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Barriers to Applying Value Management in the Vietnamese Construction Industry

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Abstract: The value management (VM) approach often faces many barriers when applied in the Vietnamese construction industry, as well as in many other developing countries. Most of the related past works identify an insufficient number of factors that hinder the application of VM. This study identified 18 factors hindering the application of VM in the construction industry. To gather views from industrial practitioners with many years of experience in construction projects, this study administered questionnaire surveys. The findings revealed that the four greatest obstacles to the application of VM were the lack of VM experts, the lack of knowledge about VM, the lack of local VM guidelines, as well as technical norms and standards, and the lack of investments, support policies and human resources to conduct VM in construction companies. Additionally, the factor analysis method was applied to investigate the correlation effects of the hindrance factors, which resulted in four core components representing the hindrance factors, namely, lack of qualified personnel to implement VM, inherent difficulties with VM workshops, lack of awareness of VM, and lack of VM application documents. The study contributes to the body of knowledge relating to the application of VM in the construction industry. The findings can be generalised to many developing countries, as they face similar problems in terms of promoting the application of VM in the construction industry.

Keywords: Value management, Value engineering, Construction industry, Developing countries, Vietnam

INTRODUCTION

The global construction industry experienced rapid growth between 2009 and 2012, driven primarily by expansion in developing countries. However, the industry's revenue growth slowed from 2012 to 2013 due to the euro crisis and the after-effects of the financial crisis in the United States (US) (ReportLinker, 2015). The construction sector in Vietnam, a fast developing country in Southeast Asia, has not escaped the problem and has faced numerous challenges in recent years. The construction industry recorded a compound annual growth rate of 16.12% during the review period (2009 to 2013), but then industry growth fell from 19.7% in 2011 to 7.0% in 2013 (Businesswire, 2014). Moreover, there are many construction projects that have been on hold or abandoned due to the lack of capital of

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investment. Accordingly, the slump of this industry has resulted in substantial impacts on other related economic sectors, such as building materials industries (Vietnam Chamber of Commerce and Industry, 2014). Under such circumstances, it is significant that the contractors and consultancy firms have the ability to reduce project costs, enhance project functions, and reduce completion times. The best way to achieve these objectives is to adopt the value management (VM) approach.

VM is also known as value engineering (VE) or value analysis (VA) (Society of American Value Engineers [SAVE], 2014). Although some schools of thought tend to distinguish VM from VE and VA, it is more widely accepted that the term VM can be used to represent other related value methodologies (Shen and Liu, 2003). For simplicity, the term VM is used synonymously with VE and VA throughout this study. VM is a systematic, multi-disciplinary, structured methodology that identifies opportunities to remove unnecessary costs, improve value and optimise the life cycle cost of a facility while assuring that quality, reliability, performance, and other critical factors meet or exceed the expectations of the customer (Dell'Isola, 1997). The origins of VM date back to WWII and the early 1940s when Lawrence D. Miles found ways to alleviate the material shortage problem in production of the General Electric Company (SAVE, 2014). The VM technique was subsequently introduced into construction by the US and the Army Corps of Engineers circa 1963. Outside the US, VM practices and applications were introduced in Japan, Italy, Australia and Canada during the 1970s (Cheah and Ting, 2005). In 1985, the association for VM practitioners was established and is knowns as the Society of American Value Engineers (SAVE) (Latief and Kurniawan, 2009).

Currently, VM is being widely practiced in many countries around the world. However, concepts and applications of VM do not seem to be well embraced in the construction sector of the majority of developing countries. For example, in Malaysia and China, VM is still in its infancy and has not been well-accepted (Jaapar et al., 2009; Li and Ma, 2012). Additionally, VM is rarely applied in the Southeast Asian construction industry (Cheah and Ting, 2005) and is also less widely practiced in South Africa (Bowen et al., 2010). Malla (2013) found that the concept of VM is only now being introduced in Nepal, whereas the adoption of VM in the Myanmar and Nigerian construction sectors is extremely slow and unpopular among construction professionals (Phyo and Cho, 2014; Aduze, 2014). In Vietnam, although there is some evidence of applying the VM process in the construction industry, it is not a popular concept. Rather, VM in Vietnam is regarded as a developing practice still in its infancy stage, with only a small number of construction projects having implemented VM as a practice (Viet and Van, 2013). In fact, very few construction companies in Vietnam have adopted the VM process to reduce costs and enhance quality, Instead, it has been applied mainly by foreign consulting firms or Engineering Procurement Construction (EPC) contractors, such as Japanese and Korean firms (Viet and Van, 2013). Conversely, the majority of owners are still unfamiliar with the concept of VM.

Thus, to promote the application of VM, it was determined that identifying factors that were impeding the adoption of VM would help practitioners assess the barriers that were preventing them from applying, accepting and implementing VM strategies. The hindrance factors identified in earlier studies were considered to be too general and lacking in detail. Moreover, the earlier studies only ranked the factors that were hindering the adoption of VM. Thus, the latent factors that were the root impediments remained undetermined. Accordingly, the objectives of the study outlined in this paper are (1) to identify the hindrance factors and assess the degree to which each factor hinders the application of VM in the construction industry and (2) to investigate the underlying relationships between these factors. Following this introduction, the second section reviews the notable factors hindering the application of VM in the construction industry and discusses the similarities and differences of this study with previous studies. The third section introduces the research methodology, including the research process and various tests and analysis techniques used in the study. The fourth section introduces the data analysis and discusses the findings of the study. The paper ends with a general conclusion.

LITERATURE REVIEW

The application of VM in the construction industry has attracted the interest of many researchers and practitioners. Shen (1997) conducted a survey to investigate VM awareness and application in Hong Kong's construction industry and highlighted three important reasons VM was not being implemented in the work environment, specifically, a lack of knowledge as to how to implement VM, a lack of confidence with respect to introducing VM to clients, and a lack of time to implement VM. He ascertained that the lack of awareness and knowledge of VM on the part of senior management in client organisations was responsible for the fact that so few companies had adopted VM as a strategy. Similarly, an insufficient amount of time to implement VM and the lack of knowledge about VM were found to be two key factors hindering the application of VM in Southeast Asia (Cheah and Ting, 2005). Lai (2006) identified ten factors hindering the application of VM in the Malaysian construction industry. The main factors included a lack of knowledge about VM, a lack of support from parties with authority, such as the government and company owners, and a lack of local VM implementation guidelines. Not surprisingly, a lack of knowledge about VM was again a key problem, whereas a lack of time to implement VM was not a factor causing significant obstacles in Malaysia. For the case of China, Li and Ma (2012) also concluded that the lack of time to implement VM was not a severe problem and that the main hindrances were a lack of expert knowledge about VM, a lack of technical norms and standards, and a lack of VM experts.

Issues related to VM have received much attention in other countries as well, especially in developing countries. Perera and Karunasena (2004) found that in Sri Lanka the application of VM in the construction sector is relatively new and there is little evidence of its implementation in the construction industry. Some reasons for the absence of VM in Sri Lanka were cited as the lack of standard procedures for implementing the VM process; the lack of encouragement, advice and guidance from the construction industry regulatory body to incorporate VM and the lack of information and guidance regarding the benefits of VM. According to Al-Yami (2008), the lack of information with respect to specifications, standards, historical data, etc., the lack of leadership, the lack of time to implement VM, the lack of awareness about VM, and the lack of client commitment were the five major obstacles impeding the application of VM in the Saudi public sector. Fard et al. (2013) investigated VM in the context of Iran and identified five factors hindering the implementation of VM in the construction industry, namely, outdated standards and specifications, habitual thinking and negative attitude, lack of local guidelines and information, lack of knowledge and practices, and change in owners' requirements. More recently, Aduze (2014) has studied the prospects and challenges of implementing VM in Nigerian construction projects. The study concluded that the lack of government legislation and policy, client's negative reception, and lack of knowledge about VM are some of the factors impeding the application of VM in Nigeria. However, the lack of awareness about VM, which was the number one factor in Hong Kong, Malaysia, and China, was not found to be the greatest factor impeding VM application. Malla (2013) made recommendations to promote the application of VM in the Nepalese construction industry rather than identifying the hindrance factors. Malla's (2014) recommendations included providing an incentive clause for a VM re-proposal in the contract document, the commitment from top management to support VM, the forming a VM team with experienced VM members, and providing sufficient time to apply VM.

