International Journal of Construction Management

ISSN: 1562-3599 (Print) 2331-2327 (Online) Journal homepage: https://www.tandfonline.com/loi/tjcm20

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To cite this article: Ernest Kissi, E. Bannor Boateng, T. Adjei-Kumi & E. Badu (2017) Principal component analysis of challenges facing the implementation of value engineering in public projects in developing countries, International Journal of Construction Management, 17:2, 142-150, DOI: 10.1080/15623599.2016.1233088

To link to this article: https://doi.org/10.1080/15623599.2016.1233088

INTERNATIONAL JOURNAL OF CONSTRUCTION MANAGEMENT, 2017
VOL. 17, NO. 2, 142–150
https://doi.org/10.1080/15623599.2016.1233088

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Principal component analysis of challenges facing the implementation of value engineering in public projects in developing countries

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ABSTRACT

Over the past decade, value engineering (VE) has developed to become a recognized methodology with ordinarily comprehended tools and procedures. Its adoption in public projects in developed countries is credited with meeting stakeholders' expectations. Although this may be so for construction industries in developed countries, the situation is bleak for developing countries. This paper considers the challenges facing the successful implementation of VE in public projects among developing countries. Using an empirical questionnaire survey, respondents were invited to rate their perception of 22 challenges identified from literature. This paper is based on a survey of construction and consulting firms based in Ghana. The data set was subjected to factor analysis. Correlations between the 22 variables show that five key components underlie the challenges facing VE in developing countries. Findings and recommendations of this study may be useful to construction professionals who are seeking innovative ways to enhance value for money.

KEYWORDS

implementation challenges; public projects; value engineering; developing countries

Introduction

Value engineering (VE) originated as a structured methodology during the 1940s in the US manufacturing industry. In 1947, Lawrence D. Miles of General Electric who was charged with maintaining production at a time of limited availability of materials in post-war America established the method as value analysis (Karim et al. 2007). In 1954, the technique was adopted by the US Department of Defense and renamed value engineering (Kelly 2007). In 1959, the formation of the Society of American Value Engineers (SAVE) formalized the term 'value engineering', which is the term mostly used in the USA (Kelly 2007). Therefore, the authors of this paper adopt the term VE throughout this present paper. SAVE International (1998) defined VE as 'the systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for that function, and provide the necessary function reliability at the lowest overall cost' while the Hong Kong Institute of Value Management (HKIVM 1995, p. 5) defined VE as 'a structured, systematic, flexible, team oriented approach for assessing the relationship between function, cost and worth'. Both definitions thus dwell on the function of a product or service. This is wholly satisfied with VE techniques such as the Function Analysis System Technique (FAST) diagram.

Presently, there are numerous challenges facing the construction of public projects in developing countries. Most often reported is the failure to meet deadlines, and to deliver within budget and to the specified quality. Consequently, VE can help to find ways to improve solutions to these challenges by providing a measured balance in cost, schedule, and scope via the generation of a large quantity of innovative alternatives (COEM 1995; Lee et al. 2010; Avege 2014). As put by Ellis et al. (2005, p. 2), VE in the UK construction industry has developed to become 'an established service with commonly understood tools, techniques and style'. However, Bowen et al. (2010) argued that the situation is definitely blurry for developing countries, although this may be so for construction industries in developed economies like Hong Kong, China, UK, USA, etc. – hence the need for this research.

Although some studies have focused on various implementation challenges, none examines the underlying factors of such challenges, especially those encountered in developing countries such as Ghana. Using principal component analysis (PCA), this study aimed to reveal the key challenges facing the successful implementation of VE in public projects among developing countries. This paper commences with the relevance of adopting VE in construction projects globally. This is followed by a description of the research survey design.

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The survey findings are then presented and discussed. Finally, conclusions are drawn and recommendations are made. Although the research concentrates on developing countries, the findings should be relevant to some developed countries, as they face similar problems in terms of implementing VE in their public projects.

