance has been an important topic for academics and organization managers since the Hawthorne studies and the human relations movement (Judge et al., 2001; Organ, 1988). Initially assumed in the 1930s and 40s that worker job satisfaction affects worker performance (e.g. Brayfield and Crockett, 1955), by the 1960s this had been reversed to assume that satisfaction was induced by rewards from good performance (Lawler and Porter, 1967). Although the lack of empirical support for either assumption has left the satisfaction-performance (S-P) nexus uncertain and even denigrated as simple 'folk wisdom' by some researchers (e.g. Fisher, 2003), others have turned to explore common antecedent variables for the S-P nexus (Judge et al., 2001; Schwab and Cummings, 1970), and disaggregate satisfaction into sub-dimensions (Lai, 2007; Nerkar, McGrath and MacMillan, 1996), to uncover many convincing results.

The notion of *project participant satisfaction* has been widely accepted, with the emergence of stakeholder theory (Freeman, 1984) and the increasing popularity of such project-based industries as construction, real-estate, offshore engineering, and software development – one fifth of the world's economic activity is organized as a project (Esenduran, Hall and Liu, 2015). More stable owner-contractor relationships have been proposed to improve life cycle costing, contracting processes, risk management, teamwork, trust, and cooperation in construction work (Dozzi et al., 1996). In addition to the 'iron triangle' measures of cost, schedule, and quality, satisfaction has been recognized as another effective measure of project performance (Ibbs and Ashley, 1987; Toor and Ogunlana, 2010; Li, Ng and Skitmore, 2013; Ha et al., 2017). Studies of construction project participant satisfaction have become increasingly prominent over the past decade, with a positive change in focus from individual performance to a greater emphasis on stakeholder interests (Toor and Ogunlana, 2010; Hosseini, Chileshe and Zillante, 2014; Ibiyemi et al., 2014; El-Sawalhi and Salah, 2015; Forsythe, 2015; Ujene and Edike, 2015; Andrief et al., 2017; Mok, Shen and Yang, 2017; Xio, Liu and Pang, 2019). Additionally, project participant satisfaction provides an early sign of the likely outputs in executing complex projects (Williams et al., 2012; Xiong et al., 2014).

Despite the wide acknowledgment and study of the *individual* satisfaction-performance (S-P) nexus, its counterpart nexus between *organizational* satisfaction and performance has received little attention. Pearsall and Ellis's (2006) command-control simulation study, for example, examined the effects of critical team member assertiveness on team performance and team satisfaction. Chiu and Ng's (2013, 2015) questionnaire surveys of quantity surveyors in Hong Kong found job satisfaction and organisational commitment improved through work group identification and working relationships. Panahi et al.'s (2016) questionnaire survey of professional construction consultants in Malaysia investigating the potential effect of value conflicts on the stakeholders' job satisfaction, revealed the importance of the interaction between personal and organizational values in construction organizations. Jaafar and Radzi's (2013) questionnaire survey of various construction industry players in Malaysia found levels of satisfaction to be related to the procurement systems used. Xio, Liu and Pang (2019) identified the competencies needed of Chinese real-estate project managers needed to guarantee the smooth implementation of projects. Similarly, Ingle and Mahesh's (2020) study of Indian construction projects identified the main factors affecting project performance, which include stakeholder satisfaction. However, none have specifically considered the S-P nexus. One approach to understanding the S-P nexus of project companies has been to follow the various studies that have been made at the individual level and assume that there is an overall S-P nexus with a complex relationship between performance and satisfaction divided into sub-dimensions. A few extant studies of contractor satisfaction, such as Xiong et al. (2014), have highlighted the different effects of external factors on contractor economic satisfaction (*ES*) and production-related satisfaction (*PS*). The nexus between contractor satisfaction and contractor performance is still unknown, however, which is identified here as the research gap.

In response to the research gap, this study aims to investigate the nature of the satisfaction-performance (S-P) nexus of construction contractors. The findings could be critical for researchers and practitioners to understand internal relationships and better decision-making. The results of a survey of 117 construction contractors' satisfaction and performance pertaining to their recent project work are analyzed through the development and comparison of two series of structural equation models. The first group of models treats contractor satisfaction as a holistic concept in examining the S-P nexus (i.e., combining economic-related satisfaction and production-related satisfaction). In carrying out a detailed analysis of contractor satisfaction, the second group of S-P models provides significantly improved explanatory power by dividing contractor satisfaction into two facets of (*PS*).

Literature review

Satisfaction has been defined as a response function of the discrepancy between 'How much is there?' and 'How much should there be?' (Wanous and Lawler, 1972). Early research in industrial settings mainly refers to satisfaction as job satisfaction. This became a popular term with the Hawthorne studies in emphasizing linkages between employees' job satisfaction and their performance – a relationship described as the 'Holy Grail' by industrial-organizational researchers (Judge et al., 2001). However, the weak empirical evidence relating to the individual S-P nexus prompted some researchers (e.g. Judge et al., 2001) to argue that the unsatisfactory outcomes in S-P linkage research have been mainly caused by the ambiguity in defining satisfaction, although some measures of job satisfaction have been developed, such as the Job Descriptive Index (JDI) (Smith, Kendall and Hulin, 1969; Onukwube, 2012) and Minnesota Satisfaction Questionnaire (MSQ) (Weiss, Dawis and England, 1967). Analysis should also treat economic satisfaction separately, since it is highly related to such pay factors as pay equity (Brown, 2001). Significantly, Lai (2007) divided satisfaction into social satisfaction and economic satisfaction when investigating the mediating effects of satisfaction in the Taiwanese motor industry, finding noneconomic satisfaction to be much more important than economic satisfaction in influencing performance.

