BARRIERS TO APPLYING VALUE MANAGEMENT IN THE VIETNAMESE CONSTRUCTION INDUSTRY

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Abstract: Value Management (VM) methodology approach often faces many barriers when applied in the Vietnamese construction industry as well as many other developing countries. Most of the related past work only identified hindrance factors of applying VM in general and not enough. This study identified 18 factors hindering the application of VM in the construction industry. The questionnaire surveys were conducted to gather views from industrial practitioners with many years of experience in construction projects. Findings revealed that the four factors causing the biggest obstacle to the VM application were lack of VM experts, lack of knowledge about VM, lack of local VM guidelines as well as technical norms and standards, and lack of investment, support policy 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 in VM workshop, little awareness of VM existence, and lack of VM application documents. The study contributes to the body of knowledge relating to the VM application in the construction industry. The findings can be reference 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 saw rapid growth from 2009 to 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 U.S (ReportLinker, 2015). The construction sector in Vietnam, a fast developing country in South-East Asia has not escaped the above problem. The Vietnamese construction industry has been facing a lot of difficulties in recent years. The construction industry recorded a compound annual growth rate of 16.12% during the review period (2009-2013) but then industry growth fell from 19.7% in 2011 to 7.0% in 2013 (Business wire, 2014). There are many construction projects being on hold or abandoned due to lack of capital of investment. Besides, the slump of this industry has caused strong impacts on other related economic sectors and hurt building materials industries (Vccinews, 2014). In such condition, it is actually significant if the contractors and consultancy firms have ability to reduce the project cost, enhance project functions, and shorten the completion time. The best way to achieve the above is by using the Value Management (VM) approach.

VM is also known as Value Engineering (VE) or Value Analysis (VA) (SAVE, 2014). Although some schools of thoughts 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 and structured methodology. It identifies opportunities to remove unnecessary costs, to improve the value and optimize the life cycle cost of a facility while assuring that quality, reliability, performance, and other critical factors will meet or exceed the customer's expectations (Dell'Isola, 1997). The origin of VM was conceived in the early 1940s by Lawrence D. Miles when he found ways to alleviate the material shortage problem in production of General Electric company during World War II

(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 – all during the 1970s (Cheah and Ting, 2005). In 1985, the association for VM practitioners was established, called as Society of American Value Engineers (SAVE) (Latief and Untoro, 2009).

Currently, VM has been 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 its infancy and it hasn't been well-accepted (Jaapar, 2009; Li and Ma, 2012). VM is rarely applied in the Southeast Asia construction industry (Cheah and Ting, 2005). It is also less widely practiced in South Africa (Bowen et al., 2010). Malla (2013) found that concept of VM is very much new in Nepal. The practice of VM in Myanmar and Nigerian construction is very slow and its term is not popular among construction professionals (Phyo and Cho, 2014; Aduze, 2014). In Vietnam, although there is some evidence of VM process applications in the construction industry, nevertheless it is still not so popular. VM in Vietnam is regarded as developing in the infant stage, only a small amount of construction projects has applied VM (Viet and Van, 2013). In fact, very few construction companies in Vietnam applied VM process to reduce costs and enhance the quality; it is applied mainly by foreign consulting firms or EPC contractors as the Japanese and Korean firms (Viet and Van, 2013). On the other hand, most owners are still very strange to the concept of VM.

Thus, in order to promote the application of VM, hindrance factors should be identified, which help practitioners assess barriers of applying VM and undertake appropriate strategies for acceptance of VM methodology. The hindrance factors identified in earlier studies are in general and not enough. Moreover, the earlier studies just stopped at the rank of hindrance factor. Latent factors that are the root hindrance have not been determined yet. The objectives of the study outlined in this paper are (1) to identify the hindrance factors and assess hindrance degree of them to 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 application of VM in the construction industry, and discusses the similarities and differences between previous studies in general. The third section introduces the research methodology, including research process, and various tests and analysis techniques used in the study. The fourth section conducts data analysis and discusses the findings in the study. The paper ends with a general conclusion.

LITERATURE REVIEW

Investigation of 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 applications in Hong Kong's construction industry and highlighted three most important reasons for not using VM at work, including lack of knowledge to implement VM, no confidence to introduce VM to clients, and lack of time to implement VM. He found out that the low level of applications is probably associated with the low level of awareness of VM among senior management in clients' organizations. Lack of time to implement VM and lack of knowledge about VM are also two key causes in hindering VM application to Southeast Asia (Cheah and Ting, 2005). Lai (2006) identified ten factors hindering the application of VM in the Malaysian construction industry. The main factors are lack of knowledge about VM, lack of support from parties with authority such as government and owners, and lack of local VM implementation guideline. Not surprisingly, the lack of knowledge about VM continues to be a key problem, whereas lack of time to implement VM is not a factor causing significant obstacles in Malaysia. For the case of China, Li and Ma (2012) also arrived at a similar conclude that lack of time to implement VM is not a severe problem and main hindrance factors come from lack of expertise knowledge about VM, lack of technical norms and standards, and lack of VM experts.