Global relevance of adopting VE in construction projects

VE is a globally known concept, utilized all over the world. Apparently, there has been appreciable research into the application of VE within the construction industry over the last three decades (Bowen et al. 2010). Usually, the purpose of implementing VE in projects is to increase performance and minimize costs in all stages of research as well as operational projects (Tohidi 2011). According to Tohidi (2011), the gross aim is to create the best value via tending to cost and performance. They further advocated that, almost half a century since the launch of VE projects, management aptitudes with functional development and growth have been allied with frequency and performance indicators in projects and have obtained maximum proficiency in carrying out projects and optimum value for their project. VE offers extra benefits such as risk reduction, quality improvement, and understanding of customer requirements (Haskins 2010) of knowledge transfer in multi-project settings (Formentini & Romano 2011). Ghorbani and Shokri (2005) suggested that delays in construction which are caused by deficiency in meticulously prepared blueprints as well as budget deficits can be eliminated through persistent application of the VE approach. Globally, VE is perpetually advancing the growth of technology, eradicating the percentage of costs that do not contribute in boosting quality regarding redundant executive costs (Tohidi 2011).

Despite distinct restrictions faced by the VE process in project management, Tohidi (2011) argued that utilizing VE has provided information, identified problem areas, proposed and developed approaches and initiatives, and developed innovative ideas and viewpoints that are incorporated comprehensively, and therefore is to be commended. Not surprising, the Royal Institution of Chartered Surveyors (RICS) has named VE one of the 10 'critical success factors' in seeking to improve value for money. This is because clients are looking for projects that are delivered at the best quality, and hence VE, as put by Tohidi (2011), improves the quality of services and products continuously, and illuminates how to use the methods to balance between the cost and the applications of a product role, and this tends to make VE one of the most significant factors of economic development.

Research methodology

The approach undertaken for this research comprised two components: a literature review, discussed in the previous section, and a self-administered survey. An empirical questionnaire survey was undertaken to explore the challenges facing the implementation of VE in public projects in Ghana. Questionnaires were administered to target industrial practitioners from both construction and consulting firms. Industrial practitioners were identified in assistance with the building directory of the Registrar General of Companies whilst simultaneously merging with the data obtained from GhanaWeb.com (2015) building directory.

The selection of respondents was based on the criteria that respondents must have been involved in a public project as either the consulting or the construction party. Similar selection criteria were adopted by Fong and Shen (2000) and Cheah and Ting (2005) in similar studies. Target respondents were asked to rate the 22 identified factors on a 5-point Likert scale, where 5 denotes very severe, 4 severe, 3 neutral, 2 less severe and 1 not severe. The respondents were required to answer the questions according to actual situations that they had experienced on projects they were working on or had recently completed.

The initial section of the survey includes some items for collecting demographic information of the respondents and their projects, such as respondents' professional background, experience in the construction industry, kind of firm, number of projects undertaken within the last 10 years, whether VE services were provided by their company, and also if their company undertakes internal VE studies within the construction project process. In the second part of the survey, the respondents were asked to rate the challenges facing VE implementation, as shown in Table 1. Blank space was provided for the participant to use if they had their own suggested VE challenges that had not been mentioned in the survey. A follow-up on the questionnaires was initiated to increase the return rate.

A pilot study was undertaken to pre-test the survey, which was subsequently modified before a final version was produced. The survey population targeted architects, civil engineers, quantity surveyors, project managers and contract managers involved in mostly public projects. The survey was conducted by delivering hard copies of questionnaires by hand.

A total of 80 target respondents were identified and survey questionnaires were administered to them. According to Leung (2001), two main objectives must guide questionnaire design – to maximize the response rate and to obtain accurate, relevant information for the

Table 1. Summary of the challenges facing value engineering (VE) implementation in developing countries.