A project is a natural and an ideal organizational form for developing products facing increasing product complexity, changing markets, cross-functional expertise cooperation, customer-oriented innovation, and technological uncertainty (Hobday, 2000). For many cross-functional projects, it is the collaboration of participating project organizations rather than the routine practices of workers in assembly lines that produce the final product (Turner, 2014). For projects, both external factors and perceived satisfaction affect the performance of participating companies (Soetanto and Proverbs, 2002; Mellado, Lou and Becerra, 2019; Nugraha and Putranto, 2019; Olugboyega and Windapo, 2019; Yakubu, Ogunsanmi and Yakubu, 2019).The best-value (BV) procurement process proposes to use other key factors as well as bid price in the evaluation and choice of the best-performing contractor (Elyamany and Abdelrahman, 2010). As Freeman's (1984) stakeholder theory holds, stakeholder satisfaction management is useful for solving corporate social-related issues effectively and generating good business performance (Porter and Kramer, 2006). In many cases, the perception of success for complex projects has little to do with whether they are completed on time, at cost, and with the desired quality, but the achievement of the desired objectives of different stakeholders (Turner and Zolin, 2012; El-Sawalhi and Salah, 2015; Ujene and Edike, 2015; Mok, Shen and Yang, 2017). Many accept participant satisfaction as a new dimension of project success (e.g. Serrador and Turner, 2015) and a new approach for use as an early warning sign (Xiong et al., 2014).

With the increasing popularity of project economics and stakeholder theory, project participant satisfaction has become an emergent area of study (Orlitzky and Swanson, 2012). Also studied by some researchers are the organizational satisfaction levels of companies taking part in construction projects, such as clients and contractors (e.g. Masrom, Skitmore and Bridge, 2013). For example, a criterion for defining success especially regarded by some researchers is client satisfaction (Munns and Bjeirmi, 1996). In exploring problems of the design and construction phases of the green-building project delivery process, dissatisfaction of the owner, and dissatisfaction of the general contractor due to "problems with material availability" can negatively affect the value and quality of the project in terms of cost and time of the project. (Seyis, Ergen and Pizzi, 2016). However, previous studies have focused on measuring and exploring the driving factors of participant satisfaction (Leung, Ng and Cheung, 2004; Li, Ng and Skitmore, 2013), contractor satisfaction (Soetanto and Proverbs, 2002; Masrom, Skitmore and Bridge, 2013; Xiong et al., 2014), and client satisfaction (Yang and Peng, 2008).

Geyskens, Steenkamp and Kumar's (1999) meta-analysis of 71 studies of satisfaction in marketing relationships, for example, resonated with Lopez's (1982) results in demonstrating the need to distinguish between economic and noneconomic satisfaction as distinct constructs with different causes and consequences. Likewise, Rodríguez, Agudu and Gutierrez (2006) demonstrated the necessity of such a categorization by examining the determinants of economic and noneconomic satisfaction in manufacturer-distributor relationships. In addition to the supply-chain, such a separation of organizational satisfaction is also applicable to construction projects. For example, Xiong et al. (2014) obtained a similar outcome in examining the effects of other key project participants' performance on the economic satisfaction (*ES*) and production satisfaction (*PS*) of construction contractors. Therefore, this study aims to explore the nexus between satisfaction and performance of construction contractors by taking sub-dimensions of contractor satisfaction into account.

Conceptual models and hypotheses

The combined efforts of different project participants generate project outcomes, and contractors – as key performance assessors – have their own psychological interpretation of other participants' performance (Soetanto and Proverbs, 2002). Clients and designers are another two key participants in construction contracts (Lai and Lam, 2010). In examining the influence of other project participants, Wang and Huang's (2006) survey of construction supervising engineers in China found client performance to be significantly correlated with project success. A major contributing factor seems to be client-led changes in project scope, which cause up to 70% of poor schedule performance in Saudi Arabian projects for example (Assaf and Al-Hejji, 2006). Poor designer performance also contributes significantly to delayed government projects in Malaysia, where defective designs account for most quality problems (Sambasivan and Soon, 2007). Ling et al. (2008) explored the project management practices of foreign architectural, engineering, and construction (AEC) companies in China, finding that project management performance is critical in predicting project outcomes in terms of cost performance, time performance, quality performance, owner satisfaction, and profit margins. Design ability has been found to be important to ensure the speedy completion of projects (Ling et al., 2004). Consistent with previous studies (e.g. Soetanto and Proverbs, 2002; Assaf and Al-Hejji, 2006; Yang and Peng, 2008; Xiong et al., 2014), the contractor S-P nexus is explored by including the influences of the performance of clients and designers in terms of the client's clarity of objectives (OC), and designer performance (DP) in terms of carefulness in the design of products or services to meet those needs.

Puzzled by the weak empirical evidence concerning both directional S-P links at the individual level, Schwab and Cummings (1970) pointed out ambiguity in defining job satisfaction may be a cause. This study disaggregated satisfaction into two parts – economic satisfaction (*ES*) and production satisfaction (*PS*). The performance part was restricted to contractor project management performance. Although some researchers followed this in exploring the relationships between disaggregated satisfaction components and performance (e.g. Lai, 2007), these studies assumed that all disaggregated satisfaction facets share the same unidirectional relationship with performance. If such an assumption is correct and these studies obtained significant results, the link between holistic satisfaction and performance should also be significant, which would not be consistent with the conclusions reached to date. To test the S-P nexus of construction contractors, therefore, it is proposed that different directional relationships exist between performance and each satisfaction sub-dimension. Two conceptual models describing the relationship between contractor satisfaction (*COS*) and contractor project management performance (*CPMP*) are developed to test these assumptions as follows.