The issues related to VM have received much attention in other countries as well, especially in developing countries. Perera and Karunasena (2004) showed that in Sri Lanka the application of VM in construction organizations is relatively new and very little evidence on its application in the construction industry. Some reasons for the absence of VM application could be lack of standard procedure for VM process, lack of encouragement, advice or guidance on projects for practicing VM from the construction industry regulatory body, and no guidance or knowledge about the benefits. According to Al-Yami (2008), lack of information such as specifications, standards, historical data, etc., lack of leadership, lack of time to implement VM, lack of awareness about VM, and client commitment were the five major obstacles hindering the application of VM in the Saudi public sector. Fard et al. (2013) conducted an investigation on the context of Iran and found five items considered as the main factors hindering VM implementation 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. Lately, Aduze (2014) has undertaken a study of the prospects and challenges of VM in the Nigerian construction projects. The study concluded that lack of policy as government legislation, client's negative reception, and lack of knowledge about VM are some factors impeding the VM application. As a result discovered, lack of awareness about VM in Saudi, Iran, and Nigeria could be noticed that it is not the most obstructing factor as found in Hong Kong, Malaysia, and China. Malla (2013) made recommendations to promote the VM application in the Nepalese construction industry instead of finding out the hindrance factors. The recommendations were given out such as incentive clause for VM re-proposal in contract document, commitment from top management, forming a VM team with experienced members, and sufficient time to apply VM.

In addition, other researchers have paid attention to problems affecting the implementation of the VM workshop. Jaapar et al. (2009) investigated the impact of VM implementation in Malaysia and confirmed that lack of VM knowledge and practice, the resistance to change by the involved parties, and the conflicting objectives of the project among parties are the main problems faced during the VM workshop. Latief and Untoro (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 regulation, personnel composition, the comprehension level of VM technique and management, and personnel's level of education. Another study was also conducted in infrastructure projects by Whyte and Cammarano (2012). They used the semi-structured interview method to investigate into the extent of the VM implementation in the Western Australian engineering industry. The study indicated that time limitations, a lack of understanding, and participation of individuals in the team will influence negatively the level of success of the VM workshop.

Each of the above-mentioned studies had different conclusions about hindrance factors. However, most of the studies revealed that the lack of knowledge and awareness about VM is one of the biggest obstacles for its limited application in the construction industry. Lack of time to implement VM has no consensus as one of the greatest hindrances compared between the studies. Some other noteworthy factors are lack of support from government and parties, especially owners, and lack VM implementation guideline.

RESEARCH METHOD

The research methodology is schematically presented in Figure 1. In order to achieve the above research objectives, questionnaire surveys were designed to gather views from industrial practitioners. This study comprises two types of questionnaires: (1) questionnaire 1 for evaluating the hindrance level of factors to the application of VM; (2) questionnaire 2 that is applied in AHP method for pair-wise comparison between the hindrance factors. The decision to use the questionnaire survey method is mainly due to this study being exploratory in nature, thus a broad-based survey should be conducted. Besides, this method also makes it possible to contact more subjects in a limited time in comparison with other methods, for example, the interview method is not always easy as not everyone who is willing to answer any questions wants to be interviewed.
Please insert Figure 1 here.

The development of the questionnaire 1 was supported by the literature review. A preliminary set of hindrance factors was collected from the literature review and presented in the pretest questionnaires. A pilot study was then carried out to validate the questionnaire with nine experts who had experience in VM practice. They were asked to test the comprehensiveness of all questions in the pretest questionnaire, especially to check the adequacy and appropriateness of the hindrance factors for conditions of Vietnam. The experts would exclude unimportant factors and add other hindrance factors that they perceived as being necessary. According to their comments, there were four additional factors and some minor adjustments in the structure of the questionnaire 1. As the outcome of the literature review and pilot test, 18 factors hindering the application of VM in the construction industry were identified as shown in Table 1.

The finalized questionnaire 1 consists of three parts. The first part of the questionnaire introduces participants to the origin, the purpose of the survey and some basic knowledge about VM. The second part of the questionnaire focuses on assessing the degree of hindrance of the 18 factors and some the other issues such as degree of understanding about VM, sources for obtaining knowledge about VM, respondent's experience and the frequency of involvement in VM workshops. Subsequently, an open-

ended question at the end of this part was provided for respondents to list recommendations for increasing understanding, acceptance and implementation of VM in the construction industry, if any. All of the hindrance factors were rated according to a five - point Likert scale (from 1- not hinder to 5 - extremely hinder) that 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). Eventually, the third part of the questionnaire requests respondent's background information.
Please insert Table 1 here.

The target respondents of the questionnaire survey included contractors, designers, consultants, and owners that are mainly involved in the VM workshops. Moreover, it is significant that the questionnaires are evaluated from different stakeholders because VM is known as a multi-disciplinary team approach. The sampling method used in this study was convenience coming under the class of non-probability sampling techniques. The researchers have got the members list of the Construction Management Association (CMA) through friends. The questionnaires were then distributed to the CMA that its members come from many different organizations and companies in the Vietnamese construction industry. A total of 270 questionnaires were disseminated in March 2014. Seventy questionnaires were hand delivered to respondents at the CMA's VM seminar and 200 online questionnaires were sent to respondents via electronic email. Based on these facts, it is believed that the sample is reasonably random in the CMA. In order to increase response rate, a reminding the respondents about responses would note after one month of distributing the questionnaires. The distribution of the questionnaires was summarized in Table 2. Out of 270 questionnaires distributed, 107 respondents returned their questionnaires. 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 was higher than the norm of 20–30% with most questionnaire surveys in the construction industry (Akintoye, 2000). It was acceptable compared with the response rates of 25% and 39% to the surveys on the application of VM conducted by Hwang et al. (2014) and Ramly et al. (2015), respectively.
Please insert Table 2 here.