In addition, other researchers have focused on problems affecting the implementation of the VM workshop. Jaapar et al. (2009) investigated the impact of VM implementation in Malaysia and confirmed that the lack of VM knowledge and practice, a resistance to change by the involved parties, and the conflicting objectives of the project among parties were the main problems mentioned during the VM workshop. Latief and Kurniawan (2009) studied the implementation of VM in the infrastructure services of Indonesia's public works department. They outlined 31 factors influencing the preparedness of implementing VM from various references and found five main factors, namely, the number of personnel with VM certification, VM implementation regulations, personnel composition, comprehension of VM techniques and management, and level of education of personnel. Another study examined infrastructure projects of Whyte and Cammarano (2012). They used a semi-structured interview method to investigate the extent of VM implementation in the Western Australian engineering industry. The study indicated that time limitations, a lack of understanding, and the participation of individual team members negatively influence the level of success of the VM workshop.

Each of the above-mentioned studies presented different conclusions about hindrance factors. However, most of the studies revealed that the lack of knowledge and awareness about VM was one of the biggest obstacles and the primary reason for the limited application of VM in the construction industry. There was no consensus regarding the lack of time to implement VM as one of the greatest hindrances when comparing studies. Other noteworthy factors include the support of government and relevant parties, especially owners, and the lack of VM implementation guideline.

RESEARCH METHOD

The research methodology is schematically presented in Figure 1. To achieve the research objectives of this study, questionnaire surveys were designed to gather views from industrial practitioners. This study incorporates two types of questionnaires. Questionnaire 1 evaluates the hindrance levels of factors with respect to the application of VM, and Questionnaire 2 applies the AHP method for a pair-wise comparison of the hindrance factors. The decision to use the broad-based survey method was mainly because this study is exploratory in nature. Furthermore, this method makes it possible to involve more subjects in a limited time in comparison with other methods. For example, the interview method does not always permit easy access to a number of participants as not everyone who is willing to answer any questions is willing to be interviewed.

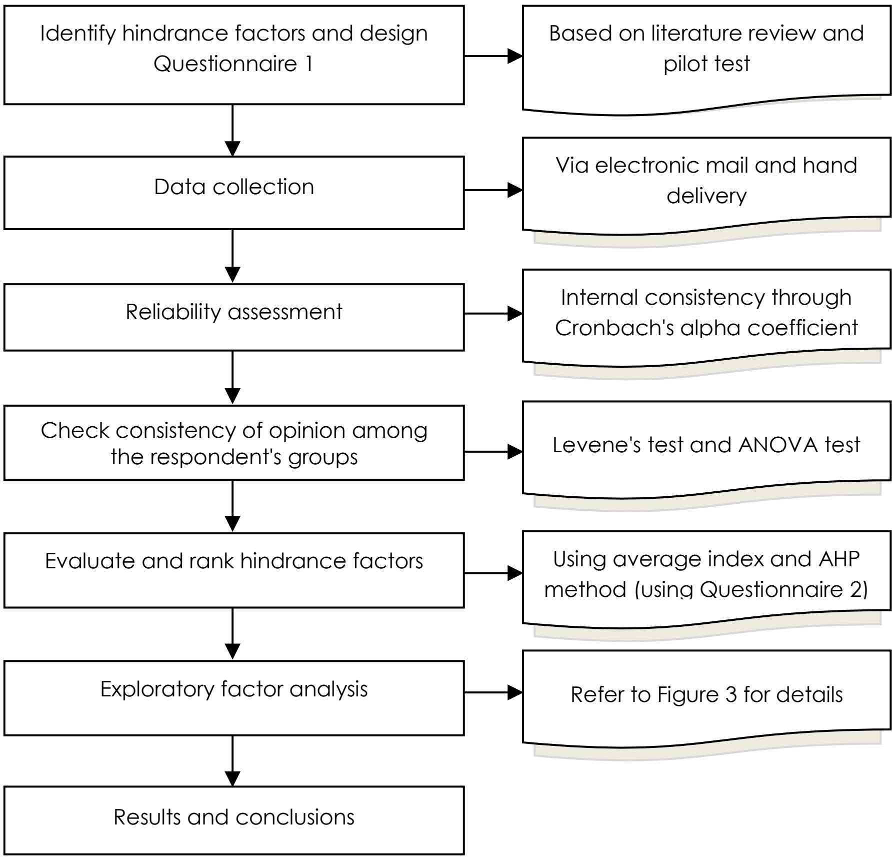

Figure 1. Conceptual Research Framework

The development of Questionnaire 1 was supported by the literature review. A preliminary set of hindrance factors was collected from the literature review and presented in the pre-test questionnaires. A pilot study was then conducted to validate the questionnaire with nine experts who had experience in VM. The experts were asked to assess the comprehensiveness of all questions in the pre-test questionnaire and to especially verify the adequacy and appropriateness of the hindrance factors specific to the Vietnam context. The experts were to exclude unimportant factors and add hindrance factors that they perceived as relevant. According to their comments, four factors were added, and some minor adjustments to the structure of Questionnaire 1 were made. As a result of the outcome of the literature review and the pilot test, 18 factors hindering the application of VM in the construction industry were identified and are presented in Table 1.

The final version of Questionnaire 1 consists of three parts. The first part of the questionnaire introduces participants to the origin and purpose of the survey and provides some basic knowledge about VM. The second part of the questionnaire focuses on assessing the degree of hindrance of the 18 factors as well as the degree of understanding of VM, sources for obtaining knowledge about VM, respondent's experiences with VM and the frequency of involvement in VM workshops. Subsequently, an open-ended question at the end of this section asked respondents to list recommendations for increasing the understanding, acceptance and implementation of VM in the construction industry. All hindrance factors were rated on a five-point Likert scale (1= Not a hindrance to 5 = Extreme hindrance), which has been widely used in many previous VM studies (Lai, 2006; Al-Yami, 2008; Jaapar et al., 2009; Li and Ma, 2012; Phyo and Cho, 2014). The third section of the questionnaire gathers background/demographic information of respondents.

Table 1. The Hindrance Factors Impeding the Application of VM in the Construction Industry

Codes	The Hindrance Factors	References
HF1	Too few construction projects applying VM	Experts' opinion
HF2	Complexity of proposed projects to apply VM	Experts' opinion
HF3	Lack of knowledge about VM	Shen (1997); Cheah and Ting (2005); Lai (2006); Li and Ma (2012); Al-Yami (2008); Fard et al. (2013); Aduze (2014); Jaapar et al. (2009); Latief and Kurniawan (2009); Whyte and Cammarano (2012)
HF4	Lack of support and active participation from owners and stakeholders	Cheah and Ting (2005); Lai (2006); Al-Yami (2008); Aduze (2014); Malla (2013); Jaapar et al. (2009); Whyte and Cammarano (2012)
HF5	Lack of contract provisions for implementation VM between owners	Cheah and Ting (2005); Fard et al. (2013); Malla (2013); Latief and Kurniawan (2009)
HF6	Inexperienced and incompetent contractors	Experts' opinion
HF7	Defensive attitude of original design team	Lai (2006); Li and Ma (2012); Fard et al. (2013)
HF8	Lack of investments, support policies and human resources to conduct VM in construction companies	Experts' opinion

(*Continued on next page*)

Table 1. (*Continued*)