CONCEPTUAL MODEL 1

The development of conceptual model 1 assumed that *COS* is a holistic concept comprising economic-related satisfaction (*ES*) and production-related satisfaction (*PS*) as suggested by Xiong et al. (2014). In this context, *ES* refers to contractor satisfaction, with such economic issues as cost, profitability, and potential business opportunities arising from current business activities. In contrast, *PS* refers to contractor satisfaction with production and service quality (Xiong et al., 2014).

Consistent with earlier studies (e.g. Soetanto and Proverbs, 2002; Lai, 2007; Xiong et al., 2014), the following hypotheses were proposed:

H1 concerns the relationships between the performance of customers and designers separate from the performance and satisfaction of the organization. H2 concerns the linkage between contractor satisfaction and performance, with H2A and H2B indicating that *COS* affects *CPMP* and *CPMP* affects *COS* respectively (H2A and H2B are contained in two separate, but otherwise identical, models named Model 1A and Model 1B).

Hypothesis 1A: OC has a positive direct effect on COS

Hypothesis 1B: OC has a positive direct effect on CPMP

Hypothesis 1C: OC has positive effects on DP

Hypothesis 1D: DP has a positive direct effect on COS

Hypothesis 1E: DP has a positive direct effect on CPMP

Hypothesis 2A: COS has a positive direct effect on CPMP

Hypothesis 2B: CPMP has a positive direct effect on COS

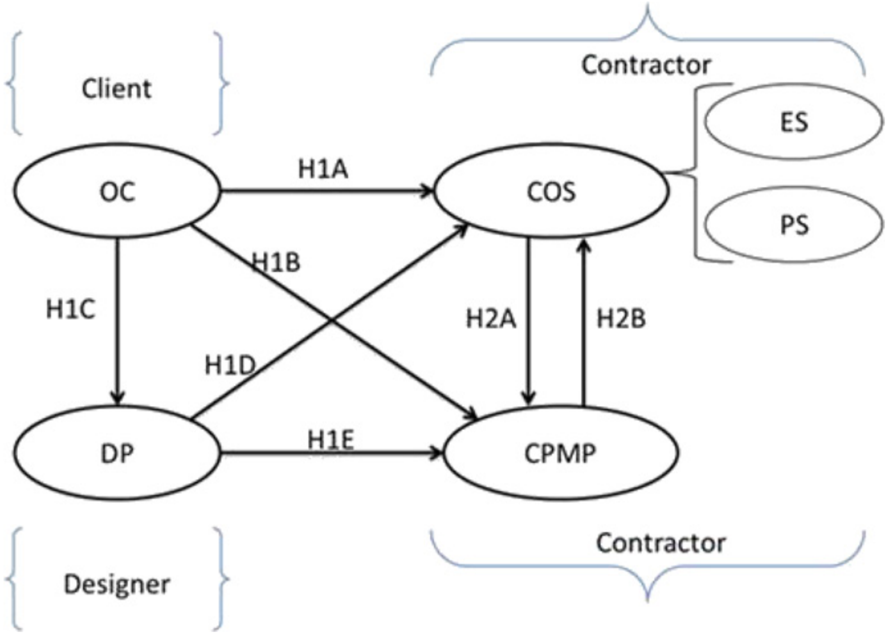

Figure 1 Conceptual model 1

CONCEPTUAL MODEL 2

Similar to conceptual model 1, the influences of *OC* and *DP* are considered as antecedent variables in exploring the contractor S-P nexus. A difference here is that satisfaction is divided into *ES* and *PS*, prompted by Geyskens, Steenkamp and Kumar (1999), Rodríguez, Agudu and Gutierrez (2006), Lai (2007), and Xiong et al. (2014) as leading examples. Unlike these earlier studies, also included are the different directional relationships that *ES* and *PS* may have with performance. As suggested by the previous literature, this research proposes that *PS* has a positive effect on *CPMP* and *CPMP* has a positive effect on *ES*. The hypotheses are as follows:

H3 concerns the relationships between the performance of customers and designers separate from the performance and satisfaction of the organization. H4 concerns the linkage between the two facets of contractor satisfaction and performance.

Hypothesis 3A: OC has a positive direct effect on ES

Hypothesis 3B: OC has a positive direct effect on CPMP

Hypothesis 3C: OC has a positive direct effect on PS

Hypothesis 3D: OC has a positive direct effect on DP

Hypothesis 3E: DP has positive direct effects on CPMP

Hypothesis 3F: DP has positive effects on PS

Hypothesis 4A: PS has a positive direct effect on CPMP

Hypothesis 4B: CPMP has a positive direct effect on ES

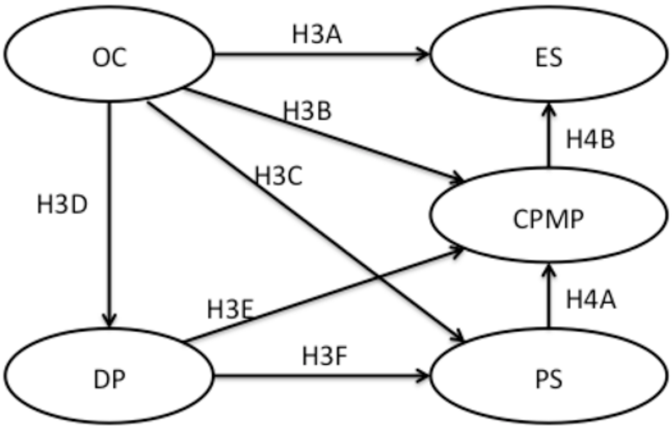

Figure 2 Conceptual model 2

Methodology

QUESTIONNAIRE SURVEY

The contributory factors of construction project situations to *COS* and their degree of influence were identified on a five-point Likert scale questionnaire survey by Masrom (2012). The questionnaire consists of general information concerning the construction contractors, respondents, and specific questions in relation to the *COS* dimensions and their contributory factors. The questionnaire was sent to 300 construction contractors registered with the Malaysian Construction Industry Development Board (CIDB) to provide feedback based on the company's most recent construction project. Of the 136 contractors' responses, 117 usable responses (i.e. a valid net response rate of 39%) were used. These contractors are evenly distributed in terms of size, with 53.0% being large companies (G7) and 47.0% small to medium companies (G1-G6), categorized by company size and permitted tendering capability (Masrom, 2012). Of the respondents (the company representatives), 93.2% have a diploma or higher degree and 82.9% have more than 5 years' working experience, indicating good ability to understand the questions and provide reasonable feedback. Table 1 summarizes the basic information concerning the construction projects involved.

