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Value Co-Creation Approach to Management of Construction Project Stakeholders

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Abstract: This article explores the link between value co-creation, a project's success and satisfaction of the project's stakeholders. It also looks at how a project's success mediates the relationship between value co-creation and the stakeholder's satisfaction. A quantitative approach with an online questionnaire was used to collect data from a sample of 140 respondents in Ghana. Data were analysed using partial least square structural equation modelling (PLS-SEM). The results show that value co-creation positively and significantly relates to a project's success and stakeholder satisfaction. The findings also support that a project's success mediates the impact of value co-creation on the stakeholders' satisfaction. Based on these findings, we suggest that project managers be critical about the type of value co-creation strategy they will use to engage project stakeholders. This would apply when adopting the value co-creation approach to manage their projects while not sacrificing success. This study focused on the impact of value co-creation on a project's success and its stakeholder's satisfaction. The survey data were collected only to evaluate the overall effect of value-co-creation on the success and stakeholder's satisfaction of projects. The adoption and implementation of value co-creation in project management may enhance the definition of the project's scope, performance specifications and other criteria used to measure the success of a project, to meet the needs of stakeholders. By empirically presenting a project's success as a key mediator in shaping the effect of adopting value co-creation in project management on the stakeholder's satisfaction, this study laid a foundation for further theoretical explorations involving value co-creation in project management.

Keywords: Value co-creation, Project stakeholder management, Project success, Stakeholder satisfaction, Project management

INTRODUCTION

The number of project failures recorded over past decades had exposed flaws in the conventional approaches to project management. These failures reflect the need for new and dynamic approaches, such as value co-creation (Cohen, Rozenes and Horowitz, 2017). The adoption of the value co-creation approach towards project management is highly recommended. This is due to the complexity, non-routine and one-time effort of projects. In addition, projects are often limited by time, budget, resources and performance specifications which are designed to meet customer needs. Projects also require good collaboration, consistent relational engagement and innovativeness across its lifespan (Rojas, Liu and Lu,

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2018; Chang et al., 2013; Matinheikki et al., 2016; Mele, 2011; Rod, Lindsay and Ellis, 2014; Nord, 2012; Liu, Fellows and Chan, 2014; Aarikka-Stenroos and Jaakkola, 2012; Jacobsson and Roth, 2014).

The major goal of a project is to satisfy the needs of all stakeholders involved in the project. Freeman (1984: 4) defined stakeholders as "any group or individual who is affected by or can affect the achievement of an organisation's objective". A project's stakeholders are individuals or organisations that may have either a positive or negative impact on the project. The successful engagement and effective participations of stakeholders throughout a project's life cycle are critical to its success.

Co-creation in projects encourages proactive engagement of a project's stakeholders in different phases of the project's life cycle, contributing to its success (Gajic et al., 2014). Co-creation occurs through effective and consistent interactions between the project manager, project team and all possible stakeholders (Smyth, Lecoeuvre and Vaesken, 2018). Cohen, Rozenes and Horowitz (2017) added that value co-creation in a project environment is a collaborative design process of engaging project stakeholders throughout the project's life cycle. The concept of value co-creation has been widely researched on across literature in the fields of management and marketing (e.g., Payne, Storbacka and Frow, 2008; Spohrer and Maglio, 2008; Edvardsson, Tronvoll and Gruber, 2011). Wei and Lam (2014) indicated that stakeholders must be involved throughout the project's life cycle to facilitate its success and ensure stakeholder's satisfaction.

In the project management context, the value co-creation approach is a new way of managing the project itself, its team, customers, sponsors and all possible stakeholders (Cohen, Rozenes and Horowitz, 2017). Value is a concept that is often understood in vague terms and is sometimes used interchangeably with words such as benefit, outcome and worth, in project management research (Schryen, 2013; Zwikael and Smyrk, 2012). To understand value co-creation in construction projects, Fuentes and Smyth (2016a) and Haddadi, Johansen and Andersen (2016) provided a framework that enables a project to move the focus of enablers from the project's perspective to a more prolonged perspective.

Alhava, Laine and Kiviniemi's (2015) investigation of an intensive big room process for co-creating value in legacy construction projects, revealed that service logic and value co-creation are unique strategies in a standard contract-based environment. They provide significant benefits to companies that are able to adopt these concepts into their business models. Similarly, Smyth, Lecoeuvre and Vaesken's (2018) qualitative study on the co-creation of value in projects showed that decision-making extends beyond the time-cost-quality/scope dimensions. Studies on the use of co-creation in construction projects attest that "the quality and quantity of value co-creation in project management are determined by the relationships, interactions and collaborations between the stakeholders and the construction firm" (Liu, Fellows and Chan, 2014).