The valid data set was analyzed on 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 the groups, was carried out to check consistency of opinion among the respondent's groups. Levene's test was also checked as the precondition for conducting the ANOVA test. Second, the hindrance factors were ranked using average index. Based on ranking, the most hindrance factors were then extracted and validated by professional's judgments. The questionnaire 2 with questions of pair-wise comparisons between the factors was designed based on the AHP method (Analytic Hierarchy Process) to collect the opinions of professionals. AHP exceeds the comparative judgment 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 (2000). The meaning of each of the values of the scale is shown in Table 3. The feedback questionnaires from professionals were estimated by consistency ratio (CR) to ensure their reliability and validity (Lee et al., 2011; Haery et al., 2014). Finally, factor analysis was conducted to derive the interrelationships among the hindrance factors.
Please insert Table 3 here.

ANALYSIS AND FINDING

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

Profiles of respondents

Table 4 summarizes the profiles of respondents in the survey. 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%). In terms of designation of respondents, directorate, construction managers, and specialists having a certain level of professional knowledge, ability and maturity account for more than half (55.1%) of the respondents. Civil engineer/architect, site supervisor, and quantity surveyors account for 28.6%, 14.3%, and 2%, respectively. In terms of years of experience, the number of respondents having experience from 5 to 10 years is 45.9% and more than 10 years as 38.8%. They account for a large rate of the respondents. Thus, the collected data are relatively reliable and valuable. The respondents with less than 5 years of experience account for only 15.3%.

Please insert Table 4 here.

The level of understanding about VM

From the analysis results, the average index of the level of understanding about VM is 3.26. This indicates that the respondents' degree of understanding about VM was average. However, it should be pointed out that this result might be a little higher than the actual figure, because there are many targeted respondents who never heard of terms of VM might not return their questionnaires. The result is the same with status of some other developing countries such as Malaysia (Lai, 2006), Myanmar (Phyo and Cho, 2014). A large number (64.3%) of respondents learned the source of VM knowledge from colleagues/friends, and books/articles. The rest of the respondents knew the terms of VM through their organization (13.3%), professional seminars (5.1%), college/university (8.2%), and 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 or 28.57 % of the total respondents had experienced in VM workshops. Involving previously in VM workshops came from directorate (9 respondents), civil engineer/architect (9 respondents), specialist (7 respondents), and construction manager (3 respondents).

Preliminary investigation

This study performs two main statistical analyses, namely, scale ranking and factor analysis, were undertaken on the data. To use these analyses, reliability check and consistency of opinion among the respondent's groups (the owners, contractors, designers, and consultants) were assessed first. 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 usually considered to be 0.7. A Cronbach's alpha of 0.795 for 18 hindrance factors was computed, which is above the recommended threshold value of 0.7, confirming the reliability of the five-point scale measurement. Regarding consistency of opinion among the respondent's groups, the ANOVA test was performed to clarify whether or not the opinions of the groups were the same for each of the 18 hindrance factors. A probability value p below 0.05 suggests a high degree of difference of opinion between the groups (Landau and Everitt, 2004). Levene's tests indicated the equality of variance of each of the hindrance factors in the groups (all p values > 0.1), and so the precondition for the ANOVA test was satisfied. The results of the ANOVA test showed 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 can be treated as a whole in further analysis. 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 shows the statistical mean, standard deviation, and rank of these factors. The standard deviation on a hindrance factor represented a degree of consensus among respondents, while a mean response on the scale was 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 the respondents (Ellif and Maarof, 2011). As described in Table 5, there are 11 factors, rated as "very hinder" ($3.5 \le$ mean < 4.5), and the others are rated as "averagely hinder" ($2.5 \le$ mean < 3.5) (Majid and Mccaffer, 1997).

Please insert Table 5 here.

"Lack of VM experts" was ranked top by the respondents, implying that VM experts are of paramount importance for development of VM in the construction industry. "Lack of VM experts" was also found as one of the major difficulties impeding the development of VM in China (Li and Ma, 2012). The VM experts, who possess many the experience and technical skills of value engineering/analysis, must have a certification of the Certified Value Specialist or the Associate Value Specialist (SAVE, 2014). Practical experience in VM workshops plays an important and is the major source of practical knowledge (Sik and Fong, 2004). The lack of VM experts in Vietnam can therefore cause significant obstacles to the application of VM procedure. VM experts' practice experience will be necessary to lead how to implement VM, whereas the reference books or articles do not. Moreover, the VM experts can be pioneers who set up the foundation for the development of domestic VM, disseminate knowledge of VM, train human resources, and cooperate with the government to give out appropriate legislation relating to the application of VM.

"Lack of knowledge about VM" was ranked second. This result was consistent with the finding of Cheah and Ting (2005). Lack of knowledge about VM can result in the practitioners' disregard to VM existence. The practitioners do not understand what are about VM and its benefits. Hence, they always prefer traditional methods in their projects. Moreover, it is very unlikely for owners who have no or little knowledge of VM to request their designers and contractors to conduct VM studies for their projects (Shen, 1997). These are an unfavourable for acceptance and usage of VM in the construction industry.

"Lack of local VM guidelines as well as technical norms and standards" was ranked third". Having the local VM guidelines, technical norms, and standards is necessary to promote the wide application of VM in the construction industry (Shen and Liu, 2004; Latief an Untoro, 2009; Fard et al., 2013). Practical guidelines for implementing VM are the need because not all practitioners are familiar with VM studies in the first times of involvement. Furthermore, the practitioners should use practical guidelines to ensure in accordance with the characteristics of domestic the construction industry.