Table 1 Description of projects

Project characters	Groups	Frequency	Percent	Cumulative percent
Client type	Federal government	40	34.19%	34.19%
	State or local authority	30	25.64%	59.83%
	Private sector	38	32.48%	92.31%
	other	9	7.69%	100.00%
Procurement method	Design-bid-build	75	64.10%	64.10%

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Table 1 continued

Project characters	Groups	Frequency	Percent	Cumulative percent
	Management contract	12	10.26%	74.36%
	Design and build	25	21.37%	95.73%
	other	5	4.27%	100.00%
Project duration	< 1 year	59	50.43%	50.43%
	1-2 year	35	29.91%	80.34%
	2-3 year	14	11.97%	92.31%
	> 3 year	9	7.69%	100.00%

The sample size here exceeds the recommended number of 100 cases suggested by Bagozzi and Yi (2012) for structural equation modelling (SEM) and is comparable with previous SEM studies in the construction industry (Xiong, Skitmore and Xia, 2015). For example, Cheung and Chow (2011) analyzed 103 responses to explore the underlying factors contributing to withdrawal in construction project dispute negotiations; and Wong and Lam (2011) used 107 responses to investigate the effect of organization learning and unlearning on the performance of construction organizations. In addition to the comparatively simple model structure, each construct contains at least three variables, which assures model identification of each measurement construct and allows a smaller sample size for fitting the model (e.g. Xiong, Skitmore and Xia, 2015).

To test the conceptual models and hypotheses, the measurement framework in Table 2 was built based on Kline's (2015) three-variable principle, where three observed variables are used to reflect a latent variable. To do this, the observed variables were extracted from Masrom's (2012) questionnaire. Company size was used as a control variable in model development, with 0 = small/medium and 1 = large contractors.

Table 2 Measurement constructs and items

Constructs	No.	Items	Main sources
Which performance level would you rate? (1=very bad, 5=very good)			
Client's clarity of objectives (OC)	Q1	Quality of project brief (e.g. needs and requirements)	Soetanto and Proverbs (2002, 2004); Assaf and Al-Hejji (2006); Park (2009); Masrom (2012)
	Q2	Completeness of project brief	
	Q3	Certainty of project brief	
Designer performance (DP)	Q4	Design constructability	CIDB (2006); Yang and Peng (2008); Park (2009); Masrom (2012)
	Q5	Comprehensiveness of design	
	Q6	Flexibility of design to accommodate changes	

Table 2 continued

Constructs	No.	Items	Main sources
Contractor project management performance (CPMP)	Q7	Productivity of project manpower	Munns and Bjeirmi (1996); Soetanto and Proverbs (2004); Wang and Huang (2006); Yang and Peng (2008); Park (2009);
	Q8	Two- way communication between participants and your project team	
	Q9	Collaborative work between participants and your project team	
	Q10	Quality of relationship between subcontractors and your project team	
Which satisfaction level would you rate? (1=very dissatisfied, 5=very satisfied)			
Production-related satisfaction (PS)	Q11	Schedule performance (actual vs budget)	Schwab and Cummings (1970); Geyskens et al (1999); Rodríguez, et al. (2006); Lai (2007); Masrom (2012); Masrom, Skitmore and Bridge (2013); Xiong et al (2014)
	Q12	Construction product quality performance	
	Q13	Safety of worksite	
Economic-related satisfaction (ES)	Q14	Project cost management performance (actual vs budget)	
	Q15	Project profitability	
	Q16	Potential business development in future	

STRUCTURAL EQUATION MODELLING: CB-SEM AND PLS-SEM

SEM is widely accepted and used in exploring and testing relationships between different constructs in the social science disciplines – its evolution being regarded as the most important statistical progress in social sciences in recent decades (Hair et al., 2012). Its particular applications in recent construction/project management studies include Qureshi and Kang (2015), Eriksson, Larsson and Pesamaa (2017), Hong et al. (2019), Lew et al. (2018) and Abulhakim and Adeleke (2019). A structural equation model includes observed variables and latent variables that are hard to observe directly due to their abstract character and are represented using several observed variables (Byrne, 2016). A structural equation model generally comprises a structural component (consisting of the relationships between the latent variables) and several measurement components (consisting of the measurement errors of the measurement variables, and the relationships between the observed variables and represented latent variable) (Washington et al., 2020). Compared with such first-generation models as principle component analysis and linear regression, SEM is a second-generation multivariate analysis method (Fornell and Larcker, 1982). It has many strengths, such as enabling the use of one model to explore an entire set of complex relationships, or the use of several observable items to represent ambiguous constructs (Kline, 2015; Cho, Hong and

Hyun, 2009). Additionally, the availability of many SEM software packages offering graphical interfaces for model development (Xiong, Skitmore and Xia, 2015) enhances the popularity of SEM.