Implementation challenges	Sources
a. Too difficult to get started	Assaf et al. (1996) Palmer et al. (1996)
b. Misconception of high initial implementation cost	Abidin (2005) Daddow and Skitmore (2005) Fowler (1990)
c. Lack of teamwork spirit	Woodhead and Downs (2001) Mirmohammadsadeghi (2005)
d. Lack of support from client	Assaf et al. (1996)
e. Lack of VE culture in most public firms	Assaf et al. (1996) Sigle et al. (1999)
f. Lack of professionalism	Stevens (1999) Abidin (2005) Mirmohammadsadeghi (2005)
g. Stakeholders overestimate VE	Woodhead and Down (2001) Kelly and Male (2002)
h. Lack of practical guidance and construction framework	Abidin (2005)
i. No qualified personnel to conduct the study	Assaf et al. (1996)
j. Reluctance toward efficient utilization of resources	Mirmohammadsadeghi (2005)
k. Cost-oriented procurement system	Clark (2000)
l. Unwillingness to apply VE	Assaf et al. (1996)
m. VE is not worthwhile	Assaf et al. (1996)
n. Inflexibility in contractual provisions	Cheah and Ting (2005)
o. Lack of government/top management support	Assaf et al. (1996) Al-Yami (2008) Cheah and Ting (2005) Daddow and Skitmore (2005) Tohidi (2011)
p. Lack of VE awareness	Sigle et al. (1999) Woodhead and Downs (2001) Cheah and Ting (2005)
q. Too complicated and theoretical	Fong (2004)
r. Projects are designed by best designers so no need of VE	Assaf et al. (1996) Abidin (2005)
s. Indisposition to assign time for VE	Cheah and Ting (2005) Mirmohammadsadeghi (2005)
t. VE will not succeed in developing countries concept	Assaf et al. (1996) Bowen et al. (2010)
u. Lack of knowledge regarding methodology	Cheah and Ting (2005) Mirmohammadsadeghi (2005) Adam (1993) Stokes (1998)
v. Apathy toward taking risks and being creative	Bordass (2000) Daddow and Skitmore (2005) Mirmohammadsadeghi (2005)

survey. A 100% response rate was gathered, due to the fact that the questionnaire administration was done purposively and expanded for a period of three months, through face-to-face encounters where respondents spent at most 45 minutes on the survey, and further clarification was given upon request. Also, the structure of the questionnaire was well planned with thoughts given to some relevant questions to ask, how the questions were asked and the general layout of the questionnaire. As put by Leung (2001), the way a questionnaire is worded has an enormous impact on the nature of information elicited. Consequently, the questionnaire for this study was carefully worded using short and simple sentences. The questions were clear and unambiguous. With the Likert scale ranking, a clear instruction was set out as to how those questions were supposed to be answered. Undoubtedly, with such a high response rate, the survey for this study was found suitable for analysis.

Data collected are presented in tables and were analyzed using factor analysis (PCA) through the International Business Machines Statistical Package for Social Sciences (IBM SPSS) version 21 which was used to identify the number of groupings that could represent the 22 identified implementation challenges. Table 1 shows a compilation of the challenges facing VE implementation specifically in developing countries identified from a thorough review of the germane literature.

Data analysis and discussion

Respondents' information

Table 2 shows information on respondents. The table indicates that 19% of respondents are from consulting firms while 81% of the respondents are from construction firms. Also, the majority of the respondents are

Table 2. Respondents' information.

		Frequency	Percentage
Kind of firm	Consulting	15	18.8
	Construction	65	81.3
	Total	80	100.0
Profession of respondents	Architect	24	30.0
	Civil engineer	20	25.0
	Quantity surveyor	9	11.3
	Project manager	21	26.3
	Contract manager	6	7.5
	Total	80	100.0
Public projects experience	Less than 5 years	7	8.8
	6–10 years	29	36.3
	11 years or more	55	55.0
	Total	80	100.0

architects and project managers, followed closely by civil engineers, in their respective organizations. This makes them the principal decision makers in execution of public projects; therefore, information from them is highly reliable. In addition, 11% of the total respondents are quantity surveyors who are mostly responsible for the cost of works, cost estimates and cost analysis dynamics of various items of work to be executed. Eight percent of the total respondents are contract managers who are usually exposed to the contract administration of projects, and agreements with suppliers concerning specified materials.

Over half of the respondents have more than 11 years of public project experience. This high level of experience gave relevance to the kind and quality of information that was given out. This illustrates that the respondents have significant experience in the field of the study. On the other hand, 36% of the total respondents have between 6 and 10 years of experience in public projects, with 9% of the total respondents having less than 5 years of experience in public projects. The profile of respondents therefore assures the value and reliability of responses.