Next, although "lack of investment, support policy and human resources to conduct VM in construction companies" was not identified and highlighted in previous studies, it was ranked fourth by the respondents, indicating the importance of construction companies in VM development. The use of VM in companies can gradually change habits of using traditional methods in the projects and accept the VM approach due to its benefits. It brings lessons learned in applying VM to other companies or organizations. Besides, a successful application can increase competitiveness and reputation of the companies within the construction market.

In Vietnam, the government did not play an important role in popularizing and promoting the VM development. This is shown by "lack of legislation providing for application of VM in the construction industry", ranked the fifth position. This problem clearly demonstrated by past experience of the United States was relatively important (Li and Ma, 2012). The legislation including incentive clauses for sharing the equitable savings and risks for implementing VM can encourage the owners and stakeholders to apply VM in their projects (Cheah and Ting, 2005). "Lack of support and active participation from owners and stakeholders" occupied the sixth position. This result implied that VM development required the parties' support and active involvement. Unwilling to pay for the VM service from owners and resistance from design consultants are elements inhibiting the wider use of VM (Hogg, 2000). Owner's support was found as the most critical success factor for VM studies (Shen and Liu, 2003) because according to Norton and McElligot (1995) (cited by Hwang et al, 2013), the owner's clear support has been argued to be the only possible way to facilitate the acceptance of the VM study and help overcome the opposition.

"Lack of time to conduct VM studies" was ranked at the bottom. It was not rated as the factor hindering significantly the application of VM in the construction industry. Drawbacks relating lack of time to implement VM can addressed by an improvement in efficiency of VM studies (Shen, 1997). For example, the assistance of development of modern information as knowledge-based systems can reduce considerably the proportion of time assigned for retrieval of historical information, creativity and idea generation, analysis and evaluation of alternatives, and presentation of study proposals. Thus, more time can be allocated to more important works such as function analysis and development of alternatives (Shen, 1993 and 1997). Furthermore, as strong evidence that the 40-hour VM job plan is widely used in many VM studies and has been proved to be successful over the past four decades by many VM organizations and practitioners (Shen, 1997).

Based on the results of ranking of the hindrance factors according to the mean, the six most hindrance factors, including HF9, HF3, HF17, HF8, FH18, and HF4, were extracted and then were validated as well as were made more meaningful by professional's judgments. The questionnaire 2 was used to collect the judgments of professionals. The professionals herein are the respondents who had participated in VM studies or VM being applied in their company. They were known from the collect data through the questionnaire 1. The questionnaires 2 were distributed to the predetermined professionals via electronic email and a total of 23 completed responses were received. The responses from the survey were analyzed with the aid of the Expert Choice software that performs the computation required by the AHP. The responses with values passing the consistency test will ensure their reliability and validity. The maximum acceptable limit of consistency ratio (CR) is 0.1 (Saaty, 2000). If the CR value of the response is more than 0.1, it will highlight that the pairwise comparison is inconsistent and hence the response is discarded. After computing, it is found that all 23 responses to the pairwise comparisons reached a CR of less than 0.1 and the CR for combined judgment of the 23 responses was 0.02 as shown in Figure 2. Therefore, the professionals' pairwise comparison matrices were acceptable or the responses were reliable and valid. Table 6 shows the ranking of six hindrance factors according to their priority weights. HF3 relating to "lack of knowledge about VM" with the 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).
Please insert Figure 2 here.

Please insert Table 6 here.

The result of comparing the ranking according to the mean and the priority weight is described in Table 7. It is easy to see that there are some minor changes in ranking 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 ranking based on the mean, not surprising that the four greatest hindrance factors are also "lack of VM experts" (HF9), "lack of knowledge about VM" (HF3), "lack of local VM guidelines as well as technical norms and standards" (HF17), and "lack of investment, support policy and human resources to conduct VM in construction companies" (HF8). HF3 and HF9 continue to be the key problems.

Please insert Table 7 here.

Factor Analysis of Hindrance Factors

Another aim of this study is that relationships between hindrance factors should be investigated to derive a reduced set of hindrance factors which 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 in performing the factor analysis using the procedure shown in Figure 3.

Please insert Figure 3 here.

As a first step of performing the factor analysis, scanning correlation matrix and testing appropriateness of factor analysis on data were conducted. If any variables have lots of correlations below 0.3 or correlate with no others then consider excluding them. The results of the correlation coefficients show that there are the four hindrance factors having all correlations below 0.3. Therefore, these factors, which should be eliminated, are "the complexity of proposed projects to apply VM" (HF2), "lack of contract provisions on implementation of VM between owners and stakeholders" (HF5), "lack of the collected information in the early stage causing difficulties in making ideas and alternatives (HF14), and lack of time to conduct VM studies" (HF16).

Then, the adequacy of the survey data was examined by conducting the Kaiser-MeyerOlkin (KMO) test and the Bartlett's test of sphericity. If the value of the KMO index is greater than 0.5 and the Bartlett's test of sphericity is significant ($p<0.05$), the data set is suitable for factor analysis (Field, 2009). In this study, the Bartlett's test of sphericity is significant ($p = 0.000$), and the value of the KMO index is 0.747 (greater than 0.5). The results confirmed that the data are appropriate for factor analysis.

The reliability of the factor model was also checked with the communalities of each variable. The sample size of this study approximated 100 samples, thus all communalities above 0.5 could be accepted (Field, 2009). In this test, there are the two hindrance factors, continuously discarded as "inexperienced and incompetent contractors" (HF6) and "lack of cooperation and interaction with the internal VM team" (HF10). Their communalities are 0.484 and 0.488, respectively. Communalities of all the other hindrance factors are found to be much greater than 0.547 that signifies that the factor model is reliable in this study. Regarding case to variable ratio, the number of observations per variable is approximately 8:1 (ratio of 98:12), which satisfies a desired ratio of 5 observations per variable (Hair et al., 2010).