There are two types of SEM approaches: covariance based (CB-SEM) and partial least squares based (PLS-SEM). CB-SEM is appropriate for confirming theoretical hypotheses, as it focuses on minimizing the difference between the model-implied covariance matrix and the sample covariance matrix and obtaining accurate parameter estimates. In contrast, PLS-SEM is preferred in *prediction*, as it focuses on maximizing the explained variance of targeted constructs (Hair, Ringle and Sarstedt, 2012). CB-SEM is more popular in theoretical studies for its stricter rules concerning data and sample size and accurate estimates of parameters, while PLS-SEM has recently increased in popularity due to its ability to provide accurate predictions of target variables with a comparatively small sample size. Additionally, PLS-SEM can accommodate both reflective measurement constructs and formative measurement constructs, while CB-SEM can only accommodate the reflective measurement construct (Ringle, Sarstedt and Straub, 2012). In reflective constructs, changes in latent variables lead to changes in observed variables but not *vice versa*, which is important for explaining the selected latent variable when deleting an observed variable. In formative constructs, the opposite is the case, with changes in observed variables leading to changes but not *vice versa*, which changes the theoretical meaning significantly when deleting an observed variable (Jarvis, MacKenzie and Podsakoff, 2003).

In the current context, organizational satisfaction is represented by contractor satisfaction (*COS*), which is composed of economic-related satisfaction (*ES*) and production-related satisfaction (*PS*), with both *ES* and *PS* being reflected by several observed variables, which means that *COS* in conceptual model 1 is a second order reflective-formative model and therefore more suitable for PLS-SEM (Becker, Klein and Wetzel, 2012). However, as Hair, Ringle and Sarstedt (2012) argue, CB-SEM and PLS-SEM have different advantages and should be complementary rather than conflicting. In this case, both methods were used – PLS-SEM for developing conceptual model 1 and CB-SEM for developing conceptual model 2, with the software *SmartPLS 2.0* (Ringle, Wende and Will, 2005) and *SPSS AMOS 21.0* used for developing the models accordingly.

Model development and results

RELIABILITY TEST

Cronbach's alpha value is used to test the reliability of the hypothesized construct based on the data, where a value exceeding 0.7 is taken as indicating the received data is acceptable for meeting the consistency requirement (Cho, Hong and Hyun, 2009; Lai, 2007). As presented in Table 3, the items are measured in five variables and the overall constructs are sufficiently satisfied.

Table 3 Reliability test

Variables	All16	Q1-3	Q4-6	Q7-110	Q11-13	Q14-Q16
Cronbach's alpha value	0.914	0.874	0.85	0.805	0.753	0.806

CONCEPTUAL MODEL 1

PLS-SEM has become a popular SEM method in recent years for its ability to accommodate both reflective and formative measurement constructs (Becker, Klein and Wetzel, 2012; Ringle, Sarstedt and Straub, 2012). For this study, satisfaction was divided into economic-related satisfaction and noneconomic satisfaction that is specific to production-related satisfaction. That is, contractor satisfaction is a formative-reflective construct. To test H2A and H2B separately, two models were constructed. Each contains three latent variables (*OC*, *DP*, and *CPMP*) with corresponding reflective indicators, one second-order hierarchical latent variable (*COS*) and two first order (reflective) constructs that form the second order (formative) construct. The repeated indicator approach was used for the conceptual model due to its comparatively high reliability and wide applications in reflective-formative construct problems (Chin, 2010; Becker, Klein and Wetzel, 2012; Ringle, Sarstedt and Straub, 2012). For this approach, a higher-order latent variable comprising lower-order latent variables could be constructed by representing all the observed variables belonging to the lower-order latent variables. This approach can estimate scores of latent variables simultaneously instead of estimating different order constructs separately, and then uses the needed construct scores to test the proposed relationships as a separate step (Ringle, Sarstedt and Straub, 2012; Hair et al., 2017).

Model fit evaluation

To validate the measurement components, three types of validity were assessed: internal consistency reliability, convergent validity, and discriminant validity. Compared with Cronbach's alpha values presented in Table 4, values of *composite reliability* are preferred in the testing of internal consistency reliability, as such measures do not assume that the observed variables share the same out-loadings (Hair et al., 2017). The average variance extracted (AVE) was used to test convergent validity. As Table 4 indicates, the values of composite reliability and AVE are greater than the required 0.7 and 0.5 respectively (Hair et al., 2017); all factor loadings of the observed variables on latent variables are significant at the 0.01 level; the discriminant validity is satisfactory, as the square root of the average variance extracted for each construct is more than the maximum correlations with other constructs (Fornell and Larcker, 1981); and the loadings are greater than the cross loadings by 0.1 as required (Hair et al., 2017).

Table 4 Validity test results

Latent variables	CR	AVE	Correlations between constructs				
			OC	*DP*	*CPMP*	*ES*	*PS*
OC	0.923	0.800	0.894				
DP	0.909	0.769	0.531	0.877			
CPMP	0.872	0.631	0.499	0.635	0.795		
ES	0.887	0.724	0.500	0.530	0.411	0.851	
PS	0.861	0.674	0.480	0.484	0.469	0.640	0.821
COS	0.889	0.572	N/A	N/A	N/A	N/A	N/A

Note: Bold numbers in the diagonal row are the square roots of the average variance extracted. Although the results presented are generated in Model 1A, the values of CR and AVE in Model 1B are the same to within 0.001 and the differences in correlations between the two models to within 0.005.

In addition to validity assessment, multicollinearity issues were checked for relatively high correlations between some variables in Table 4 (e.g. a correlation of 0.640 between *ES* and *PS*). With ranges of 1.457 to 2.044 for Model 1A and 1.458 to 2.044 for Model 1B, the values of the variance inflation factor (VIF) for all first-order constructs are acceptable.