Factor analysis

Because of the extensive number of dependent variables (22 barriers to VE implementation; see Table 1) involved in this study, there was the likelihood that some of the variables would lead to the same or similar underlying effects; hence, it was essential to embrace a data reduction technique, namely factor analysis, to refine and reduce these items to form a smaller number of coherent subscales (Pallant 2010). Factor analysis is used to identify a small number of factor groupings that can be used to represent sets of many interrelated variables (Norusis 1992). To examine the underlying structure between the 22 implementation challenges identified in this study, the survey response was subjected to this technique.

Regarding the appropriateness of factor analysis for this study, Hair et al. (1998) suggested that factor analysis is suitable for 20–50 variables, as the extraction of common factors becomes inaccurate if the studies conducted by number of variables exceeds this range. Suitably for this study, there were 22 implementation challenges. Similarly, the prior requirements for the appropriate statistical tests (correlation matrix, Kaiser-Meyer-Olkin (KMO), Bartlett's test of sphericity) for the satisfactory use of factor analysis were achieved for this study. Owing to this, it can be concluded that factor analysis is therefore considered appropriate for this study and hence can proceed with full confidence and reliability.

In this study, the value of the test statistic is large (Bartlett's test of sphericity, Chi square = 1851.641) and its associated probability is less than 0.05 (p = 0.000); therefore, the null hypothesis is rejected and suggests that the correlation matrix is not an identity matrix (cf. Osei-Kyei et al. 2014).

Table 4 presents the initial matrix and rotated matrix of the factors. The first four columns represent the initial matrix and the last three columns comprise the rotated matrix, which only shows eigenvalues greater than 1.00 as eigenvalues of less than 1.00 are less influential.

Factor analysis is dependent on the correlation matrix of the variables involved, and the correlations usually require a large size sample before they stabilize (DeCoster 1998). The same technique used for a similar analysis by Hardcastle et al. (2005) with a sample size of 61 respondents, and by Osei-Kyei et al. (2014) with a sample size of 45 respondents, had comparatively low responses, but satisfied all the appropriate statistical tests, was accepted and has been considered worthy (Chan et al. 2010a).

From Table 3, KMO value is 0.586, which is larger than 0.5. Bartlett's test has high sampling adequacy, and thus the data collected via the survey questionnaire is suitable for factor analysis (Norusis 1992). With such a high KMO achieved in this instance, there was no need to produce anti-image matrices to further check the adequacy of the sample size. Each of the variables is therefore loaded heavily on only one of the principal components while the absolute value of the loadings exceeds 0.50.

Table 4 shows the total variance explained by each component, extracted as follows: Component 1

Table 3. Kaiser-Meyer-Olkin (KMO) and Bartlett's test.

KMO measure of sampling adequacy		0.586
Bartlett's test of sphericity	Approx. Chi-square	1851.641
	df	231
	Sig.	0.000

Table 4. Initial matrix and rotated matrix of challenges facing developing countries in implementing value engineering (VE) in public projects.

	Extraction sums of squared loadings			Rotation sums of squared loadings		
Component	Total	Variance (%)	Cumulative %	Total	Variance (%)	Cumulative %
1. VE team obstructions	4.304	19.562	19.562	3.771	17.139	17.139
2. VE study obstructions	3.845	17.476	37.037	3.565	16.207	33.346
3. VE implementation barriers	3.131	14.233	51.271	3.459	15.724	49.070
4. Conceptual problems	2.337	10.624	61.894	2.601	11.823	60.893
5. Developing economies obstructions	2.077	9.441	71.335	2.297	10.442	71.335

Extraction method: principal component analysis.

(17.139%), Component 2 (16.207%), Component 3 (15.724%), Component 4 (11.823%) and Component 5 (10.442%). Thus, the final statistics of the PCA and the components extracted cumulatively explained 71.335% of the variation in the data set and fulfil the cumulative proportion of variance criterion which states that the extracted components should together be at least 50% of the variation; it also satisfies the basic requirement of 60% advocated by Malhotra (1996). Therefore, five factor groupings can be used to adequately represent the data.