However, value co-creation has not yet been thoroughly studied in the context of the management of construction projects (Keränen and Jalkala 2013; Liu, Fellows and Chan, 2014; Fuentes and Smyth, 2016b; Razmdoost and Smyth, 2016; Rojas, Liu and Lu, 2018). According to Liu, Fellows and Chan (2014), although there has been extensive research on ways to improve the performance of construction projects, there is still a dearth of research on the importance of the value co-creation process in project management. Similarly, most research studies in the past on value co-creation focused on its value in routine services, which are

unlike projects which are non-routine and temporary endeavours (Keränen and Jalkala 2013; Razmdoost and Smyth, 2016). Therefore, Fuentes and Smyth (2016b) recommended that more research needs to be conducted on how value co-creation could improve the outcomes of construction projects. Likewise, Rojas, Liu and Lu (2018) uncovered that value co-creation does not positively influence all types of projects, therefore, further investigation should be conducted on the impact of value co-creation on stakeholders, using data from a wider spectrum of project stakeholders within their population.

In addition, previous studies have either examined the relationships between value-co creation and a project's success or value co-creation and project stakeholder satisfaction alone (see Rojas, Liu and Lu, 2018; Keeys and Huemann, 2017). For instance, Rojas, Liu and Lu (2018) examined value co-creation and a project's success, while Keeys and Huemann (2017) investigated the effect of co-creation towards sustainable development of a project. The uniqueness of this research is to empirically examine value co-creation, a project's success and stakeholder's satisfaction concurrently. This research highlights how the value co-creation approach in projects leads to success and satisfaction of stakeholders. The article also examines the mediating effect of the project's success towards the relationship between value co-creation and stakeholder satisfaction.

LITERATURE REVIEW

Value Co-Creation in Project Management

Vargo and Lusch originally used the terms co-creation in 2004 (Vargo and Lusch, 2004) and later refined the concept in Lusch and Vargo (2014). Value is not static; it shifts based on past experiences, present realisations and future anticipations (Grönroos and Voima, 2013). According to Roser, Defillippi and Samson (2013: 4), "co-creation is an interactive, creative and social process between stakeholders that is initiated by the firm" (i.e., service provider). Vargo and Lusch (2016) indicate that value co-creation is where organisations and individuals/stakeholders are interdependent in creating value for customers.

Studies have shown value is co-created when organisations practice stakeholder engagement, co-production, self-service, improving customer experience, problem-solving, dialogue, co-designing and co-developing firm products and services (Alexander and Jaakkola, 2016; Gebauer, Fischer and Fleisch, 2010). In other words, value is jointly created by stakeholders and firms (Vargo and Lusch, 2016). Furthermore, because stakeholders co-create the end product with the organisation, they would feel responsible for and be more satisfied with the outcome.

In examining co-value creation in project management, Fuentes and Smyth (2016a) argued that co-creation of value needs to be managed before a service is in use. This notion however is in contrary to current trends reported in the marketing literature. Haddadi, Johansen and Andersen (2016) proposed a method that helps understand the user's strategic objectives and used this knowledge to optimize the design of buildings, to enhance the value creation of the building projects. Their study revealed that value in a project's life cycle is achieved when the needs and goals of the project are achieved. Smyth, Lecoeuvre and Vaesken (2018) applied service-dominant logic (SDL) to analyse a megaproject as a single case study in a

nuclear power station in the United Kingdom. Their findings revealed that matters relating to value are often overlooked; instead, stakeholders and individual actors focused upon managing political and financial risks, especially time and cost.

The literature review (summarised in Table 1) indicates that little empirical work focused on value co-creation in project management. The present study specifically and concurrently examines value co-creation, the project's success and its stakeholder's satisfaction. Thus, this research may contribute to the literature on project management.

Table 1. Summary of related literature on value co-creation in the management of various project

Source(s)	Focus	Factors	Method	Context	Findings
Smyth, Lecoeuvre and Vaesken (2018)	Co-creation of value and the context of projects	Cost; Time; Scope	Case study	Nuclear power station (United Kingdom)	The primary findings showed that decision-making had ramifications beyond the time-cost-quality/scope criteria of project management.
Alhava, Laine and Kiviniemi (2015)	Intensive big room process for co-creating value in legacy construction projects	Value creation with the customer; Integrated project delivery and integrated concurrent engineering	Case study	Intensive big room process (Finland)	This article presents a new method of combining a collaborative design process, requirement management and intensive big room (IBR) in a small sub-process—locking and ironmongery—in legacy construction project models.
Rojas, Liu and Lu (2018)	Moderated effect of value co-creation on project performance	Value co-creation process; Project performance, of a construction project	Cross-sectional survey	Construction industry (China)	Value co-creation process was underpinned through relational engagement, collaboration and innovativeness. These measures positively impacted the project's performance, while requirement uncertainty moderated this relationship.
Keeys and Huemann (2017)	Project benefits co-creation: Shaping sustainable development benefits	Stakeholder co-creation; Project sustainable development benefits	Exploratory case study	Construction industry (Norway)	The findings demonstrate how stakeholder co-creation enables the shaping of project service design benefits.