HF9	Lack of VM experts	Li and Ma (2012); Latief and Kurniawan (2009)
HF10	Lack of cooperation and interaction with internal VM team	Latief and Kurniawan (2009)
HF11	Lack of VM team competence to accurately estimate costs	Latief and Kurniawan (2009)
HF12	Inexperienced and incompetent VM team members	Malla (2013); Latief and Kurniawan (2009)
HF13	Unqualified VM facilitator	Jaapar et al. (2009)
HF14	Lack of gathered information in early stage causing difficulties in creating ideas and alternatives	Al-Yami (2008); Jaapar et al. (2009)
HF15	Difficulties conducting analysis and evaluating alternatives	Lai (2006)
HF16	Lack of time to conduct VM studies	Shen (1997); Cheah and Ting (2005); Lai (2006); Li and Ma (2012); Al-Yami (2008); Malla (2013); Whyte and Cammarano (2012)
HF17	Lack of local VM guidelines as well as technical norms and standards	Lai (2006); Li and Ma (2012); Perera and Karunasena (2004); Fard et al. (2013)
HF18	Lack of legislation providing for application of VM in the construction industry	Perera and Karunasena (2004); Aduze (2014); Latief and Kurniawan (2009)

Note: For all factors, the scale = 1 to 5, where 1 = Not a hindrance and 5 = Extreme hindrance

The target respondents of the survey included contractors, designers, consultants, and owners, that is, those who are involved in the VM workshops. Moreover, it is significant that the respondents to the questionnaires included by different stakeholders because VM is known as a multi-disciplinary team approach. Within the class of non-probability sampling techniques, a convenience sampling method was used in this study. The researchers obtained the list of members of the Construction Management Association (CMA) through friends. The questionnaires were then distributed to CMA members from many different organisations and companies in the Vietnamese construction industry. A total of 270 questionnaires were disseminated in March of 2014. Seventy questionnaires were hand delivered to respondents at the CMA's VM seminar, and 200 online questionnaires were sent to respondents via email. Thus, it is believed that the sample is a reasonable random sample of members of the CMA. To increase the response rate, a reminder to complete the questionnaire was sent to the potential respondents one month after the distributing of the questionnaires. The distribution of the questionnaires is summarised in Table 2. Of the 270 questionnaires distributed, 107 questionnaires were returned. Nine responses were eliminated because of a high degree of incompleteness. Consequently, this study was based on 98 valid replies, representing a response rate of 36.3%. This response rate exceeds the norm al rate of 20% to 30% for most questionnaire surveys in the construction industry (Akintoye, 2000). Thus, the response rate was deemed acceptable compared with the response rates of 25% and 39% for the surveys on the application of VM conducted by Hwang, Zhao and Ong (2014) and Ramly, Shen and Yu (2015), respectively.

Table 2. The Distribution of Questionnaires

Ways to Distribute Questionnaires	Number of Questionnaires Sent	Number of Questionnaires Received	Invalid Responses	Valid Responses	Proportion (Percent)
Hand-delivered	70	60	9	51	18.9
Electronic email	200	47	–	47	17.4
Total	270	107	9	98	36.3

The valid data set was analysed using the Statistical Package for Social Sciences (SPSS version 20) software. First, the reliability of the five-point scale used in the survey was determined using Cronbach's coefficient alpha. Subsequently, an analysis of variance (ANOVA), which tests the null hypothesis that the mean of the dependent variable is equal in all groups, was conducted to confirm consistency of opinion among the respondent groups. Levene's test was also confirmed as the precondition for conducting the ANOVA test. Second, the hindrance factors were ranked using average index. Based on ranking, the greatest hindrance factors were extracted and validated based on the judgements of professionals. Questionnaire 2, with questions for pair-wise comparisons among the factors, was designed based on the AHP method (analytic hierarchy process) to collect the opinions of professionals. The AHP exceeds the comparative judgement approach by relaxing the normality assumption of parameters (Saaty, 2010). This questionnaire used the widely accepted nine-point scale, which is the original scale suggested by Saaty and Vargas (2000). The meaning of each of the values of the scale is presented in Table 3. The feedback questionnaires from professionals were estimated using the consistency ratio (CR) to ensure their reliability and validity (Lee et al., 2011; Haery, Ghorbani and Farahmand, 2014). Finally, a factor analysis was conducted to derive the interrelationships among the hindrance factors.

Table 3. Pair-Wise Comparison Scale of Degree of Hindrance

Numerical Rating	Judgements of Degree of Hindrance
1	A hinders equally to B
2	A hinders equally to moderately more than B
3	A hinders moderately more than B
4	A hinders moderately to strongly more than B
5	A hinders strongly more than B
6	A hinders strongly to very strongly more than B
7	A hinders very strongly more than B
8	A hinders very strongly to extremely more than B
9	A hinders extremely more than B

ANALYSES AND FINDINGS

This section presents the results of the analysis of the collected data and discusses the results, including profiles of the respondents, the level of understanding about VM, the preliminary investigation, the ranking of hindrance factors, the factor analysis of hindrance factors, and a discussion of the results of the factor analysis.

PROFILES OF RESPONDENTS

Table 4 summarises the profiles of the respondents in the study. The highest number of questionnaires received was from the contractors (34.7%), followed by the owners (23.5%), the designers (22.4%) and the consultants (19.4%). Regarding the designation of the respondents, the directors, construction managers, and specialists who possess a certain level of professional knowledge, ability and maturity account for more than half (55.1%) of all respondents. Civil engineers/architects, site supervisors, and quantity surveyors account for 28.6%, 14.3%, and 2%, respectively, of all respondents. With respect to years of experience, the number of respondents with five to 10 years of experience is 45.9% and those with more than 10 years is 38.8%. Because these two groups account for a large portion of the respondents, the collected data are considered relatively reliable. Respondents with less than five years of experience account for only 15.3% of all respondents.

Table 4. Profiles of Respondents

Variable	Category	Frequency	Percentage
Field of work	Owner	23	23.5
	Contractor	34	34.7
	Designer	22	22.4
	Consultant	19	19.4
	Total	98	100.0
Designation of respondents	Directorate (Assistant director, general manager, engineering manager, project manager)	26	26.5
	Construction manager	11	11.2
	Specialist	17	17.3
	Civil engineer/Architect	28	28.6
	Quantity surveyor	2	2.0
	Site supervisor	14	14.3
	Total	98	
Years of experience	Less than five	15	15.3
	Between five and 10	45	45.9
	More than 10	38	38.8
	Total	98	100.0

The Level of Understanding about VM

The average index of the level of understanding about VM is 3.26, indicating the respondents exhibited an average degree of understanding of VM. However, it must be noted that this result may be somewhat higher than the actual figure because there were many targeted respondents who had perhaps never heard of VM and therefore may not have returned their questionnaires. The results of this study regarding VM understanding are consistent with those of some other developing countries such as Malaysia (Lai, 2006) and Myanmar (Phyo and Cho, 2014). Furthermore, a large number (64.3%) of respondents learned about VM from colleagues/friends and books/articles, whereas the remaining respondents learned about VM through their organisation (13.3%), professional seminars (5.1%), college/university (8.2%), or other sources (9.1%). This implies that there were very few formal VM training courses, VM workshops, and VM seminars held in the construction industry. Only 28 respondents (28.57%) had attended VM workshops. Specifically, nine the directors, nine civil engineers/architects, seven specialists, and three construction managers had attended VM workshops.

Preliminary Investigation

This study performs two statistical analyses of the data, namely, scale ranking and factor analysis. To verify these analyses, a reliability check and consistency of opinion among the groups of respondents (owners, contractors, designers, and consultants) were assessed. To demonstrate reliability of the five-point scale, the Cronbach's alpha coefficient was calculated to examine the internal consistency among the factors. According to Hair et al. (2010), the acceptable lower limit for the Cronbach's alpha is 0.7. The 18 hindrance factors exhibited a Cronbach's alpha of 0.795, which is above the recommended threshold value of 0.7, confirming the reliability of the five-point scale measurement. Regarding the consistency of opinion among the respondent groups, an ANOVA test was performed to clarify whether the opinions of the groups were the same for each of the 18 hindrance factors. A probability value ($p < 0.05$) suggests a high degree of difference of opinion among the groups (Landau and Everitt, 2004). Levene's tests indicate the equality of variance of each of the hindrance factors in the groups (all p values > 0.1), such that the precondition for ANOVA was satisfied. The results of the ANOVA indicate that the p values ranged from 0.14 to 0.61. These p values were much higher than 0.05, suggesting that there was a consensus of opinion among the groups. Therefore, the collected data are treated as a whole in the further analyses. The process, findings, and relevant discussion of the analyses are detailed in the following presentation.