Model development

Having confirmed their validity, the results of developing conceptual model 1 are presented in Figs 3 and 4 respectively to test H2A and H2B. *COS* is a second order latent variable consisting of *ES* and *PS*, and the relationships between the three variables are calculated by the repeated indicator approach. The non-significant low R^2 results indicated the lack of a strong enough relationship should be considered further. Since other satisfactory results were achieved, only the links between the three latent variables of *OC*, *DP*, and *CPMP*, and the second order *COS* are presented. As the company size control variable has a weak and insignificant effect in both Models 1A and 1B, its results are not presented.

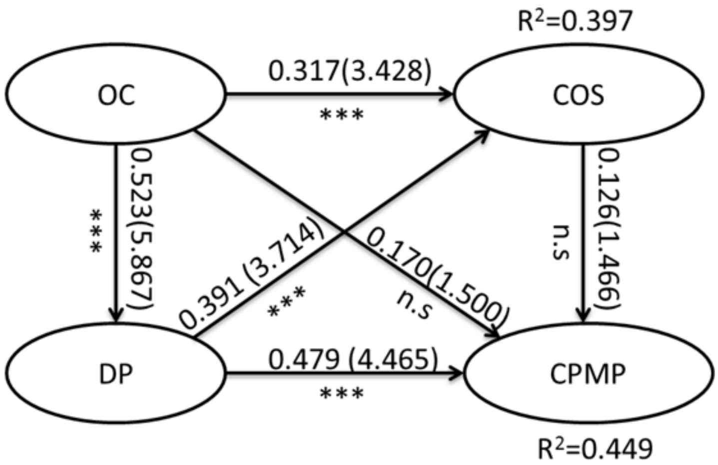

Figure 3 Model 1A testing H2A: COS affects CPMP

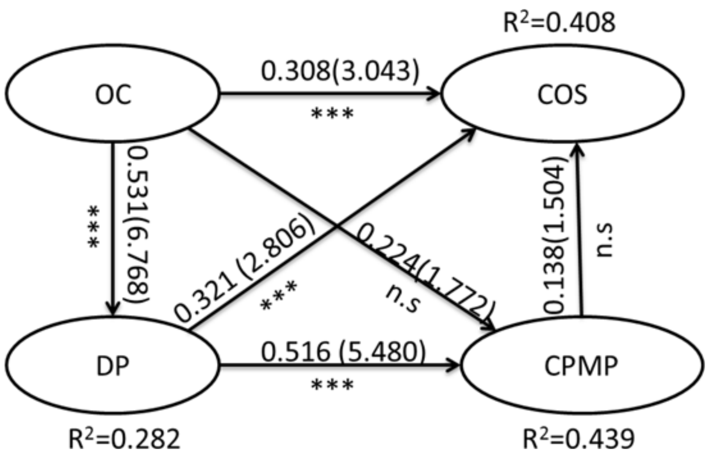

Figure 4 Model 1B testing H2B: CPMP affects COS

Note for Figs 3 and 4: The values shown above the arrows are the path coefficients validated by bootstrapping. The t-statistics are shown in parentheses and their significance at the 1% (***)/ 5% (**) level with values greater than 2.58/1.96. N.s below the arrows means the relationship is not significant at the 5% level.

These show that both *COS*→*CPMP* and *CPMP*→*COS* are highly significant at the 0.1 level (t-statistic=1.64), but still far from significant at the 0.05 level (t-statistic=1.96). These results are generally consistent with many earlier studies of the S-P relationship, in that they are positive but weak. Table 5 summarizes the results of the hypothesis tests

Table 5 Results of hypothesis tests

Hypotheses	Model 1A	Model 1B
H1A: *OC* has a positive direct effect on *COS*	Supported	Supported
H1B: *OC* has a positive direct effect on *CPMP*	Not supported	Not supported
H1C: *OC* has positive effects on *DP*	Supported	Supported
H1D: *DP* have positive direct effects on *COS*	Supported	Supported
H1E: *DP* has a positive direct effect on *CPMP*	Supported	Supported
H2A: *COS* causes *CPMP*	Not supported	N/A
H2B: *CPMP* causes *COS*	N/A	Not supported

CONCEPTUAL MODEL 2

The results gained in conceptual model 1 indicate the potential benefits of satisfaction disaggregation. In developing Model 2, although PLS-SEM is used to obtain the significance of the links and coefficients, CB-SEM is preferred for its ability to provide more accurate parameter estimates for the first-order reflective constructs (Hair, Ringle and Sarstedt, 2012). A two-step modelling method is often used when applying CB-SEM, (Byrne, 2016; Anvuur and Kumaraswamy, 2012; Xiong, Skitmore and Xia, 2015). This involves firstly carrying out a confirmatory factor analysis (CFA) from the correlations of all the latent variables and then, if the model fit results of the CFA are acceptable, changing these to propose directional relationships for further analyses.

Confirmatory factor analysis

Table 6 shows the standardized regression weights and squared multiple correlations (SMCs) for each observed item. All the regression weights (factor loadings) range from 0.627 to 0.894 and, being above 0.5, are therefore highly significant (Anvuur and Kumaraswamy, 2012). The SMCs range from 0.393 to 0.799 (mean=0.600, sd=0.113). The average SMCs of the items in the measurement models are the AVE of the latent variables and, ranging from 0.510 to 0.759, are all greater than the 0.5 threshold. In terms of goodness of fit as presented in Table 7, $\chi2$ = 187.214 (df = 170, $\chi2$/df = 1.101, p=0.174) for the CFA phase, the $\chi2$/df value of less than 2 indicating a good fit (Xiong, Skitmore and Xia, 2015).