The factor grouping based on varimax rotation was adopted, and this is indicated in Table 5. Mostly, varimax is used in orthogonal rotation. Varimax has been used by numerous researchers (Li et al. 2005b; Osei-Kyei et al. 2014). Varimax was used because it simplifies the interpretation of factors as compared to the other rotation methods; with varimax each variable is associated with one of the factors and each factor represents only a small number of variables, which was interpretable (cf. Osei-Kyei et al. 2014). Each of the variables is therefore loaded heavily on only one of the principal components while the absolute value of the loadings exceeds 0.50.

The five components are interpretable as:

- Component 1 represents VE team obstructions;
- Component 2 represents VE study obstructions;
- Component 3 represents VE implementation difficulties;
- Component 4 represents conceptual problems;
- Component 5 represents developing economies obstructions.

Table 5. Challenges facing value engineering (VE) implementation grouping results after rotated factor matrix (loading).

	Component				
Challenges	1	2	3	4	5
Component 1. VE team obstructions					
Too difficult to get started	0.857				
Misconception of high initial implementation cost	0.834				
Lack of teamwork spirit	0.715				
Lack of support from client	0.697				
Component 2. VE study obstructions					
Lack of value management culture in most public firms		0.886			
Lack of professionalism		0.698			
Stakeholders overestimate VE		0.658			
Lack of practical guidance and construction framework		0.641			
No qualified personnel to conduct the study		0.617			
Reluctance toward efficient utilization of resources		0.610			
Component 3. VE implementation difficulties					
Cost-oriented procurement system			0.756		
Not ready to apply it			0.681		
VE is not worthwhile			0.657		
Inflexibility in contractual provisions			0.598		
Lack of government/top management support			0.565		
Lack of VE awareness			0.546		
Component 4. Conceptual problems					
Too complicated and theoretical				0.739	
Projects are designed by best designers so no need for VE				0.712	
Indisposition to assign time for VE				0.667	
Component 5. Developing economies obstructions					
VE will not succeed in developing countries concept					0.909
Lack of knowledge regarding methodology					0.503
Apathy toward taking risks and being creative					0.588

Extraction method: principal component analysis.
Rotation method: varimax with Kaiser normalization.[a]
a. Rotation converged in 12 iterations.

Component 1: VE team obstructions

The principal component accounts for 19.562% of the total variances and contains four specific factors, that is:

i. Misconception of high initial implementation cost;
ii. Lack of teamwork spirit;
iii. Too difficult to get started;
iv. Lack of support from client.

These obstruction factors are all related to the value engineering team. Of the four sub-factors, 'misconception of high initial implementation cost', 'lack of teamwork spirit', and the perception 'too difficult to get started' received high loadings of 0.834, 0.715 and 0.857, respectively, while 'lack of support from client' received 0.697. A study of VE consultants operating in the construction sector in the USA revealed that projected savings made through VE are approximately 30% of the project cost (Abidin 2005). Nevertheless, proposals are frequently implemented partially or in modified form, reducing the average implemented savings to approximately 10% (Palmer et al. 1996). Due to the increase in implementation cost, the VE team is deterred from proceeding with further operations. However, the cost of implementation can impede the progress of VE particularly when the client does not have assurance about the benefits that VE can offer. Accordingly, Daddow and Skitmore (2005) argued that VE decisions sometimes result in extra initial costs in order to achieve longer term benefits.

Usually, most clients and practitioners persist in the old ways, which poses barriers to dissemination that provides alterations in the manner the construction normally operates. Seemingly, some clients feel dissatisfied with VE since the results fails to tally with the prospects (Woodhead & Downs 2001). Undoubtedly, lack of support from the client and integration into the VE team draws back the VE uptake. Also, most project teams work in a series in which the baton of responsibility is handed from one member to another (Abidin 2005). However, in instances where such a flow of responsibility seems to gear toward specifics at frequent times, the goal of the team now seems to be the specific goal. Consequently, the enthusiasm for teamwork is reduced. It is therefore recommended to create VE workshops for construction professionals and synchronize clients' expectations with VE outcomes whilst clarifying clients' perceptions about the methodology.

Component 2: VE study obstructions

Principal component 2 accounts for 17.476% of the total variance of six detailed factors, that is:

i. Lack of VE culture in most public firms;
ii. Lack of professionalism;
iii. Stakeholders overestimate VE;
iv. Lack of practical guidance and construction framework;
v. No qualified personnel to conduct the study;
vi. Reluctance toward efficient utilization of resources.