Ranking of Hindrance Factors

The first analysis ranked the hindrance factors based on the value of their means. Table 5 presents the statistical means, standard deviations, and ranks of these factors. The standard deviation on a hindrance factor represents a degree of consensus among respondents, while a mean response on the scale is an indicator of the degree of a hindrance factor's importance in relation to other hindrance factors (Singh and Singh, 2008). The standard deviation values of the hindrance factors are less than one or around one, which reflects some consensus among respondents (Ellif and Maarof, 2011). As presented in Table 5, there are 11 factors rated as "extreme hindrance" (3.5 ≤ mean < 4.5), and the others are rated as "average hindrance" (2.5 ≤ mean < 3.5) (Majid and McCaffer, 1997).

Table 5. Ranking of Hindrance Factors for VM Application

Codes	**Factors**	**Mean**	**Standard Deviation**	**Rank**
HF9	Lack of VM experts	4.17	0.84	1
HF3	Lack of knowledge about VM	4.13	0.90	2
HF17	Lack of local VM guidelines as well as technical norms and standards	4.11	0.85	3
HF8	Lack of investments, support policies and human resources to implement VM in construction companies	4.01	0.90	4
HF18	Lack of legislation providing for application of VM in the construction industry	3.98	0.98	5
HF4	Lack of support and active participation from owners and stakeholders	3.97	0.92	6
HF14	Lack of gathered information in early stage causing difficulties in creating ideas and alternatives	3.85	0.91	7
HF6	Inexperienced and incompetent contractors	3.68	1.00	8
HF5	Lack of contract provisions for implementation of VM between owners and stakeholders	3.65	0.86	9
HF12	Inexperienced and incompetent VM team members	3.60	0.99	10
HF13	Unqualified VM facilitator	3.52	0.88	11
HF10	Lack of cooperation and interaction with internal VM team	3.43	0.96	12
HF1	Too few construction projects implementing VM	3.42	1.04	13
HF11	Lack of VM team competence to accurately estimate costs	3.40	1.09	14
HF7	Defensive attitude of original design team	3.35	1.15	15
HF2	Complexity of proposed projects to apply VM	3.24	0.95	16
HF15	Difficulties conducting analysis and evaluating alternatives	3.10	0.90	17
HF16	Lack of time to conduct VM studies	3.04	1.07	18

The lack of VM experts was ranked as the primary hindrance by the respondents, implying that VM experts are of paramount importance for the development of VM in the construction industry. Similarly, the lack of VM experts was also found to be a major impediment in the development of VM in China (Li and Ma, 2012). VM experts must possess substantial experience and technical skills related to value engineering/analysis and must be certified as a Certified Value Specialist or an Associate Value Specialist (SAVE, 2014). Practical experience in VM workshops plays an important role as such workshops are the major source of the practical knowledge that is disseminated to the shareholders (Fong, 2004). Thus, the lack of VM experts in Vietnam can cause significant obstacles related to the application of VM procedures. The practical experiences of VM experts, not reference books or articles, are essential for guiding the implementation of VM. Moreover, VM experts can be the pioneers who establish the foundation for the development of domestic VM, disseminate knowledge of VM, train human resources in the application of VM, and collaborate with the government to develop appropriate legislation relating to the implementation of VM.

The lack of knowledge about VM was ranked the second greatest hindrance the successful implementation of VM. This result was consistent with the findings of Cheah and Ting (2005). The lack of knowledge about VM can result in the practitioners' disregard for the existence of VM. Because the practitioners do not understand what constitutes VM and the benefits of VM, they prefer to adhere to traditional methodologies. Moreover, it is unlikely for owners who have no or little knowledge of VM to request their designers and contractors to engage in VM practices in their projects (Shen, 1997). Thus, the result is the failure to accept and apply VM in the construction industry.

The lack of local VM guidelines, as well as technical norms and standards, was ranked third. It is essential that local VM guidelines, technical norms, and standards be established to promote the widespread application of VM in the construction industry (Shen and Liu, 2004; Latief and Kurniawan, 2009; Fard et al., 2013). Practical guidelines for implementing VM are needed because not all practitioners are familiar with VM when first attempting to implement it. Furthermore, practical guidelines for practitioners ensure compliance and alignment with the characteristics of the domestic construction industry.

Next, although lack of investments, support policies and human resources to conduct VM in construction companies was not identified or emphasised in previous studies, it was ranked fourth by the respondents in this study, indicating the importance of construction companies support in the implementation of VM. The acceptance and application of the VM approach in companies can gradually change the habits and traditional methods typically applied in projects and can enhance the companies' benefits. Furthermore, companies that adopt the VM approach can share their experiences and lessons learned with other companies and organisations. Finally, the successful application of VM can increase a company's competitiveness and its reputation within the construction sector.

In Vietnam, the government did not play an important role in popularising and promoting the development of VM. This is supported by the fact that the lack of legislation providing for application of VM in the construction industry ranked fifth. This is a problem, however, that was clearly demonstrated by past experiences of the United States, which found that government support is relatively important to the successful implementation of VM (Li and Ma, 2012). The legislation, including incentive clauses for sharing the equitable savings and risks for implementing VM, can encourage owners and stakeholders to apply VM in their projects (Cheah and Ting, 2005). That said, the lack of support and active participation of owners and stakeholders ranked sixth, implying that VM development required the support and active involvement of all parties. The unwilling of owners to pay for VM service and the resistance from design consultants are additional factors that inhibit the wider use of VM (Hogg, 2000). Owner support was determined to be the most critical success factor for VM application (Shen and Liu, 2003) because according to Norton and McElligot (1995) (cited by Hwang, Zhao and Ong, 2014), the owner's clear support has been argued to be the only possible way to facilitate the acceptance of VM and overcome opposition to its application.

The lack of time to conduct VM studies was ranked last. It was not rated as a factor that significantly hindered the application of VM in the construction industry. Drawbacks related to the lack of time to implement VM can be addressed by an improvement in efficiency of VM studies (Shen, 1997). For example, using modern information systems can reduce the amount of time spent retrieving historical information, generating creatives ideas, analysing and evaluating alternatives, and reviewing study proposals. Thus, more time can be allocated to more important tasks, such as function analysis and the development of alternatives (Shen, 1993; 1997). Furthermore, there exists strong evidence that the 40-hour VM job plan is widely used in many VM studies and has been proven to be successful over the past four decades by many VM organisations and practitioners (Shen, 1997).

Based on the results of the ranking of the hindrance factors according to means, the six greatest hindrance factors, namely, HF9, HF3, HF17, HF8, FH18 and HF4, were extracted, validated and then made more meaningful based on the judgements of professionals. Questionnaire 2 was used to the judgements of professionals. The professionals, as referred to herein, are the respondents who had participated in VM studies or who were implementing VM in their companies. These individuals were identified based on their responses to Questionnaire 1. Questionnaire 2 was distributed to the predetermined professionals via email, and a total of 23 completed responses were received. The responses from the survey were analysed with the aid of the Expert Choice software, which performs the computations as required by the AHP. The responses with values passing the consistency test are perceived as reliable and valid. The maximum acceptable limit of consistency ratio (CR) is 0.1 (Saaty, 2000). If the CR value of the response exceeds 0.1, it indicates that the pairwise comparison is inconsistent, and hence, the response is discarded. After computations, it was determined that all 23 responses in the pairwise comparisons reported a CR of less than 0.1 and that the CR for combined judgement of the 23 responses was 0.02, as presented in Figure 2. Therefore, the professionals' pairwise comparison matrices were acceptable, and the responses were reliable and valid. Table 6 presents the rankings of the six hindrance factors according to their priority weights. HF3, lack of knowledge about VM with a priority weight of 0.312, has the highest score followed by HF9 (0.289), HF8 (0.144), HF17 (0.136), and HF18, HF4 (0.059).