Table 6 Standardized regression weights and SMCs

Item	Standardized regression weights					SMC
	OC	*DP*	*CPMP*	*PS*	*ES*	
Q1	0.894[a]					0.799
Q2	0.836					0.699

Table 6 continued

Item	Standardized regression weights					SMC
	OC	*DP*	*CPMP*	*PS*	*ES*	
Q3	0.882					0.778
Q4		0.836				0.698
Q5		0.852				0.727
Q6		0.740[a]				0.548
Q7			0.627[a]			0.393
Q8			0.721			0.519
Q9			0.748			0.560
Q10			0.762			0.581
Q11				0.718[a]		0.516
Q12				0.707		0.500
Q13				0.717		0.514
Q14					0.768	0.590
Q15					0.797	0.635
Q16					0.732[a]	0.536

Structural equation modelling

As a good model fit was obtained in the CFA phase, the correlations between the latent variables are replaced by the hypothesized directional relationships of conceptual model 2. Fig. 5 shows the final model. Company size was excluded for being highly insignificant and weak. The observed variables Q1 to Q16, measurement errors, and connections of items are omitted due to space limitations.

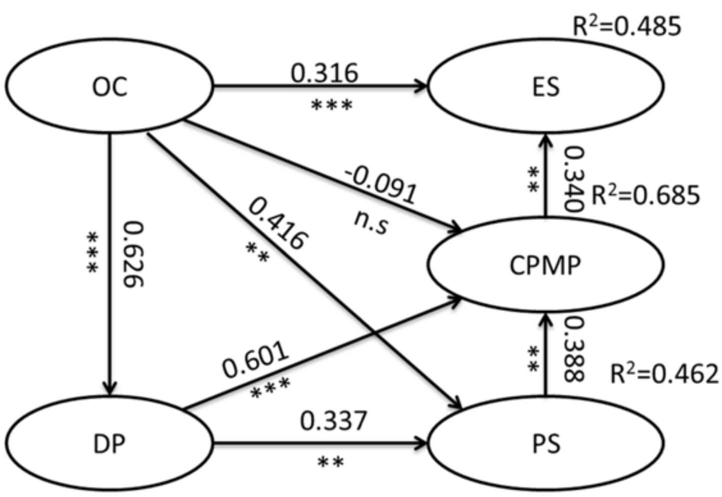

Figure 5 Model 2 testing H4A and H4B

Table 7 Goodness of fit

Goodness of fit measure	Criteria	CFA	SEM
χ^2/df	<5.0	1.101	1.294
Absolute fit			
RMSEA	<0.08	0.021	0.036
SRMR	<0.08	0.0466	0.0619
RMR	<0.05	0.031	0.044
Incremental fit			
CFI	>0.9	0.991	0.973
TLI	>0.9	0.987	0.962
Parsimonious fit			
PNFI	>0.5	0.646	0.648
PGFI	>0.5	0.573	0.574

Table 8 Hypothesis direct effects

Hypotheses	Model 2
H3A: *OC* has a positive direct effect on *ES*	Supported
H3B: *OC* has a positive direct effect on *CPMP*	Not supported
H3C: *OC* has a positive direct effect on *PS*	Supported
H3D: *OC* has a positive direct effect on *DP*	Supported
H3E: *DP* have positive direct effects on *CPMP*	Supported
H3F: *DP* has positive effects on *PS*.	Supported
H4A: *PS* has a positive direct effect on *CPMP*	Supported
H4B: *CPMP* has a positive direct effect on *ES*	Supported

Table 8 presents the results of testing the hypothesis direct effects. The SMC of *ES* is 0.485, which indicates that 48.5% of the variance in *ES* is explained by both direct effects from *OC* and *CPMP* and indirect effects from *OC*, *DP*, and *PS*. This is similar for *CPMP* and *PS* with SMCs of 0.685 and 0.462, respectively. Following Anvuur and Kumaraswamy (2012), the bias-corrected bootstrap approach was used with 500 resamples and maximum likelihood estimation to provide a robust test of the significance of the indirect effects (see Awang, Afthanorhan an Asri, 2015; Hox and Bechger, 1998). This indicates the significance to range from 0.002 to 0.050. For example, the indirect effect of *DP* on *CPMP* via the mediation of *PS* is 0.337×0.388=0.131, with a 95% confidence interval of (0.000, 0.322), p=0.045. The total effects are the sum of the direct effects and indirect effects. Fig. 5 shows the standardized direct effects, and Table 9 provides the standardized indirect effects and total effects. To maintain consistency, and as the effects of the insignificant *OC*-*CPMP* link are small, Table 9 shows the influencing effects on the dependent variables without deleting this link.

Table 9 Standardized direct/indirect/total effects

Effects	Variables	*OC*	*DP*	*PS*	*CPMP*
Direct effects	*DP*	0.626			
	PS	0.416	0.337		
	CPMP	-0.091	0.601	0.388	
	ES	0.455	0	0	0.34
Indirect effects	*DP*	0			
	PS	0.211	0		
	CPMP	0.62	0.131	0	
	ES	0.179	0.249	0.132	0
Total effects	*DP*	0.626			
	PS	0.627	0.337		
	CPMP	0.528	0.732	0.388	
	ES	0.634	0.249	0.132	0.34

Discussion

RECOGNIZING SUB-DIMENSIONS OF CONTRACTOR SATISFACTION

This paper explored the project participant satisfaction-performance nexus with empirical evidence from Malaysian construction contractors. This was partially inspired by the question proposed by Judge et al. (2001) for future research of whether the S-P relationship will be stronger at group or organization level? With this concern in mind, two satisfaction sub-dimensions comprising economic-related satisfaction (*ES*) and production-related satisfaction (*PS*) were introduced in the context of construction projects. Two series models were developed to test the S-P nexus of construction contractors. When satisfaction was seen as the usual holistic concept, the relationship between satisfaction and performance was weak – similar to previous studies at the individual level. The good fit of Model 2 demonstrated the benefit of satisfaction disaggregation and the new S-P relationships proposed in this study.