Woodhead and Down (2001) investigated improving VE capabilities and discovered that there is a possibility of clients overestimating the potential of VE. In the same vein, Kelly and Male (2002) affirmed that VE has attained a level of maturity within construction and manufacturing whereby the style and content of several workshops is rationally predictable. This could make complacency regarding VE study processes abound. Moreover, despite the fact that in VE team members should represent a cross section of the technical fields (Abidin 2005), in some cases, the team members selected do not have the expertise or experience required to confront the problem at hand (Stevens 1999). Also, Sigle et al. (1999) identified in their study that quantity surveyors have the wrong perception of the approach and techniques of VE; hence, quantity surveyors will have to be equipped with special skills to enable them to offer VE as a professional service.

Also, the unwillingness to apply VE on public projects even though it can efficiently utilize available resources tends to make the VE study fictional. Due to the rare application of VE on public projects, the elucidation to explore further is halted. Consequently, to help facilitate the study, qualified personnel are required to conduct the methodology; however, this is bleak in a developing country like Ghana. As seen, most personnel are not experienced and qualified to bring forth proper findings. Unqualified facilitators do not foresee the end process best likely decision within the constraints of the resources they have available within their team. Also, the practical guidance to define terms, describe the essential elements for the effectual implementation of VE and assign responsibilities is lacking. It is therefore recommended to create local guidelines to facilitate the study. VE facilitators should endeavor to broadly acquire knowledge in areas such as project and risk management.

Component 3: VE implementation difficulties

This principal component covers 14.233% of the total variance and consist of six factors. These are:

i. Cost-oriented procurement system;
ii. Unwillingness to apply VE;
iii. Perception that VE is not worthwhile;
iv. Inflexibility in contractual provisions;
v. Lack of government/top management support;
vi. Lack of VE awareness.

A higher loading is given to the factor 'cost-oriented procurement system' of which the significant value is 0.756. Typically, in Ghana, contracts are normally awarded to the lowest bidder instead of on the basis of value for money. For instance, Clark (2000), in an Australian survey, indicated that 43% of industry respondents stated that contracts are commonly awarded according to the lowest up-front cost, rather than value for money, thus illustrating a surprisingly low VE application considering potential benefits asserted. Also, rigidity in contract agreements between the VE team and client shifting risks as well as the culture of procurement system in Ghana tends to enrich inflexibility among contractual provisions. Apparently, the VE process in a range of project managements has encountered restrictions such as the correct application of standards and rules governing the organization (Tohidi 2011). Al-Yami (2008) suggested that the support of top management is very vital to implement the recommendations of a VE study and generate a successful project. Further insights by Cheah and Ting (2005) acquired from a sample of experienced managers (N = 54) attending an international VE training course reveal that the absence of support from those in authority (61%) is a likely cause of its limited application. Seemingly, the perception is that the allocation of resources by management, and the selection and training of the VE team, may not necessarily offer all the requirements (Daddow & Skitmore 2005).

As indicated by Woodhead and Downs (2001), some clients have shallow knowledge concerning the concept. For instance, Sigle et al. (1999), in their study on VE in the South African construction industry, revealed that the concept of VE does not have a niche in the construction industry. They further posit that clients are generally not familiar with the technique of VE and the benefits to be derived afterward. This further correlates with the factor 'unwillingness to apply VE', in that there is the hesitation to apply VE due to external factors such as financing the VE team and their study as well as low publicity about VE achievements. Consequently, the outcome of the VE process seems not of value to the clients since the productive outcomes of VE are less known. It is therefore recommended that the state should integrate laws that will enforce the use of VE on government projects whilst perpetually supporting the concept.

Component 4: Conceptual problems

Principal component 4 accounts for 10.624% of the total variance of obstruction factors and consists of three sub-factors. These are:

i. VE is too complicated and theoretical;
ii. Projects are designed by best designers so no need of VE;
iii. Indisposition to assign time for VE.