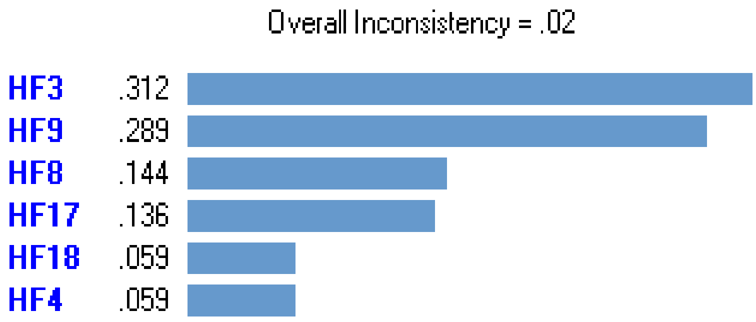

Figure 2. Consistency Ratio of Pair-Wise Comparison Matrix

Table 6. Ranking of Six Hindrance Factors

Code	Priority Weight	Rank
HF3	0.312	1
HF9	0.289	2
HF8	0.144	3
HF17	0.136	4
HF18	0.059	5
HF4	0.059	5

The results of comparing the rankings according to means and priority weights are displayed in Table 7. From Table 7, it is noted that there are some minor changes in rankings among the six factors. However, it is not significant in assessing the factors hindering the application of VM in the construction industry. Similarly, as the rankings are based on the mean, it is not surprising that the four greatest hindrance factors include the lack of VM experts (HF9), the lack of knowledge about VM (HF3), the lack of local VM guidelines, as well as technical norms and standards (HF17), and the lack of investments, support policies and human resources to implement VM in construction companies (HF8). It is further found that HF3 and HF9 continue to be the key problems.

Table 7. Results of Comparing the Rankings According to Mean and Priority Weight

Mean	Priority Weight	Rank
HF9	HF3	1
HF3	HF9	2
HF17	HF8	3
HF8	HF17	4
HF18	HF18, HF4	5
HF4	–	6

Factor Analysis of Hindrance Factors

Another aim of this study is to examine the relationships among hindrance factors to derive a reduced set of hindrance factors that can be readily used in practice. Accordingly, factor analysis was employed to capture the multivariate interrelationships existing among the hindrance factors. The SPSS was used to perform the factor analysis using the procedure presented in Figure 3.

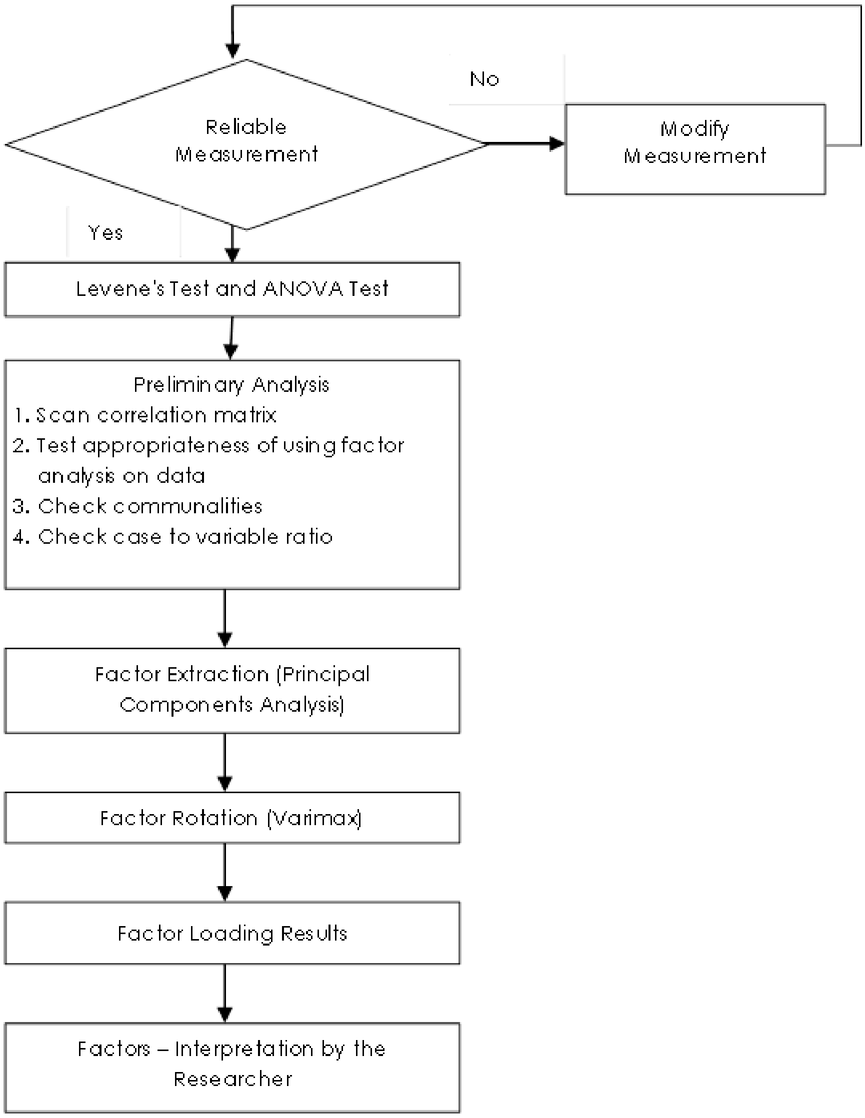

Figure 3. Factor Analysis Procedure

As a first step in performing the factor analysis, the correlation matrix was scanned, and the appropriateness of a factor analysis on the data was determined. If any variables had numerous correlations below 0.3 or exhibited no correlations, they were excluded. The results of the correlation coefficients indicate that there were four hindrance factors with correlations below 0.3. Therefore, these factors were eliminated. The eliminated factors include the complexity of applying VM in the proposed projects (HF2), the lack of contract provisions between the owners and the stakeholders with respect to implementing VM (HF5), the lack of gathered information in the early stage making it difficult to develop creative ideas and alternatives (HF14), and the lack of time to implement VM (HF16).

The adequacy of the survey data was assessed using the Kaiser-MeyerOlkin (KMO) test and the Bartlett's test of sphericity. A value greater than 0.5 on the KMO index and a Bartlett's test of sphericity where ($p < 0.05$) indicates that the data set is suitable for factor analysis (Field, 2009). In this study, the Bartlett's test of sphericity was significant ($p = 0.000$), and the value of the KMO index was 0.747 (greater than 0.5). Thus, the results confirmed that the data are appropriate for factor analysis.

The reliability of the factor model was also verified with the communalities of each variable. The sample size of this study was approximately 100, thus all communalities above 0.5 were accepted (Field, 2009). In this test, there were two hindrance factors that were continuously discarded, specifically, inexperienced and incompetent contractors (HF6) and lack of cooperation and interaction with the internal VM team (HF10). Their communalities were 0.484 and 0.488, respectively. Communalities of all other hindrance factors were found to be much greater than 0.547, indicating that the factor model is reliable in this study. With respect to the case to variable ratio, the number of observations per variable was approximately 8:1 (ratio of 98:12), which satisfies a desired ratio of five observations per variable (Hair et al., 2010).

Following a preliminary analysis, the 12 remaining hindrance factors were subjected to factor analysis, with principal component analysis and varimax rotation. Many criteria were available to assist in determining how many components to extract. The most common criterion used was the minimum eigenvalue, known as the Kaiser's criterion. The results of the principal component analysis to determine the number of components to be retained are presented in Table 8. According to Kaiser's criterion, four components exhibited eigenvalues greater than 1.0, which is the suggested number of components to be retained (Field, 2009). Moreover, the scree plot, as illustrated in Figure 4, also indicates that there are four components on the left of the point of inflection that are retained (Field, 2009; Hair et al., 2010). These four hindrance components explained 64.203% of the total variance in the data.