(*Continued on next page*)

Table 1. *Continued*

Source(s)	Focus	Factors	Method	Context	Findings
Murthy et al. (2016)	An empirical investigation of the antecedents of value co-creation in business-to-business (B2B) information technology (IT) services outsourcing	Antecedents of value co-creation in IT services outsourcing	An empirical study (quantitative)	IT outsourcing projects (India)	The study found six antecedents of value co-creation in IT services outsourcing. They are alliance relationship, strategic intent, service actualisation, intrapreneurship, collective capabilities and resource management.
Haddadi, Johansen and Andersen (2016)	A conceptual framework to enhance value creation in construction projects	Developing a framework to improve value creation in construction projects	Qualitative research	Construction industry (Norway)	The research revealed that value in a project's life cycle perspective is created when needs are fulfilled and strategic goals are achieved. From a project perspective, the efficiency and effectiveness of suppliers are also of importance.

HYPOTHESES

Value Co-Creation and Project's Success

Projects are designed and constructed to meet the needs and expectations of a wide variety of project participants and stakeholders. However, multiple stakeholders with different interests, expectations and influences, makes it very challenging to determine the success of a project. Although there has been much discussion on the nature and definition of a project's success, no consensus has emerged (Bannerman, 2008). Nevertheless, there is also a lack of common criteria which can be used to measure a project's success in the context of project management. The success of every project is determined by what is called the triple bottom constraints, which is to complete a project within the bounds of the most immediate design parameters (time, cost and scope). This meant that a successful project is one that is on time, on budget and within the design scope.

According to Bannerman (2008), a project's success variously refers to completion which is "on time, within budget, [and] to specification", the success of the product produced or success in achieving the business objectives of the project. Rojas, Liu and Lu (2018) conducted a study on the moderated effect of value co-creation on a project's performance using data from a cross-sectional survey of 120 Chilean construction project managers. The study concluded that value co-creation relates significantly and positively to a project's success and performance. Similarly, the results of Corsaro (2019) revealed that the value co-

creation process positively influences the success of a project. The results further pointed out that the management of value co-creation implies the consideration of complex interconnecting patterns with other value processes.

Savolainen et al. (2018) researched on indicators of collaborative design management in construction projects using a quantitative user satisfaction survey. The study also employed a qualitative analysis of the documentations from the case project, as a form of strategised data collection. The analysis revealed a significant positive relationship between value co-creation and the project's quality performance. This would reflect that when project stakeholders are involved in value co-creation, the chances of the project to be successful are very high. Therefore, it is hypothesised that:

H_1: Value co-creation is positively related to the success of construction projects.

Value Co-Creation and Stakeholders' Satisfaction

Customer satisfaction equates to how products and services from a firm meet the customer's expectations (Kim and Choi, 2013). Customer satisfaction is evoked by the customer's experience with a particular company (Terpstra and Verbeeten, 2014). Additionally, the satisfaction of project stakeholders has become a prominent criterion to measure a project's success, in addition to the traditional determinants of cost, quality and time (Davis, 2016). Stakeholder's satisfaction in construction projects is difficult to measure since individual stakeholders have different views on when a project is considered a success.

A study by Savolainen et al. (2018) revealed that a high level of quality in customer satisfaction is attained when construction firms or project-based firms practice value co-creation involving stakeholders. McHugh, Domegan and Duane (2018) agrees with Savolainen et al. (2018) that value co-creation with stakeholders improves their satisfaction towards the project. Both studies further revealed that co-creating value "with" stakeholders rather than "on" their behalf can build bridges and transform societies. Similarly, Sahi, Sehgal and Sharma (2017) revealed that value co-creation is a platform where customers should proactively participate. Architects are able to promote this proactiveness by acknowledging the customer's ideas and suggestions and this have resulted in a significant positive impact on customer's satisfaction.

It was also found that a project's customers and other stakeholders usually recommend and promote a construction firm to others through a positive word-of-mouth when they are allowed to participate in value creation (Sahi, Sehgal and Sharma, 2017). In support to the work by Sahi, Sehgal and Sharma (2017) and Firend and Langroudi (2016) reported that value co-creation activities have a positive impact on consumer satisfaction in the Southeast Asian manufacturing sector. According to Grisseman and Stokburger-Sauer (2012), the degree of which the stakeholders are involved in value co-creation positively influences their satisfaction towards the firm, as well as that of the customer's. Therefore, it is hypothesised that:

H_2: Value co-creation is positively related to a construction project's stakeholder's satisfaction.

Mediation Effect of Project's Success in the Relationship Between Value Co-Creation and Stakeholder's Satisfaction

Research has also shown that there is an indirect relationship between value co-creation and stakeholder's satisfaction in the marketing, management and project management literature. Markovic and Bagherzadeh (2018) in their study conducted on 1,516 Spanish firms, concluded that the breadth of external stakeholder co-creation is not directly related to the innovation's performance but rather knowledge sharing, followed by product innovation. The findings of Keeys and Huemann (2017) demonstrated that value co-creation with stakeholders enables the sustainable development of a project, which in turn creates stakeholder's satisfaction. Implementing value co-creation will help decision-makers to move their focus from what is best for the project to what is best for the users, the owner and all other possible stakeholders of the project (Haddadi, Johansen and Andersen, 2016). Therefore, it is hypothesised that:

H_3: Success of a project will mediate the relationship between value co-creation and stakeholder's satisfaction.