After preliminary analysis, the 12 remaining hindrance factors were subjected to the factor analysis, with principal component analysis and varimax rotation. There are many criteria available to assist in determining how many components to extract. The most common criterion used is the minimum eigenvalue criteria, known as the Kaiser's criteria. The results of the principal component analysis to determine the number of components to be retained are shown in Table 8. According to Kaiser's criteria, four components have 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 showed that there are four components which are on the left of the point of inflection are retained (Field, 2009; Hair et al., 2010). These four hindrance components explained 64.203% of the total variance in the data.

Please insert Table 8 here.

Please insert Figure 4 here.

The rotated component matrix along with the factor loadings of these hindrance factors on these four components after 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 and otherwise it is considered insignificant (Hair et al., 2010). As shown in Table 9, all factor loadings are greater than 0.5.

Please insert Table 9 here.

For the sake of 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 can be reasonably interpreted as follows: component 1 represents lack of qualified personnel to implement VM; component 2 is inherent difficulties in VM workshop; component 3 is little awareness of VM existence, and component 4 is lack of VM application documents. Table 10 shows the names of the four components along with the percentage of the variance after varimax rotation that each component explained. The associated explanations regarding these factors are provided in the following sections.

Please insert Table 10 here.

Discussion of factor analysis results

Component 1: Lack of qualified personnel to implement VM

This component comprises the four hindrance factors, namely, "lack of VM experts", "inexperienced and incompetent VM team's members", "lack of competence in cost estimation of VM team", and "lack of investment, support policy and human resources to conduct VM in construction companies". The component accounts for the greatest variance (19.036%) among all the components. The component shows that lack of qualified personnel such as VM experts, competent VM team, available human resources in companies are the obstacle of the application of VM in the construction industry. Incompetence in cost estimation and inexperienced members in this component imply that the training of personnel about knowledge as well as skills in practicing the VM procedures is the need. It can help to improve somewhat competence of VM team.

For Vietnam, in order to set up an initial foundation of the VM methodology in the construction industry, it is necessary to have abundant human resources with experience and knowledge about VM for promoting and developing VM in the domestic construction industry. These things can be performed by introducing actively foreign certification system (such as Certified Value Specialist, Associate Value Specialist, and Value Methodology Practitioner, granted by SAVE International), training more VM experts. Further, it should exchange with other countries having the VM methodology with a powerful development to learn from their experiences in promoting rapidly it in the construction industry.

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 workshop are "defensive attitude of the original design team", "difficulties of conducting analysis and evaluation of alternatives", and "unqualified VM facilitator". During the VM studies always exists the inherent difficulties that are inevitable such as negative attitudes of participants, poor competence of facilitator, lack of communication and coordination, lack of ideas or information, and so on. The above things can make the results of VM studies not effective and so industrial practitioners could think that VM is not a good method for their projects.

The VM procedure is need involving 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 VM studies. However, the defensive attitude of the design team is not easy to eliminate. The design team said that with their extensive background, experience, qualifications and technical team could consider their design to be satisfied and not warranting additional unnecessary and costly scrutiny (O'Farrell, 2010). They frequently consider VM as unwelcome disturbance, a waste of time, and a criticism of their technical capabilities (O'Farrell, 2010). Therefore, the design team can be quite reluctant to involve in VM studies and doubts about the benefit of applying VM as well as considers VM to be only another cost cutting methodology.

The VM facilitator should encourage and maintain a positive attitude in all participants throughout 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, controlling and leading a group of individuals working together to reach the objectives of the study, is a key component of the successful VM study (SAVE, 2014). In order to make certain that the workshop is conducted in accordance with standard VM procedures, the VM facilitator's skills should be more creative, organizational, and motivational than technical (Dell'Isola, 1997). The difficulties of conducting analysis and evaluation of alternatives in this component are problems that the VM team always encounter during the VM workshop. These should be recognized and dealt with in a positive manner. In order to mitigate the inherent difficulties in the VM workshop, the multidisciplinary composition of VM team that must be qualified, is very important. The skill and expertise of VM team members should be highly qualified and must be tailored to the nature of the specific project. Moreover, the VM team should have a qualified professional (preferably a Certified Value Specialist) as its coordinator (Dell'Isola, 1997).

Component 3: Little awareness of VM existence

This component including the three hindrance factors are "too few construction projects applied VM", "lack of knowledge about VM", and "lack of support and active participation from owners and stakeholders". It explains 14.867% of the total variance in the data. Little awareness of VM existence can be the cause of the lack of VM knowledge, the lower levels of the VM application in projects, and lack of support from project parties. The lack of VM knowledge and too little of its application can result in lack of interest and confidence from the parties. An inevitable suspicion from the parties, they hesitated that VM is effective or not and consuming of time and cost to implement VM will achieve the desired results or not. Hence, they can be lack of support and active participation in VM workshops. The results of previous projects applied VM are actually necessary to increase the interest of the parties. By referring to evidence about success and failure rates of VM applications, owners would feel more comfortable in adopting VM for their projects (Cheah and Ting, 2005).