Table 8. Principal Components Analysis Results

Principal Component	Eigenvalue	Percentage Variance Explained	Cumulative Variance Percentage
1	3.304	27.537	27.537
2	1.799	14.989	42.526
3	1.401	11.671	54.197
4	1.201	10.005	64.203
5	0.787	6.557	70.760
6	0.744	6.198	76.958
7	0.628	5.237	82.195
8	0.559	4.662	86.857
9	0.486	4.048	90.905
10	0.415	3.456	94.361
11	0.384	3.201	97.562
12	0.293	2.438	100.000

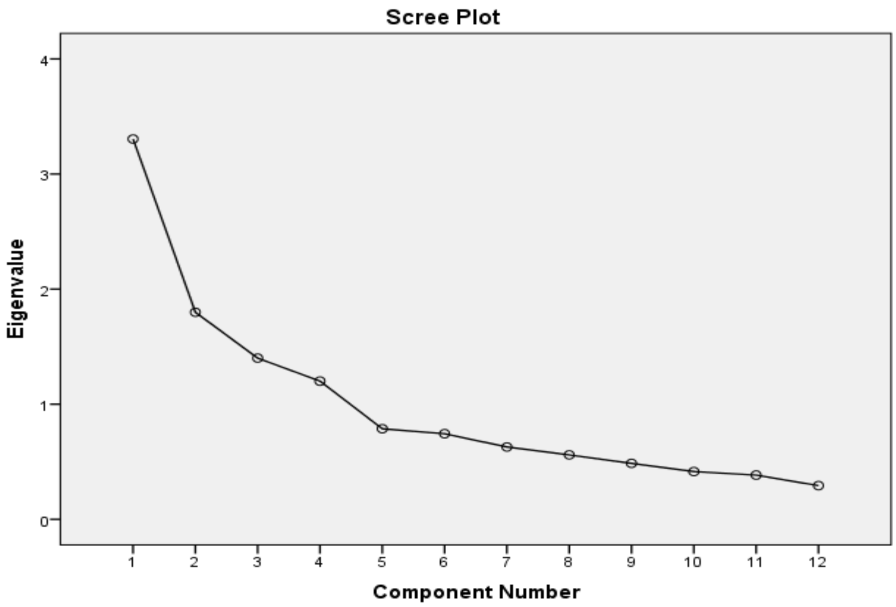

Figure 4. Scree Plot

The rotated component matrix along with the factor loadings of these hindrance factors on these four components after the varimax rotation is presented in Table 9. Factors with loadings greater than 0.5 are considered significant in contributing to the interpretation of the component; factors with loadings less than 0.5 are considered insignificant (Hair et al., 2010). As presented in Table 9, all factor loadings are greater than 0.5.

Table 9. Component Matrix After Varimax Rotation

Codes	Component 1	Component 2	Component 3	Component 4
HF9	0.752			
HF12	0.734			
HF11	0.713			
HF8	0.537			
HF7		0.739		
HF15		0.721		
HF13		0.602		
HF1			0.782	
HF3			0.724	
HF4			0.529	
HF18				0.820
HF17				0.732

Table 10. The Four Components of the Hindrance Factors

Components of Hindrance Factors	Variance Explained (%)	Codes	Hindrance Factors
Component 1: Lack of qualified personnel to implement VM	19.036	HF9	Lack of VM experts
		HF12	Inexperienced and incompetent VM team members
		HF11	Lack of VM team competence to accurately estimate costs
		HF8	Lack of investments, support policies and human resources to conduct VM in construction companies
Component 2: Inherent difficulties in VM workshop	16.029	HF7	Defensive attitude of the original design team
		HF15	Difficulties conducting analysis and evaluating alternatives
		HF13	Unqualified VM facilitator
Component 3: Little awareness of VM existence	14.867	HF1	Too few construction projects apply VM
		HF3	Lack of knowledge about VM
		HF4	Lack of support and active participation from owners and stakeholders
Component 4: Lack of VM application documents	14.271	HF18	Lack of legislation providing for application of VM in the construction industry
		HF17	Lack of local VM guidelines as well as technical norms and standards

To facilitate further discussion, it is necessary to allocate a new name to each of the components. Based on an examination of inherent relationships among the hindrance factors under each of the components, the four extracted components are reasonably interpreted as follows: component 1 represents the lack of qualified personnel to implement VM, component 2 represents the inherent challenges with conducting VM workshops, component 3 represents the lack of awareness regarding the existence of VM and component 4 represents the lack of VM application documents. Table 10 displays the names of the four components along with the percentages of the variances after the varimax rotation as explained by each component.

RESULTS OF FACTOR ANALYSES

Component 1: Lack of Qualified Personnel to Implement VM

This component comprises four hindrance factors, namely, the lack of VM experts, inexperienced and incompetent VM team members, the VM team's lack of competence to accurately estimate costs, and the lack of investments, support policies and human resources to implement VM in construction companies. This component accounts for the greatest variance (19.036%) of all the components. The component demonstrates that the lack of qualified personnel such as VM experts, a competent VM team, and available human resources are the primary obstacle impeding the application of VM in the construction industry. Incompetence in cost estimation and inexperienced members in this component imply that personnel must be appropriately trained, must be provided with the requisite knowledge and must possess the necessary skills if VM is to be successfully implemented.

With respect to Vietnam and the establishing of an initial foundation for VM methodology in the construction industry, it is necessary to have an abundance of human resources with experience and knowledge about VM who will promote and develop VM in the domestic construction industry. To accomplish this, an active foreign certification system, such as Certified Value Specialist, Associate Value Specialist, and Value Methodology Practitioner, granted by SAVE International, and the training of more VM experts are recommended. Furthermore, the construction sector of Vietnam should engage in dialogues with similar sectors in other countries that have adopted the VM methodology and learn from their experiences to promote VM.

Component 2: Inherent Difficulties in VM Workshop

This component explains 16.029% of the total variance in the data. The three hindrance factors in this component relating to inherent difficulties in VM workshops are the defensive attitude of the original design team, difficulties conducting analyses and evaluating alternatives, and the VM facilitator's lack of qualifications. The extant VM studies indicate there are always inherent difficulties associated with implementing VM, such as negative attitudes of participants, facilitator incompetence, lack of communication and coordination among stakeholders, lack of ideas and knowledge, etc. Together, these factors create an image that depicts VM as ineffective and thus industrial practitioners conclude that VM will not provide any desirable benefits to their projects.

The VM procedure requires a multi-disciplinary representative group of people working together. Hence, the contributions and the involvement of the design team are important for the success of the implementation of VM. However, it is often challenging to overcome the defensive attitude of the design team. More specifically, the design team contends that with their extensive backgrounds, experiences, qualifications and technical abilities, they consider their work to be satisfactory and further claim that their work does not warrant additional unnecessary and costly scrutiny (O'Farrell, 2010). Moreover, they frequently consider VM as an unwelcome disturbance, a waste of time, and a criticism of their technical capabilities (O'Farrell, 2010). Accordingly, the design teams are often quite reluctant to involve VM and express doubt regarding the benefits of VM, declaring it to be only another cost cutting methodology.

The VM facilitator should encourage and maintain a positive attitude among all participants during the VM workshop. A positive attitude will lead to positive results, whereas a negative attitude will result in negative results (Dell'Isola, 1997). The VM facilitator, as a key component in the successful implementation of VM, must control and lead the group of individuals as they work together to attain the requisite objectives (SAVE, 2014). To ensure that the workshop is conducted in accordance with standard VM procedures, the VM facilitator should be more creative, organised, and motivational than technical (Dell'Isola, 1997). The difficulties in conducting analyses and evaluating alternatives in this component are problems that the VM team always encounters during the VM workshops. These issues should be recognised and dealt with in a positive manner. Accordingly, to mitigate these inherent difficulties in the VM workshop, it is important that the VM team be multidisciplinary and that the members be highly qualified such that their skills and expertise be tailored to the nature of the specific project. Finally, the coordinator of the VM team should be a qualified professional (preferably a Certified Value Specialist) (Dell'Isola, 1997).