The aforementioned discussion can be summarised in a conceptual model depicted in Figure 1.

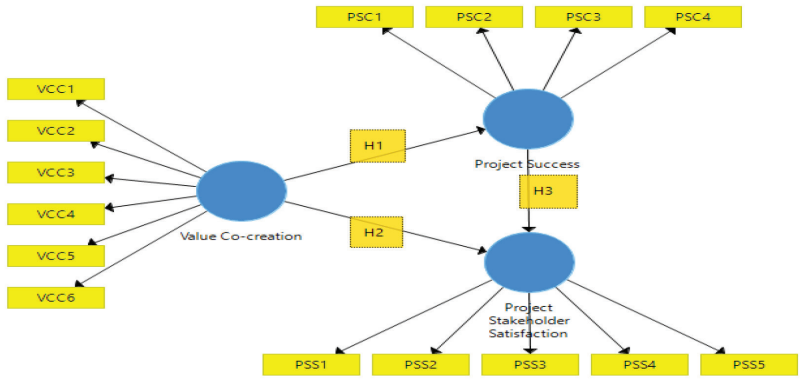

Figure 1. Relationships between value co-creation, project success and stakeholder's satisfaction

RESEARCH METHODOLOGY

This research adopted a quantitative approach to address the research problem. Sekaran and Bougie (2013) emphasised that the quantitative approach requires the research to be consistent with a positivist philosophy. The justification for using this research paradigm to test the relationship between value co-creation, project success and project stakeholder satisfaction is its frequent use in recent studies on the co-creation of value in project management (see Rojas, Liu and Lu, 2018; Savolainen et al., 2018; Sahi, Sehgal and Sharma, 2017; Demirkesen and Ozorhon, 2017).

Sampling and Data Collection

This study employs a correlational design to examine the relationships between value co-creation, project success and stakeholder's satisfaction. Correlational research is a type of non-experimental measurement of two variables and assesses the statistical relationship between them with little or no effort to control extraneous variables. To examine the conceptual model generated and test these relationships, an online survey instrument was designed and measurement scales were developed. The draft questionnaire was constructed and validity of the scales checked and improved. A revised questionnaire was finalised and used to collect data via the Kwiksurveys platform (https://kwiksurveys.com/s/WZdiMcAi). To test the study's hypotheses, data were collected from a sample of 140 project directors, managers, contractors, consultants, engineers, leaders and team members in Ghana through the online survey questionnaire. The questions on the questionnaire were structured using the 7-point Likert scale format (7 = Completely Agree and 1 = Completely Disagree).

Analysis of the demographic data revealed that 62.9% of the respondents were male and 37.1% were female. We also found that the majority (42.9%) of the respondents were 30 years old to 35 years old, followed by the 25 years old to 29 years old age group which represented 40% of total respondents. Also, a significant 78.6% of the respondents are first-degree holders while 20% and 1.4% of them, respectively, have a master's and doctorate degree as their higher education. The results showed that 51.4% of the respondents have been involved in building construction projects, 24.3% took part in road construction projects and the remaining 24.3% previously worked in other kinds of construction projects. The respondents who participated in the study consisted of 14.3% project managers and directors, 11.4% project contractors, 4.3% project consultants, 31.4% project leaders, 34.3% project team members and 4.3% project engineers. Additionally, 55.7% of the respondents indicated that they have had training in project management. Finally, 61.4% of the total respondents revealed that they have two years to five years of working experience in construction project management followed by less than two years (16.4%) and six years to nine years (15.7%).

Measures

Scales in the questionnaire were provided for items representing the respondents' opinion about value co-creation involving stakeholders, the project's success and stakeholder's satisfaction of their companies. Multi-item scales were used to measure each construct in the study. All the constructs and measurements were valid and reliable because they have been used and tested by past scholars in the study area (Rojas, Liu and Lu, 2018; Sahi, Sehgal and Sharma, 2017; Zheng, 2017).

We generated the questionnaire items by reviewing existing literature on value co-creation, project success and stakeholders' satisfaction. All the measures used in the study were adopted from previous studies.

Value co-creation was measured using nine items or criteria, each adapted from Rojas, Liu and Lu (2018) and Sahi, Sehgal and Sharma (2017); for example, VCC1 "Host communities' alignment/involvement throughout the project". Project success was measured using three items taken from Zheng (2017) and Sahi, Sehgal and Sharma, (2017). Project stakeholder satisfaction was measured with five items derived from Rojas, Liu and Lu (2018) and Sahi, Sehgal and Sharma (2017). For

instance, for PSS1, one of the questions was "How do you rate the project sponsor's satisfaction with the project's deliverables?". All items were anchored with a 7-point Likert scale (7 = Completely Agree and 1 = Completely Disagree).