Of the three sub-factors, 'VE is too complicated and theoretical' and 'projects are designed by best designers so no need for VE' received high loadings of 0.739 and 0.712, respectively, while the other factor, 'indisposition to assign time for VE', received a loading of 0.667. This proceeds from the obstruction that clients potentially demean VE in order to get it faster and cheaper as they are usually loath to dedicate the time and effort necessary to propel such penetrative thinking, which results in a lack of quality outcome (Abidin 2005). Cheah and Ting's (2005) study revealed that the most challenging obstacle noted by the experienced VE managers (respondents, 65%, N = 54) was the lack of time to implement VE on projects.

This is further coupled with the misconception that there is no need for VE since projects are designed by the best designers. This perception about VE is misleading since VE not only improves the design of elements but also increases performance and minimizes costs in all stages of research as well as operational projects (Tohidi 2011). Hence, VE considers both the designers' view and the cost. Undoubtedly, responses from preliminary surveys have indicated that growth of VE in Kumasi and Ghana as a whole is progressively stagnant. This statement was affirmed by Fong (2004) through a survey of US (from SAVE International, N = 85) and UK practitioners (in the Institute of Value Management, N = 24). From the random sample, Fong observed that despite VE having a theoretical ground, it is not driven by practice (77%) and even seems to be lacking a professional image (79%). It is therefore recommended to enhance publicity about VE achievements and benefits while enhancing communication with the outside world.

Component 5: Developing economies obstructions

This principal factor covers 9.441% of the total variance and consists of three sub-factors, which are:

i. VE will not succeed in developing countries concept;
ii. Lack of knowledge regarding methodology;
iii. Apathy toward taking risks and being creative.

The above listed factors or variables lead to one result – the mentality that VE will not thrive well in developing countries (Naderpajouh & Afshar 2008). Prevalently, the construction industry in Ghana is loath to change. This tends to affects VE uptake in the industry. This proceeds from the fact that VE inspires and incites the VE team to reason outside the ordinary, to challenge existing barriers and redeem options that are destined not to reduce the reliability or compromise the quality of a project (Adam 1993). Nevertheless, Daddow and Skitmore (2005) explained that the actual results of the alterations

identified are uncertain as there are usually no precedents. Consequently, this breeds resistance as a result of the perceived risks – risk of failure, risk of success and risk of repercussions (Stokes 1998) – the fear of the unfamiliar and general lack of enthusiasm to take the initiative and accept new ideas (Bordass 2000). Additionally, the lack of knowledge flow prevents VE workshops from yielding productively more. However, through persistent application of the VE approach, such obstructions may be eliminated (Naderpajouh and Afshar 2008).

Conclusion and recommendations

This paper concludes that, following a factor analysis, the 22 challenges facing the implementation of VE in developing countries considered in the study can be grouped into five principal component groupings: 'VE team obstructions', 'VE study obstructions', 'VE implementation difficulties', 'conceptual problems' and 'developing economies obstructions'. These identified key challenges should be considered by the governments of various developing countries. The concept of value engineering indeed does have a niche in the construction industry. However, for it to become a general practice, the fulfilment of certain conditions is regarded to be a prerequisite of the VE process. The quality and costs of public projects can benefit by the application of well-elaborated VE methodologies. Specifically, the VE methodology provides a sound approach for analyzing the project objectives and attributes, which, in turn, focuses on the development of alternatives in the value study.

It is recommended that: a policy be devised for the inclusion of VE clauses in contract sections of public projects; clients' perceptions about VE should be clarified while synchronizing clients' expectations with VE outcomes; local guidelines and data on VE techniques should be created while applying effective techniques and tools in VE such as the FAST diagram; and governments of developing countries should perpetually support the implementation of such beneficial methodology, as seen in Hong Kong, the USA, Japan, the UK and even Saudi Arabia. Consequently, among 698 Japanese companies, about 71% of their value was in engineering products and benefits services (Tohidi, 2011). Not surprisingly, VE in the Australian construction industry has received attention and support from the Australian State and Federal Governments since the early 1990s (Institute of Value Management 2000). Future research will be carried out to explore the strategies for implementing value management (VM) in the construction industry of Ghana, as this would be valuable to policymakers and construction professionals who are in pursuit of innovative ways to implement VM in their projects.

Acknowledgements

We acknowledge the construction professionals of various construction and consulting firms for their valuable input enabling us to complete this research.

Disclosure statement

No potential conflict of interest was reported by the authors.

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