Lack of support and active participation from the parties is also probably due to the conflicting benefits of project and thus the parties have negative mindsets towards applying VM in their projects. For example, to the designers, spending time, cost, and manpower for implementing VM is not usually considered, because of reducing their profits while the design fee calculated on the total project cost is a very low fee (O'Farrell, 2010). The designers usually design in a routine and from the same process, and so the search for new alternatives and the change in design plans, consuming time, may not be better than the former designs from their thought. Hence, why do they spend much effort in getting approvals of the contractor and the owner (Miles, 1993)?

To the owner, many the owners believe that the designers perform VM as part of the normal design work and their responsibilities is to ensure the quality of designs, to provide their owners with economical designs, to meet or exceed the owner's specification (O'Farrell, 2010). The owners encourage the designers to perform VM in their projects, but they really do not take any action and responsibility for the cost of implementing VM and the results of VM (Miles, 1993). To the contractors, the alternatives from the results of VM studies can result in new construction methods or new materials that are different from traditional ways, mean different fabricating methods, unpredicted problems, and perhaps costly delays and repairs. The contractors are reluctant to bid in areas of change without adding contingency costs, which may nullify their benefits of the change on that job and they, in general, are not the promoter of change (Miles, 1993).

As known, VM can promote innovation and provides many benefits. However, it is not an easy task to change habits and present working. In order to improve the lack of knowledge and awareness of VM, it is necessary to introduce the VM methodology in the organizations of the owners, designers, and contractors by arranging VM seminars, training and sample implementation of some projects. These can help them to realize significant benefits of VM, to support and participate actively in applying VM in their projects.

Component 4: Lack of VM application documents

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

Legal documents play a supporting role in implementing VM. There are many related difficulties of applying this methodology if there is not government legislation such as size of projects suggested for applying VM, specific rules for each type of projects, sharing benefits earned from applying VM for the stakeholders in the project, and so on. Aduze's research (2014) showed that VM as a technique if back-up with legislation and applied to all construction projects will ensure effective function maximization and removal of unnecessary cost. Governments, construction authorities, and regulators should play a lead role in promoting VM and consider creating and establishing VM implementation based on law like other developed countries. The United States, for instance, had implemented legally based on their laws as 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 Untoro, 2009). And Federal Acquisition Regulation Parts 48 and 52, presenting clear policies and procedures for using and administering VM techniques in contracts, included processing VM change proposals, sharing acquisition savings, related to other incentives, and so on (The Federal Facilities Council, 2001). Moreover, FIDIC (2005) had also affirmed that VM can be applied in construction works according to the terms of sub-clause 13.2.

CONCLUSIONS

This paper performed the surveys that were to discover the barriers of applying VM to the Vietnamese construction industry. This study identified the 18 hindrance factors. Ranking according to the mean and the priority weight pointed out that "lack of VM experts", "lack of knowledge about VM", "lack of local VM guidelines as well as technical norms and standards", and "lack of investment, support policy and human resources to conduct VM in construction companies" were the four most highly hindrance factors. The next two factors were "lack of legislation providing for application of VM in the construction industry" and "lack of support and active participation from owners and stakeholders". Five of the six factors listed above except "lack of investment, support policy and human resources to conduct VM in construction companies" have been found to be the main factors in previous studies (Li and Ma, 2012; Cheah and Ting, 2005; Lai, 2006; Aduze, 2014).

By using the factor analysis technique, the relationships among 12 of the 18 hindrance factors were investigated and were categorized into the four components: (1) lack of qualified personnel to implement VM, (2) inherent difficulties in VM workshop, (3) little awareness of VM existence, and (4) lack of VM application documents.

Despite the achievement of the objectives, this study has some limitations to its conclusions. First, some ways including conducting pilot test, ensuring the target respondents, discarding the respondents who do not totally understand about VM in the study can be not enough to minimize the bias associated with the scoring of the hindrance factors. Thus, there may be biases inherent in the sample. Second, assessing the hindrance degree of factors could be more rigorous if multiple regression analysis on the extracted components was employed to explore the relative importance. This would highlight the significance in the unit hindrances to the

VM application in the construction industry. Lastly, the study was conducted in context of Vietnam, therefore the findings may not be generalized to other geographical locations.

The findings of this study can help the practitioners in the Vietnamese construction industry to assess status and barriers of applying VM in order to give out appropriate strategies for their organizations in applying VM procedure. The study can be considered as valuable additional contribution to the body of knowledge relating to the VM application in the construction industry. Although the study concentrates on Vietnam, the findings can be reference to many developing countries, as they face similar problems in terms of promoting the application of VM in the construction industry.

Based on the findings of this study, some following recommendations are given to promote and develop VM in the construction industry. More efforts should be required to train and educate industrial practitioners and owners on knowledge and skills of VM as well as there should be local guidelines that are consistent with the characteristics of domestic the construction industry. Moreover, the government also should play an important role in the popularization and application of VM together with giving out appropriate legislation relating to implementation of VM. Recommendations are also made herein for further research. More research should be conducted to explore the inter-relationships between the four components of the hindrance factors. Studies can also be conducted to compare the outcome of this study in Vietnam with that of other developing countries in the world as a way of strengthening the validity of the outcome.