Evaluation of the Measurement Model

The most important measurement models used to evaluate the predictive capability of a study model are internal consistency (Cronbach's alpha and composite reliability), convergent validity (indicator reliability, average variance extracted [AVE]) and discriminant validity (cross-loading and heterotrait-monotrait [HTMT] ratio). The estimation results for the measurement model are presented in Tables 2 and 3. Cronbach's alpha and composite reliability were used to measure the reliability of the internal consistency. Results of the partial least square structural equation modelling (PLS-SEM) algorithm report shows that all the values met the accepted value of 0.7 (Henseler, Ringle and Sarstedt, 2015; Hair et al., 2016; Nunnally, 1978). Meeting the accepted value validated that the questions used to measure the constructs were reliable.

Table 2. Evaluation of the measurement model

Latent Variables	Indicators	Internal Consistency Reliability		Convergent Validity		Discriminant Validity
		Composite Reliability	Cronbach's Alpha	Loading	AVE	
		0.6–9.0	0.6–0.9	> 0.7	> 0.5	HTMT Confidence Interval Does Not Include 1
Value co-creation	VCC1	0.939	0.920	0.734	0.723	Yes
	VCC2			0.951		
	VCC3			0.948		
	VCC4			0.670		
	VCC5			0.851		
	VCC6			0.906		
Project success	PSC1	0.88	0.825	0.595	0.670	Yes
	PSC2			0.953		
	PSC3			0.852		
	PSC4			0.830		
Project stakeholder satisfaction	PSS1	0.903	0.865	0.671	0.657	Yes
	PSS2			0.959		
	PSS3			0.610		
	PSS4			0.947		
	PSS5			0.805		

Table 3. Cross-loading results

Indicators	Project Success	Project Stakeholder Satisfaction	Value Co-creation
PSC1	0.595	0.573	0.590
PSC2	0.953	0.853	0.895
PSC3	0.852	0.734	0.745
PSC4	0.830	0.765	0.784
PSS1	0.545	0.671	0.560
PSS2	0.913	0.959	0.952
PSS3	0.367	0.610	0.452
PSS4	0.911	0.947	0.946
PSS5	0.747	0.805	0.702
VCC1	0.688	0.652	0.734
VCC2	0.892	0.887	0.951
VCC3	0.911	0.928	0.948
VCC4	0.583	0.550	0.670
VCC5	0.779	0.774	0.851
VCC6	0.843	0.878	0.906

To evaluate the extent to which the measures of the same constructs positively correlated with each other, the outer loadings of the indicators and AVEs were calculated. Results of the PLS-SEM algorithm revealed that all loadings (except loadings VCC4, PSC1 and PSS3) and AVEs are greater than the recommended threshold of 0.7 and 0.5, respectively. This suggested that an adequate convergent validity and fulfils all the acceptable criteria (Henseler, Ringle and Sarstedt, 2015; Hair et al., 2016; Bagozzi and Yi, 1988; Fornell and Larcker, 1981).

To test the construct's uniqueness or the extent to which a construct is truly distinct from the other constructs, discriminant validity evaluation was used. Cross-loading analysis (as shown in Table 2) was also performed to test the discriminant validity, while the PLS-SEM algorithm report showed that all the indicator's outer loading on the associated construct was greater than all of its loadings on other constructs. Therefore, the cross-loading and discriminant validity criteria for PLS-SEM was fulfilled (Henseler, Ringle and Sarstedt, 2015; Hair et al., 2016; Chin, 2010; Fornell and Larcker, 1981).

Finally, we tested whether the HTMT values were significantly different from 1 (Henseler, Ringle and Sarstedt, 2015) and the confidence internals bias-corrected results in the bootstrapping report showed that all numbers are different from 1. The PLS-SEM algorithm and bootstrapping reports of the SmartPLS analysis showed that the measures used were internally consistent, reliable and adequately valid.

Data Analysis

The relationships in Figure 1 were analysed using PLS-SEM and SmartPLS 3.2.2 software. PLS-SEM method was used instead of the traditional covariance-based technique (CB-SEM) because CB-SEM requires a large sample size (Kline, 2012; Henseler, Ringle and Sarstedt, 2015; Hair et al., 2016). In addition, the PLS-SEM method was preferred based on the objective to explain the variance (prediction of the constructs). The first step in applying the PLS-SEM method was the outer model's validation and the second was the inner model path's calculation.

Validating the outer model consisted of determining the convergent and discriminant validity as well as the reliability of the constructs (Henseler, Ringle and Sarstedt, 2015; Hair, Ringle and Sarstedt, 2013; Hair et al., 2016). Once the model was validated, assessment of the PLS-SEM results of the inner model was fitted-in by calculating the path's coefficients, collinearity, coefficients of determinants (R^2 value), effect size (f^2), blindfolding, predictive relevance (Q^2) and effect size (q^2). The significance of the results was demonstrated through bootstrapping. To examine the mediating effect of the project's success in the relationship between value co-creation and stakeholder's satisfaction, the bootstrapping analysis was employed.