RECOGNIZING DIFFERENT DIRECTIONAL RELATIONSHIPS BETWEEN CONTRACTOR SATISFACTION SUB-DIMENSIONS AND CONTRACTOR PERFORMANCE

The development of the first conceptual model gave a similar result to previous research at the individual level, in that the linkage of satisfaction and performance was positive but weak. Although Organ (1988) found a high probability of the existence of a functional S-P relationship, and Judge et al. (2001) obtained a 0.30 mean true correlation by conducting a meta-analysis, significant evidence of both directional models was still lacking. Our findings for this model to test the S-P links of construction contractors were similarly insignificant. However, these results are sufficiently counterintuitive for research to continue in the measurement and estimation of project participant satisfaction in order to improve satisfaction (e.g. Soetanto and Proverbs, 2002; Leung, 2004; Li, Ng and Cheung, 2013; Masrom, 2013;

Xiong et al., 2014). This suggests the solution to the S-P problem is more complex than previously realized. Therefore, unlike previous empirical work, which assumed that all satisfaction facets share common unidirectional relationships with performance (e.g. Lai, 2007), the Model 2 presented here hypothesizes that *PS* had a positive effect on *CPMP* and *CPMP* positively affected *ES*. In addition to providing a satisfactory R^2 explanatory ability of Model 2, the hypothesized paths were significant. The conflicting relationships of the two satisfaction dimensions on performance validated here may also explain some of the previous findings at the individual level. For example, Lai (2007) found noneconomic satisfaction to be much stronger than economic satisfaction in determining the influence of decision strategies on performance. This suggests that a key problem of the theoretical debate on the S-P nexus to be the conflicting dimensions of satisfaction, which has important implications for future research at both individual and organizational levels.

Conclusions

The nature of the nexus between satisfaction and performance has been debated for decades without a satisfactory resolution. This paper provided results of the empirical validation of the hypothesized conceptual models among construction project participants. The results demonstrated that the definitions of satisfaction and performance should be more specific when discussing the S-P nexus. The findings of the disaggregated sub-dimensions of contractor satisfaction and the different directional relationships between contractor satisfaction sub-dimensions and contractor performance offered an innovative and reasonable way to understand the S-P nexus among project participants, which has significant implications for future research and practice.

This study was consistent with findings of previous studies in that other participant performance factors are critical to contractor performance. In addition, production-related satisfaction (*PS*) was found to mediate the effects of the factors on contractor performance. Future similar studies are encouraged to identify common antecedent variables (e.g. *OC* and *DP*) of the S-P nexus, as well as critical factors to *PS* (e.g. safety climate). Contractor performance could be improved by improving these aspects.

A further contribution was the comprehensive use of CB-SEM and PLS-SEM in solving the research problem. Although CB-SEM and PLS-SEM are increasingly used in social science studies, they are rarely used together in the same research (Hair, Ringle and Sarstedt, 2012). This study combined the advantages of both approaches to provide a suitable model development procedure for testing the formative-reflective construct in the first step and then disaggregating the formative component in the second step. This can be seen as a good demonstration of using both methods simultaneously and provides a reference for similar future research.

Being a pioneer study of the organizational satisfaction-performance nexus, the research was limited by the measures for satisfaction and performance being less well established than such widely used scales as JDI and MSQ for individual satisfaction. Building a comprehensive analysis framework (e.g., considering organizational citizenship behaviour, further classifying project quality into project quality and process quality, and considering the dimension of relational satisfaction) will be beneficial for further studies, otherwise the inconsistency of measures may lead to a significant bias and difficulty in conducting comprehensive analyses (e.g. meta-analysis). The framework also needs to be sufficiently flexible since the items to measure noneconomic satisfaction may be different for different industries and working roles.

This study contributed to this aspect by demonstrating the necessity to distinguish between economic and noneconomic dimensions. Another limitation is that, although two antecedent variables and one control variable were considered here, some potential moderators may exist between satisfaction and performance. For example, for trust among project participants, one possible situation is that when trust is high, the positive link between noneconomic satisfaction and performance will be larger, and *vice versa*. Similarly, design errors are likely to have an influencing role. Additionally, public/private sector differences, industry differences, cultural differences, and country differences are also possible as well as changes over time. Future research will therefore benefit from identifying the influence of potential antecedents, mediators, and moderators. Although the hypotheses were verified by evidence at the time of the research from the Malaysian construction industry, which is typical of the construction industries in most market economies, the relevance of our results to other industries and other countries is uncertain: more empirical studies are needed of different industries, contexts and time periods to understand the bigger picture. Similarly, the effects of stakeholders other than owners and designers are in need of further investigation; it would be beneficial to test the hypothesis that noneconomic satisfaction positively affects performance, and performance positively affects economic satisfaction at the individual level; and it would be interesting to investigate the use of the PLS and CB models in a single research to see how they complement each other and which offers a more accurate predictive power.

Finally, this study only focused on the relationships between satisfaction and performance of project participating companies. Further studies are needed to explore such cross-level influences as the impact of perceived organizational economic/noneconomic satisfaction on individual performance, organizational performance on individual satisfaction, and *vice versa*. Additional work is also needed to understand on how these findings could be of practical benefit in creating harmonious relationships between participants. Despite this study being derived in the context of the Malaysia construction industry, the models developed, and findings provided are likely to be useful for other industries and countries in understanding and improving project planning, implementation, and outcome assessments.

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Declaration of interest

There are no conflicts of interest.

Data availability

The data are available from the authors.

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