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

Codes	The hindrance factors	References
HF1	Too few construction projects applied VM	Experts' opinion
HF2	The 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 Untoro K (2009), Whyte and Cammarano (2012)

Codes	The hindrance factors	References
HF4	Lack of support and active participation from owners and stakeholders	Cheah and Ting (2005), Lai (2006), Al-Yami (2008), Aduze (2014), Shreena Malla (2013), Jaapar et al., (2009), Whyte and Cammarano (2012)
HF5	Lack of contract provisions on implementation of VM between owners	Cheah and Ting (2005), Fard et al., (2013), Shreena Malla (2013), Latief and Untoro K (2009)
HF6	Inexperienced and incompetent contractors	Experts' opinion
HF7	Defensive attitude of the original design team	Lai (2006), Li and Ma (2012), Fard et al., (2013)
HF8	Lack of investment, support policy and human resources to conduct VM in construction companies	Experts' opinion
HF9	Lack of VM experts	Li and Ma (2012), Latief and Untoro K (2009)
HF10	Lack of cooperation and interaction with the internal VM team	Latief and Untoro K (2009)
HF11	Lack of competence in cost estimation of VE team	Latief and Untoro K (2009)
HF12	Inexperienced and incompetent VM team's members	Shreena Malla (2013), Latief and Untoro K (2009)
HF13	Unqualified VM facilitator	Jaapar et al., (2009)
HF14	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives	Al-Yami (2008), Jaapar et al., (2009)
HF15	Difficulties of conducting analysis and evaluation 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), Shreena 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 Untoro K (2009)

Note: For all factors, the scale = 1-5, where 1 = not hinder and 5 = extremely hinder

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

Table 3. Pair-Wise Comparison Scale of Hindrance Degree

Numerical rating	Judgments of hindrance degree
1	A hinders equally to B
2	A hinders equally to moderately over B
3	A hinders moderately over B
4	A hinders moderately to strongly over B
5	A hinders strongly over B
6	A hinders strongly to very strongly over B
7	A hinders very strongly over B
8	A hinders very strongly to extremely over B
9	A hinders extremely over B

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	Below 5	15	15.3%
	5-10	45	45.9%
	Above 10	38	38.8%
	Total	98	100.0%

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 investment, support policy and human resources to conduct 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 the collected information in the early stage causing difficulties in making ideas and alternatives	3.85	0.91	7
HF6	Inexperienced and incompetent contractors	3.68	1.00	8
HF5	Lack of contract provisions on implementation of VM between owners and stakeholders	3.65	0.86	9
HF12	Inexperienced and incompetent VM team's members	3.60	0.99	10
HF13	Unqualified VM facilitator	3.52	0.88	11
HF10	Lack of cooperation and interaction with the internal VM team	3.43	0.96	12
HF1	Too few construction projects applied VM	3.42	1.04	13
HF11	Lack of competence in cost estimation of VM team	3.40	1.09	14
HF7	Defensive attitude of the original design team	3.35	1.15	15
HF2	The complexity of proposed projects to apply VM	3.24	0.95	16
HF15	Difficulties of conducting analysis and evaluation of alternatives	3.10	0.90	17
HF16	Lack of time to conduct VM studies	3.04	1.07	18

Table 6. Ranking of Six Hindrance Factors

Codes	Priority weights	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

Table 7. Result of Comparing the Ranking according to the Mean and the Priority Weight

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

Table 8. Principal Components Analysis Results

Principal component	Eigenvalue	Percentage of 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

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 the hindrance factors	Vari	Co	The hindrance factors
Component 1 : Lack of qualified personnel to implement VM	19.0	HF	Lack of VM experts
		HF	Inexperienced and incompetent VM team's members
		HF	Lack of competence in cost estimation of VM team
		HF	Lack of investment, support policy and human resources to conduct VM in the construction companies
Component 2: Inherent difficulties in VM workshop	16.0	HF	Defensive attitude of the original design team
		HF	Difficulties of conducting analysis and evaluation of alternatives
			Unqualified VM facilitator
Component 3: Little awareness	14.8	HF	Too few construction projects applied VM

of VM existence		HF	Lack of knowledge about VM
		HF	Lack of support and active participation from owners and stakeholders
Component 4: Lack of VM application documents	14.2	HF	Lack of legislation providing for application of VM in the construction industry
		HF	Lack of local VM guidelines as well as technical norms and standards