FINDINGS

Assessing the Structural Model

Results of the PLS-SEM structural model were assessed by examining the model's predictive capabilities and relationships between the constructs. Firstly, a collinearity assessment was done to identify any potential collinearity of the indicators. The collinearity statistics indicated that values of the variance inflated factors (VIF) for value co-creation (1.000), project success (4.507) and stakeholder's satisfaction (4.507) were below 5, demonstrating that there were no collinearity problems (Hair, Ringle and Sarstedt, 2011; Hair et al., 2016).

The next procedure of the PLS-SEM was determining the path coefficients, which is the coefficient linking of constructs in the structural model and represents the hypothesised relationship or the strength of the relationship. Results of both the inner model path coefficients and the outer loadings are depicted in Figure 2.

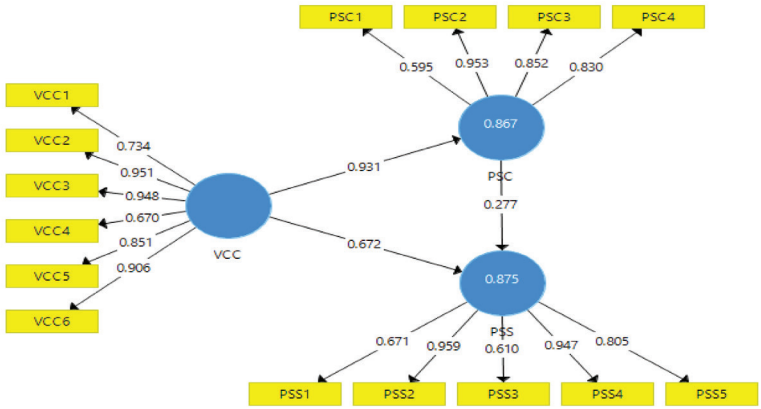

Figure 2. Result of PLS algorithm with path coefficient and R^2 values
Notes: PSC = Project stakeholder satisfaction; PSS = Project stakeholder satisfaction; VCC = Value co-creation

Assessing the structural model, bootstrapping was used to assess the significance of the path coefficients at a minimum number of bootstrap samples with 5,000 valid observations (Hair et al., 2016). This helped to compute the empirical *t*- and *p*-values for all structural path coefficients. The SmartPLS bootstrapping report is summarised in Table 4.

Path Coefficients and Direct Effects

The results of path coefficients and direct effects shown in Table 4 are used to examine H_1 and H_2.

H_1: Value co-creation is positively related to construction project success.

H_2: Value co-creation is positively related to a construction project's stakeholder's satisfaction.

Table 4. A summary of the path coefficient estimates, *t*-values and *p*-values

Direct Effects	Path Co-Efficient	Mean	Standard Deviation	*T* Statistics	Critical Value	Statistically Significant	*p*-Values	Critical Value	Statistically Significant
PSC → PSS	0.277	0.281	0.090	3.080	1.96	Yes	0.002	0.05	Yes
VCC → PSC	0.931	0.932	0.008	123.170	1.96	Yes	–	0.05	Yes
VCC → PSS	0.672	0.669	0.089	7.584	1.96	Yes	–	0.05	Yes

Results of the bootstrapping analysis revealed that value co-creation is significantly, directly and positively related to the construction project's success (path coefficients = 0.931, $p < 0.05$ and $t < 1.96$). This result supports H_1 of the study. Furthermore, the study found that there is a significant positive and direct relationship between value co-creation and stakeholder's satisfaction of the project (path coefficients = 0.672, $p < 0.05$ and $t < 1.96$). This result supports H_2. These findings indicate that the impact value co-creation had on a project's success is much stronger than the impact on stakeholder's satisfaction.

Mediation (Indirect) Effect

Bootstrapping analysis was also performed to test the indirect effect identified in H_3. Findings on H_3 are presented in Table 5.

H_3: A project's success will mediate the relationship between value co-creation and stakeholder's satisfaction.

The path analysis results revealed that a project's success mediates the relationship between value co-creation and stakeholder's satisfaction (path coefficients. = 0.258, $p < .05$). The result supports the indirect effect of value co-creation on stakeholder's satisfaction through the project's success (H_3). This type of mediation is called complementary mediation (Nitzl, Roldán and Cepeda, 2016; Hair et al., 2016), because both the indirect and direct effects are significant and point to the same direction.

Table 5. Indirect effect (mediation)

Mean, standard deviation (STDEV), *t*-values, *p*-values

	Original Sample (O)	**Sample Mean (M)**	**STDEV**	***T* Statistics (O/STDEV)**	***p*-Values**
VCC → PSC → PSS	0.258	0.262	0.084	3.081	0.002

The Coefficient of Determination (R^2) and Effect Size (f^2)

The PLS-SEM algorithm was calculated for the R^2 results and f^2 (as shown in Table 6). The coefficient of determination (R^2 value) shows the structural model's predictive accuracy and is calculated as the squared correlation between a specific endogenous construct's actual and predicted values (Hair et al., 2014). R^2 represents the amount of variance in the endogenous constructs explained by all the exogenous constructs linked to it (Hair et al., 2014).