Component 3: Lack of Awareness Regarding the Existence of VM

This component includes the three hindrance factors, specifically, the lack of construction projects that implement VM, the lack of knowledge about VM, and the lack of support and active participation from owners and stakeholders with respect to promoting and implementing VM. Accordingly, this component explains 14.867% of the total variance in the data. The lack of awareness regarding the existence of VM may well be the cause for the lack of knowledge about VM knowledge, the low numbers associated with the application of VM application in the construction sector, and the lack of support from project parties. The lack of knowledge about VM and its minimal use in the sector may result in the parties' lack of interest and confidence in VM as a strategy the parties. Thus, if the parties question the effectiveness of VM and express concern regarding the amount of time and money needed to implement it, it is likely that VM as a strategy will not be positively received, and hence, there will be a lack of support and active participation by the relevant parties in VM workshops. The results of previous projects that have implemented VM indicate that the support and active participation of all relevant stakeholders is essential for increasing the interest of the parties in VM. The evidence with respect to the success and failure rates of the application of VM applications indicate that owners feel more comfortable adopting VM for their projects when there is a high level of interest (Cheah and Ting, 2005).

A lack of support and active participation by the parties is likely due to the conflicting benefits of the project, causing the parties to develop negative attitudes towards the implementation of VM in their projects. For example, with respect to the designers, spending time, cost, and manpower to implement VM is usually not a consideration because it will reduce their profits, especially given that the design fee as calculated for the total project cost is extremely low (O'Farrell, 2010). The designers typically adhere to a specific routine and process when creating their design process. Furthermore, they contend that the search for new alternatives and the implementing of changes in their design plans will take time and the end result may not be any better than their former designs. Hence, they do not feel it is worth the effort to obtain the approvals of the contractor and the owner to incorporate changes that may or may not be effective (Miles, 1993)

With respect to the owner, many owners believe that the designers perform VM as part of the normal design work and that it is their responsibility to ensure the quality of the designs, to provide the owners with economical designs and to meet or exceed the owner's specifications (O'Farrell, 2010). The owners encourage the designers to perform VM in their projects, but they (the owners) rarely take any action or assume the responsibility for the cost of implementing VM and ensuring the results of VM (Miles, 1993). Regarding the contractors, the alternatives, based on the results of VM studies, indicate that adopting new construction methods or new materials require different fabricating methods, which can cause unpredicted problems and possible costly delays and repairs. Therefore, contractors are reluctant to bid when changes are part of the plan without adding contingency costs, which may, in turn, nullify their benefits of the change on that job if they are not the promoters of the change (Miles, 1993).

Though it is recognised that VM can promote innovation and can provide many benefits, it is not easy to implement changes in habits and working conditions. To improve the lack of knowledge and awareness of VM, it is necessary to introduce the VM methodology in the organisations of the owners, designers, and contractors by providing VM seminars, training and sample implementation of VM in some projects. In this way, the relevant stakeholders can better understand and realise the significant benefits of VM and thus be more willing to support, promote, and participate in the application of VM in their projects.

Component 4: Lack of VM Application Documents

This component explains 14.271% of the total variance of the data. The two factors, namely, the lack of legislation providing for application of VM in the construction industry and the lack of local VM guidelines as well as technical norms and standards, included in the component are related to the lack of documents regarding the application of VM. Local VM guidelines, technical norms, and standards are considered as manual documents that are necessary for the implementation of VM. A lack of practical guidelines for implementing VM in the construction industry is a key factor blocking the wide application of VM (Shen and Liu, 2004) because the theoretical knowledge from books and articles is not sufficient for ensuring the correct implementation of the VM procedure. Moreover, if there are no practical VM guidelines or manuals in the local language, it is difficult for industrial practitioners to be familiar with the VM methodology. Hence, to promote the application of VM, a number of documents specifically related to the local context should be published in the construction industry.

Legal documents play a supporting role in implementing VM. There are many related difficulties when applying this methodology if there is not government legislation regulating, for example, the size of projects suggested for applying VM, specific rules for each type of project, the sharing among shareholders of benefits earned from applying VM, etc. Aduze's research (2014) indicated that VM, as a technique, when backed up with legislation and applied to all construction projects will ensure effective maximisation of function and removal of unnecessary costs. Governments, construction authorities, and regulators should play a lead role in promoting VM and should consider creating and establishing VM implementation based on law, as currently practiced in developed countries across the world. The United States, for instance, legally implemented VM based on Public Law 104-106 - Section 4306 - Value Engineering for Federal Agencies, which stated that each agency shall establish and maintain cost effective procedures based on value engineering (Latief and Kurniawan, 2009) and on Federal Acquisition Regulation Parts 48 and 52, which present clear policies and procedures for using and administering VM techniques in contracts, including the processing of VM change proposals, sharing acquisition savings, and other related incentives programmes (The Federal Facilities Council, 2001). Moreover, the FIDIC (2005) has affirmed that VM can be applied in construction projects according to the terms of sub-clause 13.2.

CONCLUSIONS

This paper administered surveys intended to discover the barriers to applying VM in the Vietnamese construction industry. This study identified 18 hindrance factors. Ranking them according to their mean and priority weights, it was determined that the four greatest hindrances to the application of VM were the lack of VM experts, the lack of knowledge about VM, the lack of local VM guidelines, as well as technical norms and standards, and the lack of investments, support policies and human resources to conduct VM in construction companies. These were followed by the lack of legislation providing for the application of VM in the construction industry and the lack of support and active participation from owners and stakeholders. Five of the aforementioned six factors, the exception being the lack of investments, support policies and human resources to conduct VM in construction companies, were found to be main factors in previous studies (Li and Ma, 2012; Cheah and Ting, 2005; Lai, 2006; Aduze, 2014).

Using factor analysis, the relationships among 12 of the 18 hindrance factors were investigated and categorised into four components, namely, (1) lack of qualified personnel to implement VM, (2) inherent difficulties in VM workshops, (3) lack of awareness of VM and (4) lack of VM application documents.

Despite achieving the objectives, this study has certain limitations. First, even though a pilot test was conducted and target respondents who did not fully understand VM were eliminated from the study, we could only minimise the bias associated with the scoring of the hindrance factors. Thus, there may be biases inherent in the sample. Second, assessing the degree of hindrance of the factors could be more rigorous if multiple regression analyses on the extracted components were employed to explore the relative importance. Doing so would highlight the significance of the unit hindrances in the application of VM in the construction industry. Last, because the study was conducted in the context of Vietnam, the findings may not be generalised to other geographical locations.

The findings of this study can help practitioners in the Vietnamese construction industry assess the status of and barriers to applying VM so they can identify appropriate strategies for their organisations to implement VM procedures. Thus, this study is as valuable additional contribution to the body of knowledge related to the application of VM in the construction industry. Although the study focuses on Vietnam, the findings may be relevant for many developing countries, as they face similar problems with respect to promoting the application of VM in their construction industries.

Based on the findings of this study, some following recommendations are offered to promote and develop VM in the construction industry. Greater effort should be made to train and educate industrial practitioners and industry owners about VM. Furthermore, local guidelines should be established that are consistent with the characteristics of the domestic construction industry. More importantly, the government should assume a greater role in the popularisation and application of VM and should adopt the appropriate legislation related to the implementation of VM. It is further recommended that future research be conducted to explore the inter-relationships between the four components of the hindrance factors and that future studies compare the outcomes of this study in Vietnam with results in other developing countries to strengthen the validity of the outcomes.

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REFERENCES

Aduze, O.C. (2014). A study of the prospects and challenges of value engineering in construction projects in Delta and Edo States of Nigeria. MSc diss. Nnamdi Azikiwe University.

Akintoye, A. (2000). Analysis of factors influencing project cost estimating practice. *Construction Management and Economics*, 18(1): 77–89. http://dx.doi.org/10.1080/014461900370979.

Al-Yami, A. (2008). An integrated approach to value management and sustainable construction during strategic briefing in Saudi construction projects. PhD diss. Loughborough University.

Bowen, P., Cattell, K., Edwards, P. and Jay, I. (2010). Value management practice by South African quantity surveyors. *Facilities*, 28(1/2): 46–63. http://dx.doi.org/10.1108/02632771011011396.