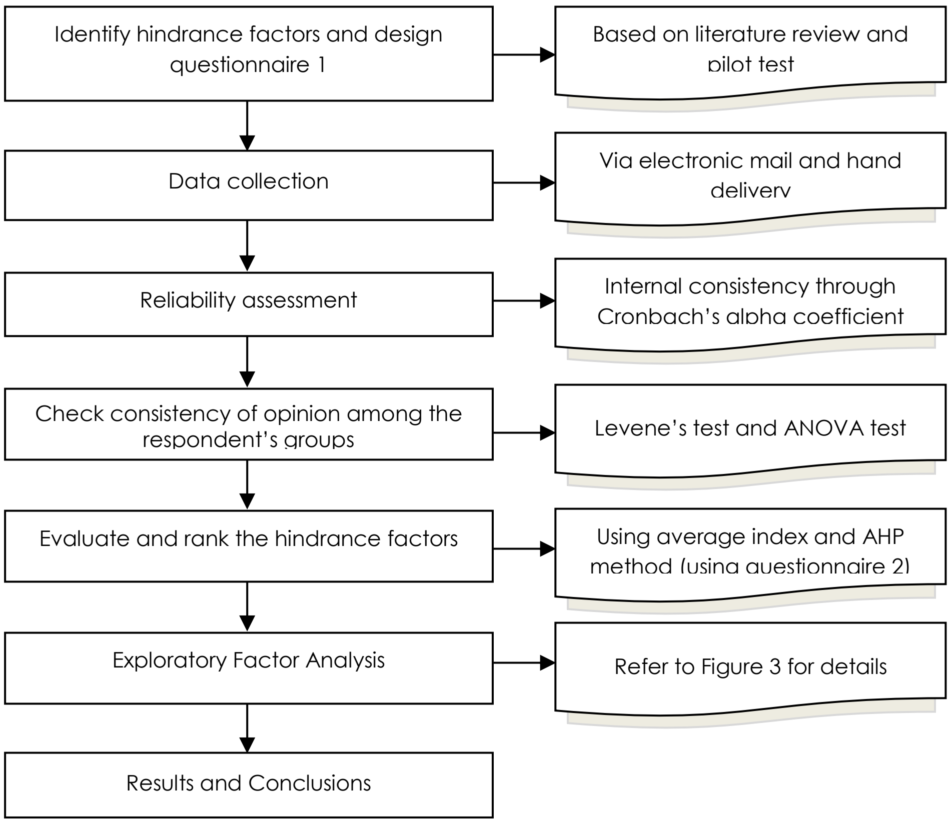

Figure 1. Conceptual research framework

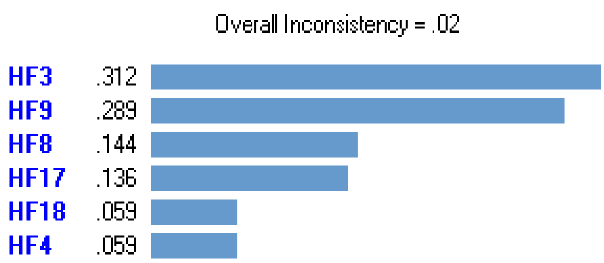

Figure 2. Consistency Ratio of Pair-Wise Comparison Matrix

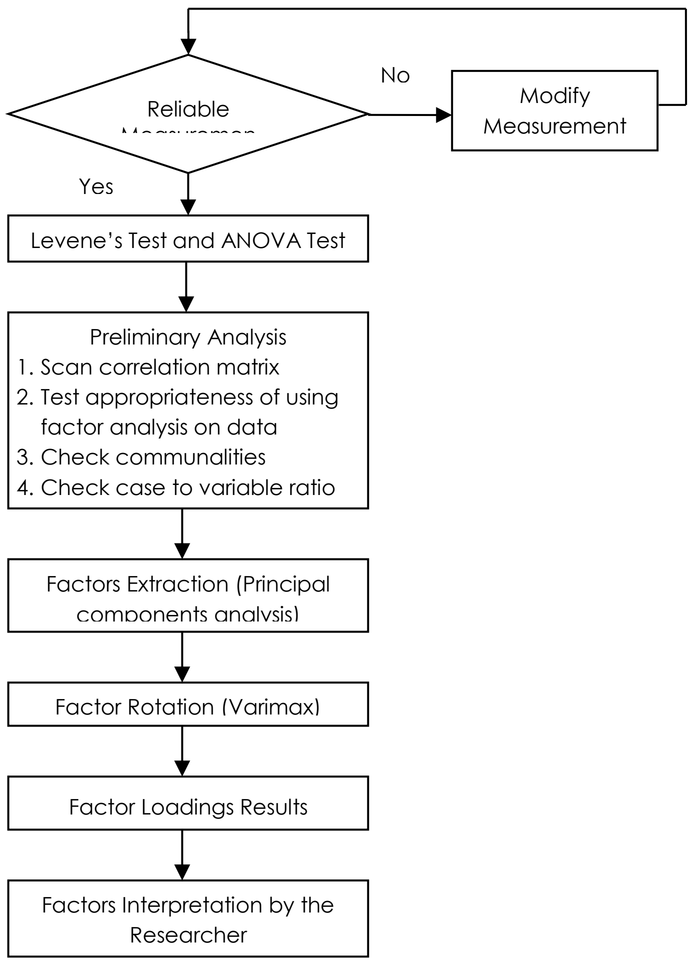

Figure 3. Factor Analysis Procedure

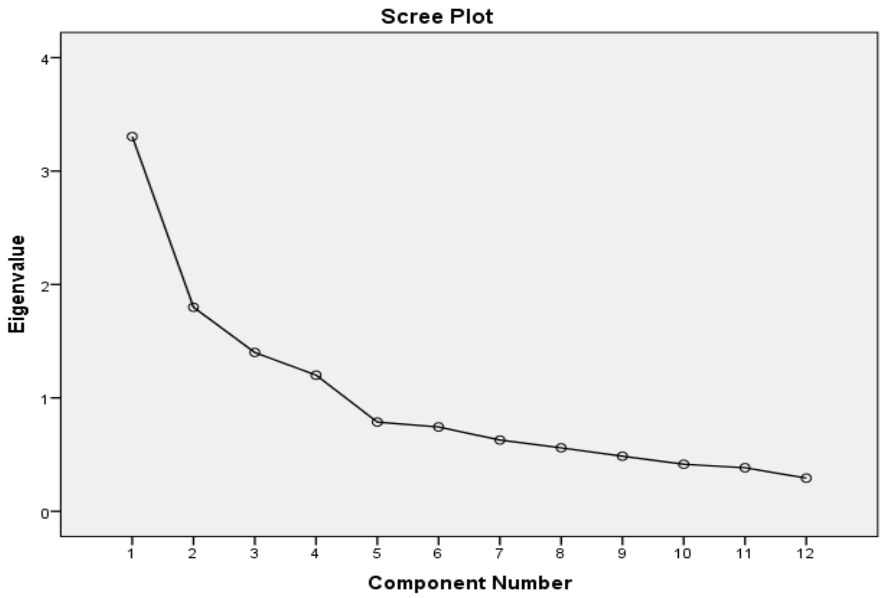

Figure 4. Scree Plot