The R^2 results revealed that an acceptable part of the constructs' variance can be explained by the model ($R^2 = 0.867$ and 0.875, for the PSC and PSS constructs, respectively). The R^2 value ranged from 0 to 1 and a value near 1 indicated a high predictive accuracy. These findings demonstrate that value co-creation can more substantially predict both the project's success and stakeholder's satisfaction (Hair,

Ringle and Sarstedt, 2011; Henseler, Ringle and Sinkovics, 2009; Chin, 1998). We also assessed the effect size (f^2) of each exogenous construct for its impact on the endogenous constructs. According to Cohen (1988), f^2 values of 0.02, 0.15 and 0.35, represent small, medium and large effects, respectively, of the exogenous latent variable (Cohen, 1988). The results revealed that the effect size of all variables was large (> 0.35).

Table 6. Coefficient of determination (R^2) and effect size (f^2)

Constructs	R^2	R^2 Adjusted	Predicting Accuracy	Constructs	F^2			
					PSC	PSS	VCC	Effect Size
PSC	0.867	0.866	Substantial	PSC		0.082		Large
PSS	0.875	0.873	Substantial	PSS				
				VCC	6.507	0.480		Large

Blindfolding and Predictive Relevance (Q^2) and Effect Sizes (q^2)

The final procedures of the PLS-SEM are the blindfolding, predictive relevance (Q^2) and effect size (f^2) (as shown in Table 7). While the R^2 values denote predictive accuracy, the predictive relevance (Q^2) indicates the model's predictive relevance, which is called "Stone-Geisser's Q^2 value" (Geisser, 1974; Stone, 1974). The Q^2 value was obtained by the blindfolding procedure for a specified omission distance (D) with a value between 5 and 10 (Hair et al., 2016). Q^2 values larger than zero for a certain reflective endogenous latent variable indicates the path model's predictive relevance for the construct (Hair et al., 2014: 178).

The blindfolding analysis with D value of 7, indicates that the Q^2 value is greater than zero (0.493) and shows that our path model's predictive relevance is high (Hair et al., 2014). Finally, effect size (f^2) was calculated with the formula {q^2 = (Q^2 included – Q^2 excluded)/ (1 – Q^2 included), where Q^2 included and Q^2 excluded are the Q^2 values of the endogenous latent variable when a selected exogenous latent variable is included or excluded from the model}, to assess an exogenous construct's contribution to an endogenous latent variable's Q^2 value. The results show that the exogenous construct (value co-creation) has a large (0.741) predictive relevance for the endogenous construct (project success).

Table 7. The results of the blindfolding and predictive relevance (Q^2) and effect sizes (q^2)

	Q^2 Included			Q^2 Excluded			q^2 = (Q^2 incld – Q^2 excld)/(1 – Q^2 incl)	Effect Size
	SSO	SSE	Q^2 (= 1 – SSE/SSO)	SSO	SSE	Q^2 (= 1 – SSE/ SSO)		
PSC	560.000	257.920	0.539	560.000	560.000			
PSS	700.000	330.476	0.528	700.000	355.078	0.493	0.741	Large
VCC	840.000	840.000						

Notes: SSO = The sum of squared prediction errors based on prediction with mean; SSE = the sum of squared prediction errors based on comparison of the original data and predicted data.

DISCUSSION AND CONCLUSION

The research objectives are to identify the link between value co-creation and a project's success and its stakeholder's satisfaction, in addition to the mediating effect the success has on the relationship between value co-creation and stakeholder's satisfaction. The results of the study revealed that there are high and substantial predictability and large predictive relevance between value co-creation and a project's success. The findings imply that when project managers and project organisations involve project stakeholders throughout the project's life span through collaboration, consultations and stakeholder meetings, the likelihood of the project to be successful is high.

This finding is in line with the results of a study by Rojas, Liu and Lu (2018), which validated that value co-creation relates significantly and positively to a project's success and performance. Similarly, Corsaro (2019) and Savolainen et al. (2018) found that the adoption of a value co-creation approach in project management positively and directly influenced the success of the project. The findings also support Chang et al.'s (2013) study which concluded that the key to a project's success is found in the value created and captured during and after projects, both for the funding organisation as well as for the stakeholders.

Secondly, it was found that value co-creation had a significant positive and direct influence on a project's stakeholder's satisfaction. Additionally, value co-creation had a very strong and substantial predictability and large predictive relevance for stakeholder's satisfaction. The result implies that when the stakeholder is involved in value creation, their needs are met and they become satisfied with the project's performance. This finding is consistent with the results of McHugh, Domegan and Duane (2018), Savolainen et al. (2018), Sahi, Sehgal and Sharma (2017), Keeys and Huemann (2017), Firend and Langroudi (2016), Grisseman and Stokburger-Sauer (2012), Lambert and Enz (2012) and Roggeveen, Tsiros and Grewal (2011).