Businesswire. (2014). *Research and Markets: Construction in Vietnam; Key Trends and Opportunities to 2018*. San Francisco, CA: Businesswire. Available at: http://www.businesswire.com/news/home/20140820005594/en/Research-Markets-Construction-Vietnam---Key-Trends#.VWzpRNJVhBc [Accessed on 15 May 2015].

Cheah, C.Y.J. and Ting, S.K. (2005). Appraisal of value engineering in construction in Southeast Asia. *International Journal of Project Management*, 23(2): 151–158. http://dx.doi.org/10.1016/j.ijproman.2004.07.008.

Dell'Isola, A.J. (1997). *Value Engineering Practical Applications: For Design, Construction, Maintenance, and Operations*. Massachusetts, USA: RS Means Company.

Ellif, Z.H.A. and Maarof, N. (2011). Oral communicative activities in the Saudi third year secondary EFL textbooks. *Advances in Language and Literary Studies*, 2(1): 9–17.

Fard, A.B., Rad, K.G., Sabet, P.G.P. and Aadal, H. (2013). Evaluating effective factors on value engineering implementation in the context of Iran. *Journal of Basic and Applied Scientific Research*, 3(10): 430–436.

Federal Facilities Council, (2001). Sustainable federal facilities: A guide to integrating value engineering, life-cycle costing, and sustainable development. *Federal Facilities Council Technical Report No. 142*. Washington DC: National Academy Press.

Field, A. (2009). *Discovering Statistics Using SPSS*. Thousand Oaks, CA: Sage Publications.

Fong, P.S.W. (2004). A critical appraisal of recent advances and future directions in value management. *European Journal of Engineering Education*, 29(3): 377–388. http://dx.doi.org/10.1080/03043790410001663292.

Haery, F.A., Ghorbani, H. and Farahmand, A.A. (2014). An AHP approach for ranking critical success factors of customers experience in Iranian banks from managers' viewpoint. *International Journal of Marketing Studies*, 6(1): 168–176. http://dx.doi.org/10.5539/ijms.v6n1p168.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate Data Analysis*. 7th Ed. Upper Saddle River, NJ: Pearson Education. http://dx.doi.org/10.1016/j.jmva.2009.12.014.

Hogg, K. (2000). Factors inhibiting the expansion of value methodology in the U.K. construction sector. *Society of American Value Engineers (SAVE) International Conference Proceedings*. Dayton, OH: SAVE International, 91–97.

Hwang, B.G., Zhao, X. and Ong, S.Y. (2014). Value management in Singaporean building projects: Implementation status, critical success factors, and risk factors. *Journal of Management in Engineering*, 31(6): 04014094-1–10.

International Federation of Consulting Engineers (FIDIC). (2005). *Conditions of Contract for Construction, for Building and Engineering Works Designed by the Employer*. Geneva: FIDIC.

Jaapar, A., Endut, I.R, Bari, N.A.A. and Takim, R. (2009). The impact of value management implementation in Malaysia. *Journal of Sustainable Development*, 2(2): 210–216. http://dx.doi.org/10.5539/jsd.v2n2p210.

Lai, N.K. (2006). Value management in construction industry. MSc diss. Universiti Teknologi Malaysia.

Landau, S. and Everrit, B.S. (2004). *A Handbook of Statistical Analyses Using SPSS*. Boca Raton, FL: Chapman & Hall/CRC Press LLC.

Latief, Y. and Kurniawan, V.U. (2009). Implementation of value engineering in the infrastructure services of Indonesia's public works department. *SAVE International*, 32(3): 10–14.

Lee, C.P., Lou, S.J., Shih, R.C. and Tseng, K.H. (2011). An AHP-based weighted analysis of network knowledge management platforms for elementary school students. *The Turkish Online Journal of Educational Technology*, 10(4): 52–59.

Li, X. and Ma, W. (2012). Appraisal of value engineering application to construction industry in China. In Y. Zhang (ed.). Future wireless networks and information systems. Vol. 2. *Lecture Notes in Electrical Engineering*. Vol. 144. Berlin: Springer, 303–311.

Majid, M. and McCaffer, R. (1997). Assessment of work performance of maintenance contractors in Saudi Arabia. *Journal of Management in Engineering*, 13(5): 91. http://dx.doi.org/10.1061/(ASCE)0742-597X(1997)13:5(91).

Malla, S. (2013). *Application of Value Engineering in Nepalese Building Construction Industry*. Available at: http://professionalprojectmanagement.blogspot.kr/2013/06/application-of-value-engineering-in.html [Accessed on 15 May 2015].

Miles, L.D. (1993). *Techniques of Value Analysis and Engineering*. 3rd Ed. Washington DC: Lawrence D. Miles Value Foundation.

Norton, B.R. and McElligot, W.C. (1995). *Value Management in Construction: A Practical Guide*. London: Macmillan.

O'Farrell, P.K. (2010). Value engineering: An opportunity for consulting engineers to redefine their role. MSc diss. Waterford Institute of Technology.

Perera, S. and Karunasena, G. (2004). Application of value management in the construction industry of Sri Lanka. *The Value Manager*, 10(2): 4–8.

Phyo, W.W.M. and Cho, A.M. (2014). Awareness and practice of value engineering in Myanmar construction industry. *International Journal of Scientific Engineering and Technology Research*, 3(10): 2022–2027.

Ramly, Z.M., Shen, G.Q. and Yu, A.T.W. (2015). Critical success factors for value management workshops in Malaysia. *Journal of Management in Engineering*, 31(2): 1–9.

ReportLinker. (2015). *Construction Industry Outlook: Find the Latest Market Statistics and Trends*. Lyon, France: ReportLinker. Available at: http://www.reportlinker.com/ci02286/Construction-and-Building.html [Accessed on 15 May 2015].

Saaty, T.L. (2010). *Mathematical Principles of Decision Making*. Pittsburgh, PA: RWS Publications.

Saaty, T.L. and Vargas, L.G. (2000). *Models, Methods, Concepts and Applications of the Analytic Hierarchy Process*. Boston: Kluwer Academic Publisher.

Shen, Q. and Liu, G. (2004). Application of value management in the construction industry in China. *Engineering, Construction and Architectural Management*, 11(1): 9–19. http://dx.doi.org/10.1108/09699980410512629.
Shen, Q. and Liu, G. (2003). Critical success factors for value management studies in construction. *Journal of Construction Engineering and Management*, 129(5): 485–491. http://dx.doi.org/10.1061/(ASCE)0733-9364(2003)129:5(485).
Shen, Q.P. (1997). Value management in Hong Kong's industry: Lessons learned. *Society of American Value Engineers (SAVE) International Conference Proceedings*. Dayton, OH: SAVE International, 260–265.
Shen, Q.P. (1993). A knowledge-based structure for implementing value management in the design of office buildings. PhD diss. University of Salford.
Singh, M. and Singh, D.P. (2008). *Violence: Impact and Intervention*. New Delhi: Atlantic Publishers and Distributors (P) Ltd.
Society of American Value Engineers (SAVE) International. (n.d.). *Homepage*. Available at: www.value-eng.org [Accessed on 3 August 2014].
Viet, N.T. and Van, L.T. (2013). Study on process of internal Value Engineering (VE) in construction projects in Vietnam. *Review of Ministry of Construction in Vietnam*, 52(7): 68–71.
Vietnam Chamber of Commerce and Industry. (2014). VND50 trillion credit package: Construction chain link activated. *Vietnam Business Forum Magazine*, 5 May. Hanoi: Vietnam Chamber of Commerce and Industry. Available at: http://vccinews.com/news_detail.asp?news_id=30387 [Accessed on 15 May 2015].
Whyte, A. and Cammarano, C. (2012). Value management in infrastructure projects in Western Australia: Techniques and staging. In S.D. Smith (ed.). *Proceedings: The 28th Annual ARCOM Conference*. Edinburgh, UK: Association of Researchers in Construction Management, 797–806.