McHugh, Domegan and Duane (2018) and Savolainen et al. (2018) found a significant positive and direct correlation between value co-creation and stakeholder's satisfaction. Similarly, Sahi, Sehgal and Sharma (2017) revealed that value co-creation has a significant positive impact on customer satisfaction. Keeys and Huemann (2017) and Firend and Langroudi (2016) agreed that addressing stakeholder's concerns towards value through value co-creation positively and directly influences the stakeholder's satisfaction. Finally, Grisseman and Stokburger-Sauer (2012), Lambert and Enz (2012) and Roggeveen, Tsiros and Grewal (2011) found that the degree to which the stakeholders are involved in value co-creation positively influences the customer's and stakeholder's satisfaction with the firm.

Finally, the results of the indirect or mediating effect analyses indicated that value co-creation positively and indirectly influenced stakeholder's satisfaction through the project's success. The mediation effect analysis results indicated that there is a complementary mediation because both the indirect and direct effects are significant and has the same direction (Nitzl, Roldán and Cepeda, 2016; Hair et al., 2016). The results also indicated that a project's success has a greater effect size on stakeholder's satisfaction than value co-creation. These findings suggest that involving stakeholders in the creation of value in project management will not necessarily make them satisfied, but rather until the project's outcomes satisfies all its requirements. This is consistent with Markovic and Bagherzadeh's (2018) study which found that the breadth of the external stakeholder's co-creation is not directly related to performance of the innovation. Furthermore, value co-creation with stakeholders aids the shaping of sustainable development of projects which ultimately creates stakeholder satisfaction (Keeys and Huemann, 2017).

Research Implications

This study fortifies several research implications in existing theories in value co-creation, previous project management research studies and studies on stakeholder satisfaction. Even though there is an ever-growing body of literature that investigates value co-creation and satisfaction, fewer exists on value co-creation in the management of stakeholders of construction projects. This research is in response to fill this perceived gap in the extant literature, by investigating the linkages between value co-creation and a project's success (schedule, budget, scope and quality) and stakeholder's satisfaction.

Majority of the studies in the past were conceptual (Haddadi, Johansen and Andersen, 2016) and qualitative in nature (Smyth, Lecoeuvre and Vaesken, 2018), thus not exploring the cause-and-effect relationships in the context of construction project management. The empirical findings provide evidence of the influence of value co-creation on stakeholder satisfaction of projects through its success (as shown in Figure 3). Thus, the theoretical framework in Figure 3 provides a summary of how value co-creation influences the satisfaction of project stakeholders.

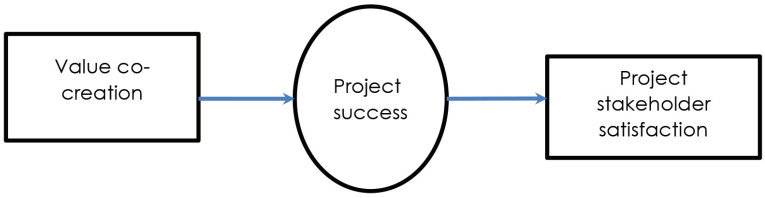

Figure 3. The theoretical framework on value co-creation and project stakeholders' satisfaction

Managerial Implications

This study has some practical and managerial implications. The findings concluded that co-creating value with project stakeholders has a positive impact on the project's success and stakeholder's satisfaction. The adoption and implementation of value co-creation in project management enhanced the definition of the project's scope, performance specifications and other success criteria to meet the stakeholder's needs. Also, when project firms and managers co-create value with stakeholders, it eases the difficulties in changing the project's scope when the need arises.

The adoption of the value co-creation approach in the management of projects should not undermine the success of the project; rather, it has to lead to its success. This study has confirmed that value co-creation impacts stakeholder's satisfaction through the project's success. This would mean that irrespective of the degree of a stakeholder's involvement in the project's value creation process, if it does not lead to success, clients, customers, team members, sponsors and all other possible stakeholders will be dissatisfied. Based on this possibility, we suggest that project managers be critical of the type of value co-creation strategy they will use to engage project stakeholders, when adopting the value co-creation approach to manage their projects while not sacrificing success.

We second scholars who found that the value co-creation approach has a significant positive and direct impact on a project's success. The current study adds to the value co-creation and project management literature with empirical evidence about the positive correlation between value co-creation and a project's success and stakeholder satisfaction. Also, by making project success as a mediator, this article lays a foundation for further theoretical explorations in value co-creation in project management. Finally, we conclude that the adoption of the value co-creation approach to project management has a significant positive direct and indirect impact on stakeholder's satisfaction.

Further research directions

This study focused on the impact of value co-creation on a project's success and stakeholder's satisfaction. The survey data were collected only for the overall effect of value co-creation on the project's success and stakeholder's satisfaction. Therefore, we suggest that future studies on value co-creation in project management should also consider investigating the type of value co-creation strategy or approach that

has a higher impact. In addition, we suggest further studies on the proposed model with a larger sample size from different countries and industries. Finally, we suggest that our model be further tested using the Covariance-based structural equation modelling (CB-SEM) approach.

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